IFL Project Report
13-05

Rannsóknastofnun fiskiðnaðarins

July 2005

MONITORING OF THE MARINE BIOSPHERE AROUND ICELAND IN 2003-2004

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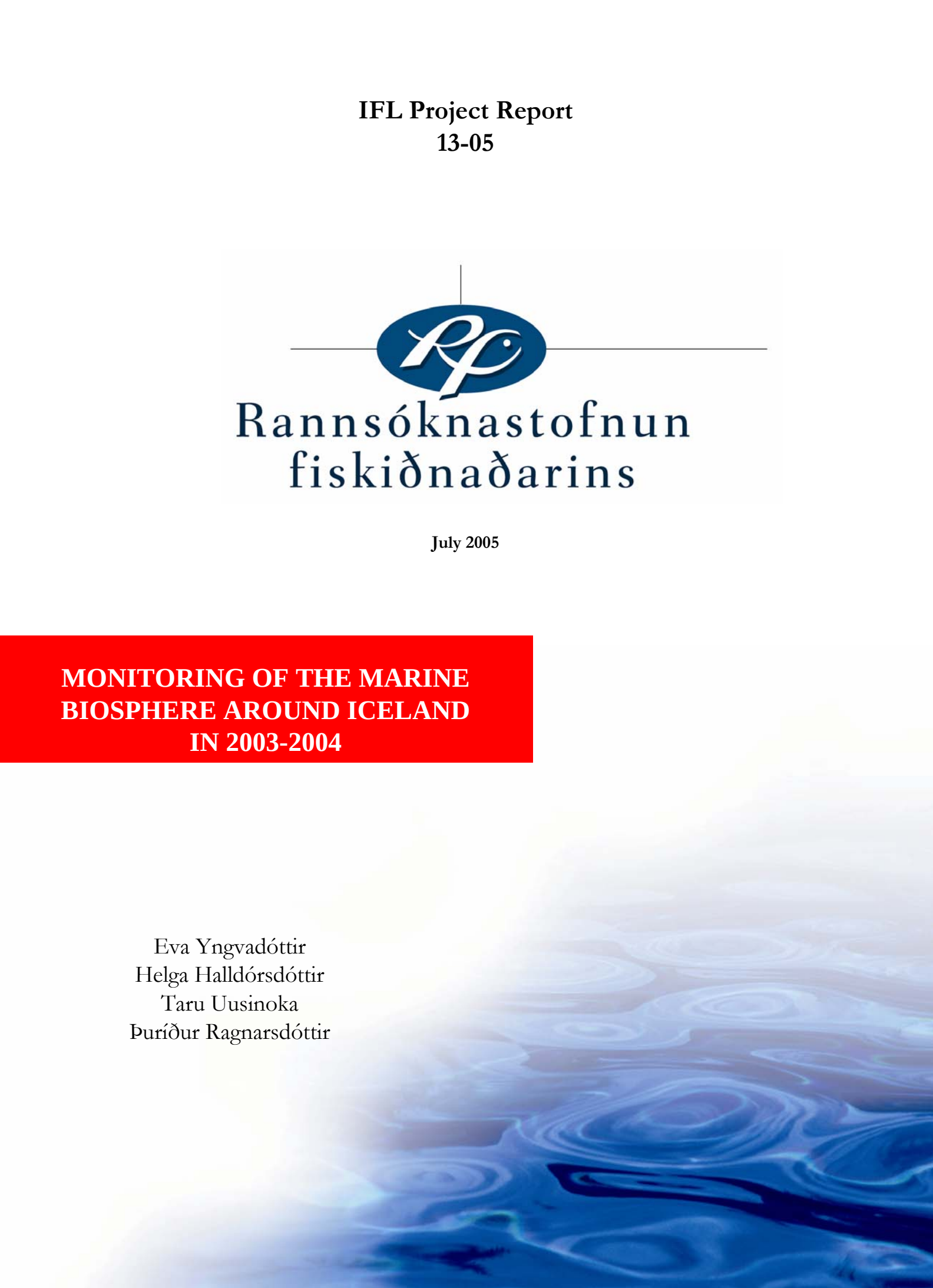

Skýrsluágrip Rannsóknastofnunar fiskiðnaðarins

Icelandic Fisheries Laboratories Report Summary

Titill / Title	Mengunarvöktun í lífríki sjávar við Ísland 2003 og 2004/ Monitoring of the marine biosphere around Iceland 2003 and 2004		
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Skýrsla Rf /IFL report	13-05	*Útgáfudagur / Date:*	July 2005
Verknr. / project no.	1610		
Styrktaraðilar / funding:	*Umhverfisráðuneyti/Ministry for the Environment*		

Ágrip á íslensku:

Í þessari skýrslu eru birtar niðurstöður árlegs vöktunarverkefnis á vegum Umhverfisráðuneytisins fyrir árin 2003 og 2004. Markmið með þessari vöktun er að uppfylla skuldbindingar Íslands varðandi Oslóar- og Parísarsamninginn (OSPAR), auk AMAP (Artic Monitoring Assessment Program). Gögnin hafa verið send í gagnabanka Alþjóðlahafrannsóknarráðsins (ICES). Hafró sér um að afla sýna og Rf hefur umsjón með undirbúningi sýna og mælingum á snefilefnum í lífríki hafsins. Sýnin eru mæld á Rf og á Rannsóknastofu í lyfja- og eiturefnafræði.

Mæld voru ýmis ólífræn snefilefni og klórlífræn efni í þorski veiddum í árlegu vorralli Hafró í mars 2004 og í kræklingi sem safnað var á 7 stöðum í kringum landið í ágúst 2003. Vöktun í lífríki sjávar við Ísland hófst 1989.

Lykilorð á íslensku: *OSPAR, AMAP, vöktun á lífríki sjávar, ólífræn snefilefni, klórlífræn efni, þorskur, kræklingur.*

Summary in English:

This report contains results of the annual monitoring of the biosphere around Iceland in 2003 and 2004. The project, overseen by the Environmental and Food Agency of Iceland, is to fulfil the OSPAR (Oslo and Paris agreement) and AMAP (Arctic Monitoring Assessment Program) agreements. The data has been submitted to the ICES databank (ices.dk), collection of data began 1989. The Icelandic Fisheries Laboratories (IFL) is the coordinator for marine biota monitoring and is responsible for methods relating to sampling, preparation and analysis of samples. The samples were analyzed at the IFL and at the Department of Pharmacology and Toxicology at the University of Iceland.

Trace metals and organochlorines were analysed in cod *(Gadus morhua)* caught in March 2004 and in blue mussel *(Mytilus edulis)* collected in August 2003. Marine monitoring began in Iceland 1989.

English keywords: *OSPAR, AMAP, monitoring, trace metals, organochlorine compounds, cod (Gadus Morhua), blue mussel (Mytilus edulis).*

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APPENDICES

I. Introduction

This report contains the results of the annual monitoring of heavy metals and organochlorine analyses for blue mussel (*Mytilus edulis*), collected in the waters around Iceland in 2003, as well as for cod (*Gadus morhua*), collected in Icelandic territorial waters in 2004. Annual monitoring of trace metals in the marine biota around Iceland began in 1989 and the monitoring of organochlorine compounds a few years later, in 1991. Several reports have already been published on this matter (1-10). To meet the requirements of the OSPAR (Oslo and Paris agreement) and the AMAP (Arctic Monitoring Assessment Program), data has been submitted to the ICES databank (ices.dk), the first data from 1989. The project is supervised by the Environment and Food Agency in Iceland and financed by The Ministry for the Environment. The Icelandic Fisheries Laboratories (IFL) is the coordinator for the marine biota monitoring and responsible for methods relating to sampling, preparation and analysis of samples. The samples were analyzed at the IFL and at the Department of Pharmacology and Toxicology at the University of Iceland.

II. Sampling and preparation of samples

The Marine Research Institute handles all sampling, whereas the IFL is responsible for the storage of samples, preparation and chemical analysis.

2.1 Sampling

Using standard sampling guidelines (JMP, ICES and OSPAR), the sampling of cod (30-45 cm length, 3 samples) and dab (20-35 cm length, 3 samples) was carried out in the annual bottom trawl survey in March 2004. Blue mussel, 4-6 cm length, was collected from 11 sites around the country in August 2003. Sampling sites for cod, dab and blue mussel are shown in figure I and coordinates are given in appendix I and II. Icelandic waters have been divided into five main locations (N-NW, NE, SE-E, S, SW).

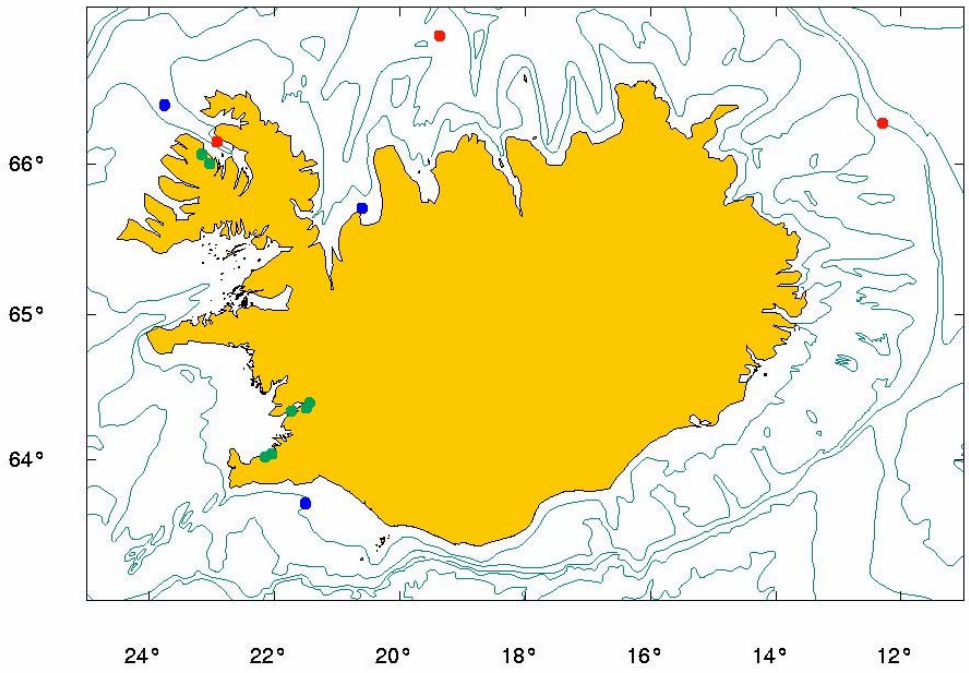

Figure 1. Locations for sampling of cod (Gadus morhua) (red dots), dab (Limanda limanda) (blue dots) 2004 and blue mussel (Mytilus edulis) (green dots) 2003.

2.2 Preparation of samples prior to analysing

Each sample of mussel contained 50 ± 5 individuals. Each mussel was weighed and its length (4-6 cm), height and width measured. The flesh and the shell were then weighed separately (Appendix I). After each sample (50 individuals) had been homogenized it was kept frozen until the analysis took place.

30-45 cm long cod was selected and dab in the range of 20-35 cm, each sample containing 25 ± 5 individuals. No further work was done with the dab samples in this project due to lack of funding and the samples are currently being kept frozen at the IFL. At the time of the sampling, the total weight as well as the gender of each fish was determined, livers were put in pre-weighed and pre-cleaned glass jars and, finally, the fish was gutted. All samples were kept frozen until further preparation for analysis took place. Later, the otoliths were removed for age determination, the fish was filleted, skinned, and the flesh weighed (Appendix II). Finally, each sample of flesh (25 ± 5 individuals) was homogenized. The livers of each cod sample were

divided into sub samples, according to the weight of the livers. All liver samples were homogenized and kept frozen until analysis took place.

III. Analysis

3.1 Metals and organic contaminants in biota

The trace metal analysis of lead, cadmium, copper, zinc, mercury, arsenic and selenium was carried out at the IFL, as well as analysis of the supporting parameters, dry matter and fat. The following organic compounds were analysed at the Department of Pharmacology and Toxicology at the University of Iceland: 11 PCBs, HCB, a-HCH, b-HCH and g-HCH, p,p'-DDT o,p'-DDT, p,p'-DDE and p,p'-DDD, transnonachlor, a-chlordan, g-chlordan, oxychlordan, TOX-26, Tox-50 and Tox-62. Table 1 presents the samples and all the parameters measured in each sample. 11 blue mussel samples were collected but 4 have not yet arrived at IFL. Those are samples from Grímsey, Mjóifjordur I, II, III. One cod flesh sample from 2002 was analysed for Hg in this round. Livers from this 2002 cod sample were analysed and published 2003 (9).

Table 1. Parameters measured in different samples.

Species	Number of samples	Number of individuals	Type of sample	Number of groups	Inorganic contaminants	Organic contaminants	Other
Mussel, 2003 (***Mytilus edulis***)	7	50	Whole soft body		Cd, Cu, Zn, Pb,As, Se, Hg	X*	dry matter and fat
Cod, 2004 (***Gadus morhua***)	3	25	Flesh	3	Hg		dry matter and fat
			Liver	16	Cd, Cu, Zn, Pb, As, Se	X*	dry matter and fat
Cod, 2002 (***Gadus morhua***) Labels: Cod-N-NW (1) 04 Cod-N-NW (2) 04 Cod-NE 04 Cod-N-NW 02	1	25	Flesh	1	Hg		dry matter and fat

X* : PCB28, PCB31, PCB52, PCB101, PCB105, PCB118, PCB138, PCB153, PCB156, PCB170, PCB180, a, b, g-HCH, HCB, p,p'-DDT, o,p'-DDT, p,p'-DDE, p,p'-DDD, transnonachlor, a-chlordan, g-chlordan, oxychlordan, TOX-26, Tox-50, Tox-62.

3.2 Methods

The metals were analysed by using cold vapour atomic absorption (Hg), FAA/impact bead using D_2-background correction (Cd, Cu, Zn, Pb) and hydride generation (As, Se) atomic absorption. The organochlorine compounds were analysed by GC-ECD using HP5890 Series II with an automatic injector (HP7673). A detailed description of the analyses of metals, organic compounds and supporting parameters (dry matter and fat) is given in previous report (7).

3.3 Quality assurance

The quality of the **metal** analysis was checked in several ways. Certified reference materials are routinely treated and analysed in the same manner as the samples. For all the elements measured, standard additions to tissue homogenates prior to decomposition were implemented. The additions corresponded to 50, 100 and 150% increase of the expected concentrations. Results for analysis of reference materials, recovery of standard additions and limits of detection are shown in table 2 and 3 in appendix III. Also shown are Z scores for the reference materials. The trace analytical lab at the IFL has participated in Quasimeme annually with satisfactory results. Also, IFL participated in Quash with satisfactory results. The average field blank (C_B), derived from the sample field blanks, and three times its standard deviation ($3xS_B$), were used to evaluate the limit of detection (LOD).

For **organic contaminants,** a solvent blank and sample of certified reference material was extracted with each batch of samples. A certified standard solution was also run with the samples to check own standards. The limit of detection was estimated to be 3 x STDEV of the blanks. The Department of Pharmacology and Toxicology at the University of Iceland has participated in Quasimeme annually with satisfactory results. Results for analysis in certificate mussel and cod liver samples are presented in appendix III, tables 4 and 5 along with relevant detection limits in table 6.

IV. Results

This report contains data from the years 2003 and 2004 which has not been statistically evaluated in connection with previous results. However, there are apparently no obvious changes in contaminant concentrations pattern seen in previous years see (graphical representation in appendices VII and VIII). To be able to monitor long term trends and to indicate large scale spatial difference in the marine biota around Iceland, data from many years needs to be assessed with statistical models.

4.1 Biological variations

Figures 2a-d in appendix VI shows the biological variation in cod *(Gadus morhua)* 1990-2004, (average age, average weight of ungutted fish, average weight of liver, and average fat content in liver).

4.2 Heavy metals

Results for metals in blue mussel (2003) and cod (2004) are presented in tables 7 and 8 in appendix IV. New data is presented along with data from previous years (1, 4-10) in figures 3a-c and 4a-c (Appendix VII) for blue mussel and in figures 6a,b and 7a-f (Appendix VIII) for cod, giving an overview of a period of 13-14 years. It should be noted that results for cod are on a wet weight basis but for mussel on a dry weight basis.

4.2.1 Blue mussel

Figures 3a-c in appendix VII show the average concentration of heavy metals in blue mussel 1991-2003, on a dry weight basis. The horizontal red line shows the ICES90 75% baseline (11). Figures 4a-c in appendix VII show average concentrations (dw), of heavy metals in blue mussel from different sampling sites, 1990-2003. Metal concentrations vary considerably between years and different locations. Concentration of arsenic is noticeably higher at Úlfsá, Skutulsfjordur than any other sample place for blue mussel. Lead was detected below the limits of detection in all cases. The results show low values for Hg in blue mussel when compared with ICES90 75% baseline values. Cu and Zn are close to these values but Cd is high in blue mussel from

Icelandic coasts, compared to other areas. This cadmium is considered to be of natural origin since no anthropogenic source is known.

4.2.2 Cod

Figures 6a-b in appendix VIII show the average heavy metal concentration in livers of 30-45 cm cod (wet weight), caught in Icelandic waters in March every year between 1990-2004. Figures 7a-f in appendix VIII show average concentrations (ww), of heavy metals in cod from different sampling sites, 1990-2004. Mercury is measured in the flesh. Lead concentration was below the limits of detection in all samples. Variations in concentration between years and locations over the time interval can be seen. The concentration of heavy metals in cod from Icelandic waters is low compared to cod from other northern locations (6). As for the blue mussel the only exception is cadmium which is probably of natural origin reflecting the natural background values. However, the amount of cadmium in cod and other species in Icelandic costal waters is far below the TWI (Tolerable Weekly Intake) standard of WHO, even with heavy consumption (6).

4.3 Organic compounds

Results for organic compounds in blue mussel (2003) and cod (2004) are presented in appendix V, tables 9 and 10. The results for cod are presented on a wet-weight basis but results for blue mussel are on a dry-weight basis. New data is shown along with data from previous years (1,4-10) in figures 5a-b (Appendix VII) for blue mussel and in figures 8 and 9a-e (Appendix VIII) for cod, giving an overview of a 13-14 year period.

4.3.1 Blue mussel

Figures 5a-b in appendix VII show the concentration on a dry-weight basis of organic compounds in blue mussel from different locations in Iceland 1991-2003. The most common organochlorines found in blue mussel are PCBs. The concentration of PCBs in blue mussel found in Iceland are comparable with values found in mussels from remote areas of the west coast of United States and also similar to the lowest values found in mussels on the coast of the United Kingdom and Ireland (6). In general, concentration of HCH, HCB and DDE is low, close to the limit of detection.

4.3.2 Cod

Figures 8 in appendix VIII show the average concentration on a wet-weight basis of organic compounds in livers of 30-45 cm cod, caught in Icelandic waters in March every year between 1991-2004. Figures 9a-e in appendix VIII show average concentrations (ww), of some organic compounds in cod from different sampling sites, 1991-2004. The sum of seven PCBs (PCB-28, PCB-52, PCB-101, PCB-118, PCB-138, PCB-153 and PCB-180) are about 90% of the 11 PCBs measured. The concentrations of the organic substances that are measured in cod from Icelandic waters correspond to the lowest values observed elsewhere (6).

V. Conclusion

This report contains the results of an evaluation of trace elements in Icelandic marine biota for the years 2003 and 2004. It adds to the information gathered every year to determine: if the concentration of trace elements is increasing, decreasing or not changing; if current situation is a cause for health concerns; and if the marine environment is being threatened by pollution. A full statistical analysis of all data is needed to confirm changes if any. This was done in 1998 (6) but new data calls for a new evaluation. In addition, when comparing data of livers it is necessary to keep in mind the factors (i.e. fat, age, dw) that may affect the quantity and concentration of trace elements.

Iceland is unique in terms of geology, oceanography and meteorology. High levels of heavy metals, particularly cadmium, occur naturally in the environment in Iceland. Therefore, natural background values need to be kept in mind when comparing contamination levels with other countries.

VI. Acknowledgement

The following participated in the project:

IFL: Eva Yngvadóttir, Eyrún Þorsteinsdóttir, Helga Halldórsdóttir, Taru Uusinoka and Þuríður Ragnarsdóttir.

UIPT: Kristín Ólafsdóttir.

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Appendix I.

Biological measurements of Blue mussel (*Mytilus edulis*) 2003

Species:	**Blue mussel (*Mytilus edulis*)**	Date of sampling:	**12.8.2003**
Length:	4-6 cm	Sampled by:	Marine Inst.
Location:	**Úlfsá, Skutulsfjörður**	Date of preparation:	2.9.2004
Coordinates	660360-230996	IFL#:	SN-2004-00418

	Length (mm)	Width (mm)	Height (mm)	Total weight (g)	Weight soft body (g)	Weight shell (g)
1	47,5	21,5	20,4	12,03	6,22	5,71
2	44,1	20,7	16,8	8,12	4,46	3,57
3	41,0	19,5	17,3	9,02	4,02	4,92
4	48,7	23,0	18,3	10,45	6,19	4,24
5	47,8	24,8	21,8	14,97	8,20	6,77
6	42,5	19,5	17,2	7,88	4,49	3,28
7	57,5	20,0	30,1	23,68	12,65	10,96
8	48,7	21,5	22,7	14,75	6,79	7,93
9	49,2	23,0	21,2	12,78	6,84	5,81
10	44,1	21,1	17,3	8,93	5,10	3,70
11	49,7	24,0	19,1	12,04	6,75	5,22
12	47,7	20,9	18,4	9,87	5,61	4,19
13	43,2	21,2	17,3	9,03	4,78	4,22
14	50,7	22,2	23,9	16,86	8,53	8,27
15	48,3	24,5	20,4	13,86	7,42	6,37
16	50,2	25,4	18,4	11,01	6,35	4,59
17	52,4	25,3	24,9	19,64	10,38	9,19
18	43,6	20,1	20,3	9,46	5,80	3,63
19	48,6	23,0	21,8	13,70	7,03	6,63
20	40,9	18,0	18,0	7,78	4,31	3,45
21	44,7	20,8	19,8	10,94	5,59	5,32
22	47,8	24,4	21,6	14,90	7,8	6,99
23	47,3	22,3	20,3	12,93	6,59	6,22
24	43,7	21,4	17,0	9,02	5,05	3,93
25	50,4	23,8	20,3	13,44	7,01	6,26
26	46,2	22,1	19,6	11,77	6,08	5,63
27	49,4	22,7	22,8	12,27	6,22	5,95
28	50,8	22,6	19,1	11,90	6,85	5,01
29	42,7	22,0	14,7	6,09	3,38	2,41
30	47,1	20,7	17,6	9,02	4,77	4,32
31	47,3	21,6	19,1	10,55	5,89	4,56
32	47,7	21,4	22,4	12,50	6,58	5,82
33	45,5	23,0	18,3	10,78	6,05	4,66
34	48,9	21,8	21,3	13,69	7,04	6,61
35	46,5	22,2	23,2	14,13	7,10	7,02
36	43,8	22,0	18,4	9,51	5,17	4,31
37	40,0	18,8	17,2	8,24	3,85	4,32
38	44,6	21,5	17,1	8,48	4,92	3,49
39	46,9	23,0	20,3	13,30	6,98	6,34
40	58,1	26,0	25,0	19,19	11,47	7,64
41	40,0	21,0	15,4	5,48	3,41	1,85
42	40,6	20,2	16,1	7,14	4,21	2,96
43	40,0	19,2	14,9	6,61	3,28	3,23
44	46,0	22,2	19,4	11,13	6,12	5,01
45	40,0	19,3	16,0	6,86	3,47	3,27
46	41,3	21,3	19,1	9,56	4,86	4,65
47	41,7	20,2	15,5	6,57	3,75	2,70
48	47,2	22,7	21,1	13,79	6,85	6,92
49	43,6	21,0	16,4	7,68	4,69	2,98
50	50,0	24,1	20,2	12,89	7,37	5,46
	Length	**Width**	**Height**	**Total weight**	**Weight soft body**	**Weight shell**
Average	46,3	21,9	19,5	11,32	6,09	5,17
Stdev	4,1	1,8	3,0	3,65	1,93	1,82
Min	40,0	18,0	14,7	5,48	3,28	1,85
Max	58,1	26,0	30,1	23,68	12,65	10,96

Species:	**Blue mussel (*Mytilus edulis*)**	Date of sampling:	**12.8.2003**
Length:	4-6 cm	Sampled by:	Marine. Inst.
Location:	**Dvergasteinn, Álftafjörður**	Date of preparation:	1.9.2004
Coordinates:	655989-230215	IFL#:	SN-2004-417

	Length (mm)	**Width (mm)**	**Height (mm)**	**Total weight (g)**	**Weight soft body (g)**	**Weight shell (g)**
1	55,8	26,3	23,5	18,06	10,12	7,60
2	41,1	20,9	12,9	7,90	5,09	2,76
3	51,5	23,5	13,5	11,51	6,66	4,79
4	49,0	21,1	18,7	9,50	5,72	3,73
5	54,2	25,2	21,6	16,34	9,44	6,79
6	49,6	25,4	18,7	11,28	6,32	4,78
7	49,5	23,3	18,9	11,15	6,39	4,68
8	48,6	23,9	19,4	9,88	5,23	4,45
9	49,5	21,6	20,7	12,01	7,01	4,90
10	52,9	25,9	20,7	13,60	8,19	5,36
11	41,4	21,5	11,2	6,73	3,96	2,72
12	53,1	22,9	21,8	14,89	8,54	6,35
13	48,2	22,2	16,9	7,81	3,40	4,32
14	42,0	22,1	16,8	8,52	5,31	3,11
15	47,3	21,6	18,4	8,68	5,02	3,58
16	46,8	21,6	12,3	9,17	5,37	3,77
17	44,7	23,5	17,3	9,32	4,86	4,42
18	46,8	22,2	19,2	11,29	6,33	4,92
19	49,0	23,5	20,5	12,63	7,59	8,01
20	47,8	23,6	19,9	10,65	6,50	4,12
21	51,9	23,2	23,5	16,55	8,91	7,61
22	47,6	23,1	21,2	14,64	8,32	6,22
23	44,4	22,2	16,0	7,23	4,44	2,54
24	47,6	21,6	19,4	9,28	5,42	3,59
25	49,6	25,6	20,2	11,20	6,19	4,94
26	40,3	20,5	15,2	6,06	3,29	2,30
27	41,1	18,7	15,1	6,25	3,42	2,47
28	45,6	21,5	16,7	8,06	4,35	3,28
29	44,8	22,8	16,6	8,67	4,19	3,75
30	43,0	20,3	15,9	7,40	3,98	3,02
31	47,0	23,0	17,4	9,31	5,15	3,72
32	44,6	21,4	19,2	8,65	4,83	3,33
33	43,3	21,4	14,9	6,00	3,44	2,23
34	46,2	22,8	15,5	7,84	3,78	2,96
35	45,6	24,4	17,4	9,97	5,58	4,12
36	47,1	23,6	20,1	11,86	6,15	5,02
37	46,5	25,3	18,9	11,49	6,65	4,66
38	48,4	28,9	21,2	11,81	7,17	4,60
39	41,2	20,5	15,2	7,12	4,14	2,92
40	40,7	21,6	18,0	8,07	4,19	3,89
41	40,2	21,1	15,6	6,72	3,50	3,20
42	48,5	23,9	19,2	11,55	6,78	4,74
43	51,5	24,6	20,5	12,38	7,16	5,21
44	44,6	19,8	18,6	8,62	5,33	3,27
45	47,3	23,5	19,1	10,08	6,23	3,82
46	44,2	20,7	19,0	9,16	5,07	4,12
47	42,8	21,3	19,7	10,31	5,53	4,72
48	44,5	22,1	20,5	10,39	6,19	4,19
49	45,7	22,5	18,5	9,81	5,65	4,14
50	48,5	24,9	21,3	12,05	6,95	4,87
	Length	**Width**	**Height**	**Total weight**	**Weight soft body**	**Weight shell**
Average	46,7	22,8	18,3	10,19	5,78	4,29
Stdev	3,8	1,9	2,7	2,75	1,64	1,34
Min	40,2	18,7	11,2	6,00	3,29	2,23
Max	55,8	28,9	23,5	18,06	10,12	8,01

Species:	**Blue mussel (*Mytilus edulis*)**	Date of sampling:	**13.8.2003**
Length:	4-6 cm	Sampled by:	Marine Inst.
Location:	**Hvítanes, Hvalfjörður**	Date of preparation:	25.10.2004
Coordinates:	642185-212970	IFL#:	SN-2004-415

	Length (mm)	**Width (mm)**	**Height (mm)**	**Total weight (g)**	**Weight soft body (g)**	**Weight shell (g)**
1	43,4	20,8	18,3	9,26	4,84	4,32
2	46,0	18,3	17,2	7,22	3,74	3,43
3	43,3	19,5	20,7	9,80	5,87	4,36
4	42,7	20,0	17,2	7,33	4,27	2,99
5	42,8	18,7	16,5	7,15	3,89	3,19
6	43,8	18,7	19,2	8,90	4,81	4,02
7	48,1	22,5	19,8	12,78	6,86	5,92
8	46,6	21,7	20,6	12,20	5,93	6,20
9	40,6	19,8	18,3	8,68	4,42	4,23
10	40,1	20,1	19,6	9,01	5,14	3,83
11	47,0	20,7	20,4	11,45	6,02	5,38
12	40,2	17,7	19,4	7,69	4,18	3,43
13	43,8	17,7	17,9	7,45	4,09	3,33
14	43,8	18,6	18,9	8,49	4,62	3,84
15	42,5	17,9	18,3	8,61	4,10	4,42
16	50,7	24,6	23,7	15,20	8,66	6,32
17	48,1	20,4	18,5	9,24	5,33	3,65
18	44,2	21,4	19,2	9,42	5,12	4,23
19	43,3	18,9	17,5	8,03	4,32	3,65
20	41,9	19,4	18,4	8,39	4,63	3,74
21	41,7	18,5	19,9	6,75	3,69	3,04
22	45,6	19,4	20,1	9,98	5,31	4,62
23	40,0	18,7	18,4	8,87	4,28	4,50
24	45,1	20,7	21,4	11,22	5,86	5,34
25	42,9	19,9	18,8	8,46	4,81	3,60
26	44,5	21,0	18,3	9,33	5,45	3,79
27	41,7	18,8	17,1	9,00	5,03	3,88
28	47,0	21,2	20,0	10,28	5,85	4,40
29	43,8	19,1	18,1	9,31	4,52	4,65
30	42,0	12,7	20,9	9,56	4,99	4,55
31	42,0	20,4	16,3	6,92	3,83	3,02
32	43,3	19,6	18,8	7,79	4,81	2,94
33	46,4	20,3	19,5	9,98	5,51	4,45
34	40,0	17,5	17,7	7,36	3,89	3,40
35	40,3	16,7	19,4	8,49	4,22	4,26
36	42,5	19,6	18,7	9,68	5,28	4,36
37	40,7	17,9	18,7	7,53	4,14	3,36
38	42,8	18,8	17,7	7,46	4,52	2,88
39	46,3	20,1	22,2	12,53	7,07	5,45
40	42,5	19,4	17,6	7,69	4,39	3,28
41	41,9	18,8	17,6	6,65	3,10	3,48
42	41,5	20,5	18,1	7,94	4,40	3,50
43	40,8	19,7	16,1	7,30	4,02	3,26
44	41,3	19,9	18,0	8,38	4,32	3,97
45	41,5	19,6	20,0	9,36	5,00	4,33
46	47,5	22,2	20,7	11,47	6,67	4,78
47	43,4	21,4	17,3	8,58	5,05	3,50
48	40,2	17,9	16,4	7,10	3,80	3,25
49	41,2	18,8	18,3	8,16	4,20	3,83
50	43,2	19,1	18,8	9,10	4,46	4,57
	Length	**Width**	**Height**	**Total weight**	**Weight soft body**	**Weight shell**
Average	43,3	19,5	18,8	8,97	4,87	4,05
Stdev	2,5	1,7	1,5	1,74	1,01	0,83
Min	40,0	12,7	16,1	6,65	3,10	2,88
Max	50,7	24,6	23,7	15,20	8,66	6,32

Species:	**Blue mussel (*Mytilus edulis*)**	Date of sampling:	**13.8.2003**
Length:	4-6 cm	Sampled by:	Marine Inst.
Location:	**Eyri, Hvalfjörður**	Date of preparation:	8.11.2004
Coordinates:	642050-214390	IFL#:	SN-2004-414

	Length (mm)	**Width (mm)**	**Height (mm)**	**Total weight (g)**	**Weight soft body (g)**	**Weight shell (g)**
1	42,9	18,8	17,2	7,04	3,84	2,96
2	41,1	19,2	14,8	5,26	2,37	2,29
3	45,8	22,0	16,8	9,09	4,17	3,47
4	46,2	22,2	18,0	9,61	4,70	4,36
5	45,5	21,0	17,2	8,88	4,57	3,96
6	42,2	21,0	17,3	6,85	3,60	2,86
7	41,2	19,1	16,0	4,93	1,82	2,98
8	44,9	20,9	19,0	8,65	4,79	3,45
9	42,0	20,7	15,8	7,27	3,49	3,26
10	46,9	22,2	17,0	9,29	4,20	4,19
11	42,9	21,9	17,6	7,93	3,82	3,68
12	47,2	21,8	18,9	9,66	5,52	3,84
13	46,3	20,7	19,0	9,88	5,33	4,14
14	44,3	19,8	18,2	8,30	4,46	3,43
15	44,5	21,8	17,3	7,47	3,51	3,67
16	43,4	18,4	18,2	7,83	3,36	4,25
17	48,5	22,6	20,6	11,26	5,59	5,33
18	44,8	21,0	17,9	8,09	4,91	2,94
19	45,5	21,4	16,3	7,98	4,14	3,44
20	42,4	21,0	16,4	7,57	3,90	3,28
21	41,7	20,2	16,9	7,80	3,48	3,79
22	43,7	21,3	16,3	9,26	4,58	4,14
23	46,5	22,8	17,0	8,53	4,24	3,41
24	45,3	20,5	17,9	8,78	4,41	3,78
25	48,2	22,3	20,6	12,92	5,97	6,35
26	47,3	20,9	16,2	6,40	3,04	2,95
27	44,6	20,7	18,6	9,60	4,52	4,71
28	48,7	23,0	18,8	11,36	4,95	5,87
29	48,4	22,4	19,3	11,12	5,56	4,94
30	49,7	22,1	20,7	11,33	5,95	4,82
31	47,0	23,4	20,6	10,53	4,74	5,4
32	51,6	24,1	19,0	12,11	6,01	5,49
33	49,6	23,8	20,7	13,13	6,65	5,93
34	41,8	19,3	15,8	6,76	3,57	3,09
35	44,8	22,0	20,1	9,14	4,71	4,08
36	44,0	21,3	17,6	8,51	4,37	3,93
37	45,7	20,5	18,5	8,64	4,23	4,04
38	45,2	22,5	16,8	7,76	4,48	3,12
39	48,2	22,3	18,6	10,30	5,58	4,55
40	50,4	24,4	19,5	11,37	5,97	5,18
41	47,1	24,7	17,7	10,32	5,89	4,12
42	47,4	22,9	21,3	12,15	6,23	5,74
43	43,1	22,1	16,4	8,61	4,48	3,84
44	46,1	22,2	18,1	8,94	5,47	3,24
45	42,6	20,1	16,4	6,93	3,57	3,14
46	45,7	21,8	17,2	8,21	4,57	3,36
47	43,1	20,4	17,9	8,54	4,60	3,71
48	43,0	21,8	17,5	7,85	4,02	3,26
49	44,5	22,0	16,9	7,61	3,90	3,41
50	41,9	19,8	16,0	6,62	3,41	2,84
	Length	**Width**	**Height**	**Total weight**	**Weight soft body**	**Weight shell**
Average	45,3	21,5	17,9	8,88	4,50	3,96
Stdev	2,6	1,4	1,5	1,84	1,00	0,94
Min	41,1	18,4	14,8	4,93	1,82	2,29
Max	51,6	24,7	21,3	13,13	6,65	6,35

Species:	**Blue mussel (*Mytilus edulis*)**	Date of sampling:	**12.8.2003**
Length:	4-6 cm	Sampled by:	Marine Inst.
Location:	**Hvassahraun**	Date of preparation:	3.2.2005
Coordinates:	640125-220900	IFL#:	SN-2004-412

	Length (mm)	**Width (mm)**	**Height (mm)**	**Total weight (g)**	**Weight soft body (g)**	**Weight shell (g)**
1	51,0	26,3	21,0	14,95	9,21	5,63
2	47,8	26,6	20,7	13,56	8,84	4,67
3	48,1	25,6	21,5	13,61	8,90	4,69
4	47,2	23,4	20,1	13,05	7,43	5,61
5	46,6	24,4	18,9	9,88	6,31	3,50
6	55,0	26,3	23,9	20,35	11,69	8,54
7	54,4	26,4	24,1	16,95	10,90	5,99
8	54,3	25,9	23,2	16,55	10,11	6,01
9	53,1	25,5	22,3	16,35	9,83	6,47
10	48,0	24,3	19,9	11,43	7,39	4,03
11	46,3	23,2	18,3	10,21	5,64	4,51
12	44,0	23,6	18,4	9,88	6,01	3,70
13	45,6	24,3	18,5	10,26	6,02	3,99
14	43,9	22,2	18,8	9,61	5,34	3,76
15	54,2	26,4	22,3	18,08	10,24	7,54
16	54,4	26,3	23,1	18,62	10,53	7,86
17	52,6	25,7	20,9	14,81	8,93	5,51
18	49,4	25,0	20,7	12,81	7,35	4,93
19	48,8	23,4	21,8	13,85	8,30	5,39
20	48,7	23,5	19,7	10,92	6,31	4,01
21	46,7	23,1	21,2	11,62	6,56	4,56
22	49,0	24,8	22,9	15,97	8,89	6,70
23	50,6	25,2	21,8	15,22	8,65	6,31
24	50,2	25,3	19,9	15,70	9,19	6,23
25	50,9	24,5	21,7	15,33	8,42	6,55
26	47,2	25,0	19,3	13,08	6,35	6,12
27	46,4	25,0	18,8	11,67	6,50	6,83
28	45,2	23,0	17,8	10,33	5,80	4,14
29	45,6	21,8	19,6	10,63	6,12	4,08
30	60,0	31,1	23,3	22,55	13,44	8,98
31	55,6	27,4	21,8	18,96	10,96	7,95
32	51,5	24,2	22,2	15,65	8,93	6,61
33	49,0	23,7	20,4	11,72	7,38	4,31
34	48,8	24,8	20,0	12,85	7,73	4,93
35	47,8	23,2	21,2	10,11	5,49	4,41
36	51,2	23,9	21,4	14,55	9,10	5,21
37	47,9	24,0	19,4	11,93	6,51	5,31
38	46,3	24,2	18,8	11,73	6,46	5,19
39	45,3	23,4	18,2	9,66	6,02	3,53
40	43,6	22,0	19,8	9,67	5,59	3,96
41	43,3	23,2	19,2	10,14	6,14	3,96
42	43,1	21,4	18,1	8,27	4,51	3,48
43	41,7	20,5	17,7	7,26	4,53	2,65
44	48,2	25,9	20,7	15,15	7,92	6,90
45	47,8	22,8	19,2	11,68	6,73	4,63
46	46,3	24,3	19,6	11,70	6,99	4,35
47	47,0	22,2	19,1	11,32	6,28	4,78
48	47,8	23,1	18,4	9,73	6,54	3,00
49	47,3	22,2	19,7	11,41	6,45	4,67
50	44,4	21,8	17,8	9,30	4,74	3,95
	Length	**Width**	**Height**	**Total weight**	**Weight soft body**	**Weight shell**
Average	48,6	24,3	20,3	13,01	7,60	5,21
Stdev	3,8	1,8	1,7	3,28	1,98	1,46
Min	41,7	20,5	17,7	7,26	4,51	2,65
Max	60,0	31,1	24,1	22,55	13,44	8,98

Species:	**Blue mussel (*Mytilus edulis*)**	Date of sampling:	**13.8.2003**
Length:	4-6 cm	Sampled by:	Marine Inst.
Location:	**Hvalstöð, Hvalfjörður**	Date of preparation:	3.2.2005
Coordinates:	642375-212670	IFL#:	SN-2004-416

	Length (mm)	**Width (mm)**	**Height (mm)**	**Total weight (g)**	**Weight soft body (g)**	**Weight shell (g)**
1	50,3	23,2	19,3	11,81	5,77	5,69
2	57,6	25,2	25,6	20,60	10,16	10,11
3	57,4	27,5	22,5	19,22	10,96	8,17
4	59,8	26,8	22,4	19,13	10,21	8,75
5	57,2	25,3	22,7	17,48	9,93	7,42
6	56,4	25,9	25,0	22,26	10,45	11,47
7	58,7	26,1	23,0	18,22	10,58	7,22
8	57,5	26,0	19,4	14,41	8,01	7,10
9	56,0	27,0	23,1	17,41	8,99	8,01
10	53,4	24,7	24,6	17,62	8,20	9,09
11	52,4	23,3	22,7	16,11	6,82	8,96
12	52,4	25,5	22,3	14,91	8,29	6,45
13	45,4	22,5	13,1	10,02	4,40	5,37
14	59,8	28,2	24,6	23,86	12,00	11,62
15	60,0	26,7	23,2	19,31	11,47	7,53
16	57,2	27,2	22,9	18,44	10,83	7,28
17	58,5	27,5	21,8	16,54	9,72	6,68
18	58,1	27,5	22,8	17,87	10,92	6,58
19	53,6	26,3	21,4	16,56	8,77	7,30
20	53,5	25,5	24,1	17,29	8,18	8,39
21	50,4	24,3	23,4	14,60	7,56	6,66
22	51,2	23,5	20,5	12,27	6,17	5,72
23	60,0	28,5	25,5	25,46	13,09	12,10
24	59,5	28,4	25,3	24,58	13,11	11,37
25	60,0	24,5	24,7	20,16	11,88	8,15
26	59,5	27,2	24,9	13,02	12,56	10,54
27	59,2	26,7	22,0	14,67	6,72	7,57
28	56,7	27,4	23,0	19,33	10,37	8,88
29	56,7	27,2	20,8	16,38	9,22	7,12
30	49,1	23,2	20,7	13,37	7,25	5,99
31	47,0	22,7	20,5	12,59	6,31	6,1
32	46,0	23,7	16,9	9,50	4,57	4,46
33	59,7	28,4	24,8	22,57	12,33	9,95
34	56,0	27,8	22,4	16,69	9,99	6,36
35	57,9	29,3	22,1	18,94	10,41	8,05
36	57,7	26,6	21,8	17,95	9,83	8,05
37	55,7	23,7	24,8	20,91	10,39	10,43
38	56,1	25,0	23,3	17,74	9,29	7,81
39	45,4	24,8	16,5	9,14	4,81	4,26
40	44,1	23,2	17,0	8,34	4,32	3,81
41	44,0	21,7	18,0	8,61	4,67	3,64
42	44,6	23,2	18,1	9,58	5,07	4,08
43	60,0	29,1	27,8	28,44	15,67	12,60
44	59,8	28,9	25,8	26,27	14,63	11,39
45	59,7	25,7	28,1	27,67	14,08	13,29
46	60,0	28,1	24,5	23,82	12,67	10,97
47	59,9	31,8	28,1	30,99	17,02	13,71
48	54,0	28,6	25,3	26,27	11,68	14,18
	Length	**Width**	**Height**	**Total weight**	**Weight soft body**	**Weight shell**
Average	55,1	26,0	22,5	17,89	9,59	8,26
Stdev	5,1	2,2	3,1	5,48	3,05	2,66
Min	44,0	21,7	13,1	8,34	4,32	3,64
Max	60,0	31,8	28,1	30,99	17,02	14,18

Species:	**Blue mussel (*Mytilus edulis*)**	Date of sampling:	**12.8.2003**
Length:	4-6 cm	Sampled by:	Marine Inst.
Location:	**Straumur, Straumsvík**	Date of preparation:	8.11.2004
Coordinates:	640260-220250	IFL#:	SN-2004-413

	Length (mm)	**Width (mm)**	**Height (mm)**	**Total weight (g)**	**Weight soft body (g)**	**Weight shell (g)**
1	50,6	21,2	21,3	12,29	7,32	4,67
2	48,0	22,3	22,7	12,75	7,44	5,08
3	48,5	24,3	20,4	10,92	6,77	4,03
4	47,5	21,0	18,2	9,92	5,33	4,18
5	45,9	22,2	21,4	11,30	6,05	5,13
6	50,6	22,8	19,5	11,57	6,88	4,57
7	52,1	24,0	19,0	12,78	7,70	4,96
8	48,6	22,3	21,7	12,09	7,31	4,57
9	48,2	19,0	19,7	10,21	6,08	4,02
10	51,5	21,3	21,6	14,32	7,04	6,87
11	52,0	24,0	19,9	12,04	7,50	4,30
12	50,3	23,4	23,0	14,89	7,98	6,70
13	56,5	23,6	22,5	14,45	8,80	5,34
14	44,5	21,9	18,9	9,34	5,29	3,81
15	46,8	22,1	18,5	10,69	5,83	4,50
16	51,0	23,5	21,6	12,83	7,45	5,09
17	53,5	24,2	21,8	15,05	8,72	6,07
18	57,3	26,4	24,4	18,47	11,27	6,99
19	52,8	21,9	20,8	12,91	6,91	5,53
20	46,7	23,7	18,2	9,76	5,63	3,62
21	51,2	23,0	21,4	13,98	7,91	5,86
22	48,3	21,8	22,1	12,60	6,97	5,26
23	45,7	22,2	20,1	10,31	5,13	4,61
24	52,1	23,2	21,4	13,33	7,89	5,18
25	49,9	18,3	22,5	12,22	6,48	5,20
26	54,8	24,3	24,9	17,72	10,14	7,24
27	51,9	21,9	21,5	13,73	7,60	5,81
28	52,5	23,5	20,2	12,80	7,00	5,11
29	52,2	24,4	21,8	13,94	6,33	7,29
30	54,9	24,4	23,8	18,28	9,04	8,94
31	53,0	24,2	22,4	14,23	8,10	5,77
32	51,4	23,9	22,6	16,04	8,82	6,76
33	59,7	21,7	23,5	18,87	11,16	7,27
34	57,6	22,5	24,6	20,75	11,28	8,71
35	60,0	27,2	29,2	23,34	14,02	9,11
36	46,3	20,8	21,6	9,89	5,60	3,92
37	49,8	22,1	18,4	9,87	5,71	3,89
38	48,2	21,4	24,5	12,58	6,44	5,63
39	49,9	23,8	20,9	12,11	7,01	4,84
40	53,0	23,9	22,6	15,83	8,78	6,55
41	54,4	24,4	22,4	16,10	8,96	7,02
42	54,3	24,6	22,0	14,26	8,11	5,69
43	55,2	24,7	24,1	17,35	9,54	7,29
44	53,9	23,2	21,7	12,99	7,38	5,29
45	58,2	26,5	22,8	16,45	8,97	7,10
46	59,8	25,2	24,5	19,68	12,24	7,23
47	57,3	27,8	22,5	16,76	10,08	6,20
48	60,0	29,1	25,6	21,14	10,62	9,84
49	59,9	27,8	25,8	21,77	12,32	8,81
50	60,0	26,9	26,0	22,02	12,30	9,18
	Length	**Width**	**Height**	**Total weight**	**Weight soft body**	**Weight shell**
Average	52,4	23,5	22,1	14,39	8,10	5,93
Stdev	4,3	2,1	2,2	3,58	2,10	1,59
Min	44,5	18,3	18,2	9,34	5,13	3,62
Max	60,0	29,1	29,2	23,34	14,02	9,84

Appendix II.

Biological measurements of Cod (*Gadus morhua*) 2004

Species:	**Cod (*Gadus Morhua*)**	**exped./station**			**date**	**n**
Location:	**Northeast off Iceland**	TBR1-2004-63	661562	121754	**8.3.2004**	23
Lenght:	30-45cm					
Ship:	Brettingur NS-50					
Expd.leader:	Valur Bogason					

Group	exped.-station	Weight jar IFL g	Weight jar and liver g	Weight liver g	Weight ungutted fish, g	Sex 0=female 1=male	Lenght cm	Weight gutted fish, g	Weight fillets g	Age
H 1	TBR1-2004-63	102,61	116,66	14,05	362	0	34,0	320	104,2	3
	TBR1-2004-63	105,81	120,25	14,44	408	0	35,0	345	119,6	4
	TBR1-2004-63	106,52	122,51	15,99	466	0	40,0	419	134,9	4
			Sum	44,48	1236,0		109,0	1084,0	358,7	11,0
			Average	14,83	412,0		36,3	361,3	119,6	3,7
			STDEV	1,03	52,1		3,2	51,5	15,4	0,6
			Min	14,05	362,0		34,0	320,0	104,2	3
			Max	15,99	466,0		40,0	419,0	134,9	4
H 2	TBR1-2004-63	97,88	115,40	17,52	585	1	42,0	531	160	4
	TBR1-2004-63	111,70	130,51	18,81	781	0	45,0	699	225,9	4
	TBR1-2004-63	97,72	118,74	21,02	555	1	41,0	494	153	4
	TBR1-2004-63	106,43	128,92	22,49	722	1	44,0	653	236,9	4
	TBR1-2004-63	102,16	125,77	23,61	397	1	36,0	332	101,2	3
			Sum	103,45	3040,0		208,0	2709,0	877,0	19,0
			Average	20,69	608,0		41,6	541,8	175,4	3,8
			STDEV	2,52	150,7		3,5	144,5	56,1	0,4
			Min	17,52	397,0		36,0	332,0	101,2	3
			Max	23,61	781,0		45,0	699,0	236,9	4
H 3	TBR1-2004-63	106,77	137,73	30,96	778	1	43,0	664	225,1	4
	TBR1-2004-63	106,67	140,49	33,82	668	0	41,0	566	189,2	4
	TBR1-2004-63	102,14	135,21	33,07	625	1	41,0	513	169,1	4
	TBR1-2004-63	102,14	140,37	38,23	804	0	45,0	683	250,6	4
	TBR1-2004-63	107,32	148,58	41,26	540	0	39,0	460	145,1	4
	TBR1-2004-63	106,97	148,34	41,37	627	1	41,0	530	169,4	4
			Sum	218,71	4042,0		250,0	3416,0	1148,5	24,0
			Average	36,45	673,7		41,7	569,3	191,4	4,0
			STDEV	4,45	100,3		2,1	87,8	39,4	0,0
			Min	30,96	540,0		39,0	460,0	145,1	4
			Max	41,37	804,0		45,0	683,0	250,6	4
H 4	TBR1-2004-63	102,15	146,29	44,14	754	0	44,0	616	205,5	4
	TBR1-2004-63	110,09	155,02	44,93	834	0	45,0	721	230,1	4
	TBR1-2004-63	98,42	144,54	46,12	771	0	44,0	607	198,5	4
	TBR1-2004-63	97,11	147,53	50,42	711	0	43,0	614	219,1	4
	TBR1-2004-63	106,54	160,40	53,86	755	0	44,0	640	213	4
			Sum	239,47	3825,0		220,0	3198,0	1066,2	20,0
			Average	47,89	765,0		44,0	639,6	213,2	4,0
			STDEV	4,12	44,5		0,7	47,2	12,2	0,0
			Min	44,14	711,0		43,0	607,0	198,5	4
			Max	53,86	834,0		45,0	721,0	230,1	4
H 5	TBR1-2004-63	102,45	160,66	58,21	734	1	44,0	616	191,3	4
	TBR1-2004-63	101,57	164,49	62,92	767	1	43,0	652	216,4	4
			Sum	121,13	1501,0		87,0	1268,0	407,7	8,0
			Average	60,57	750,5		43,5	634,0	203,9	4,0
			STDEV	3,33	23,3		0,7	25,5	17,7	0,0
			Min	58,21	734,0		43	616	191	4
			Max	62,92	767,0		44	652	216	4
H 6	TBR1-2004-63	97,95	173,36	75,41	815	0	44,0	653	218,7	4
	TBR1-2004-63	97,47	177,93	80,46	777	1	44,0	638	192,8	4
			Sum	155,87	1592,0		88,0	1291,0	411,5	8,0
			Average	77,94	796,0		44,0	645,5	205,8	4,0
			STDEV	3,57	26,9		0,0	10,6	18,3	0,0
			Min	75,41	777,0		44	638	193	4
			Max	80,46	815,0		44	653	219	4
H1, H2, H3, H4, H5,H6			**Sum**	883,1	15236,0		962,0	12966,0	4269,6	90,0
			Average	38,4	662,4		41,8	563,7	185,6	3,9
			STDEV	19,1	145,1		3,2	119,6	43,3	0,3
			Min	14,1	362,0		34,0	320,0	101,2	3
			Max	80,5	834,0		45,0	721,0	250,6	4

Species:	**Cod (*Gadus Morhua*)**	**exped./station**			**date**	**n**
Location:	**North- Northvest off Iceland(1)**	TP1-2004-73	660822	225453	8.3.2004	21
Lenght:	30-45cm	TP1-2004-74	661168	231300	8.3.2004	1
Ship:	Páll Pálsson ÍS-102		**660838**	**225537**		
Expd.leader:	Jón Sólmundsson					

Group	exped.-station	Weight jar IFL g	Weight jar and liver g	Weight liver g	Weight ungutted fish, g	Sex 0=female 1=male	Lenght cm	Weight gutted fish, g	Weight fillets g	Age
H 1	TP1-2004-73	97,98	101,26	3,28	206	0	29,0	197	76,0	2
	TP1-2004-73	106,95	111,40	4,45	213	1	30,0	203	67,1	3
	TP1-2004-73	97,85	102,59	4,74	292	0	33,0	280	87	3
	TP1-2004-73	98,50	103,44	4,94	403	1	35,0	363	127,7	3
	TP1-2004-73	97,93	104,34	6,41	246	0	30,0	225	74,7	2
			Sum	23,82	1360,0		157,0	1268,0	432,5	13,0
			Average	4,76	272,0		31,4	253,6	86,5	2,6
			STDEV	1,12	80,7		2,5	69,4	24,1	0,5
			Min	3,28	206,0		29,0	197,0	67,1	2
			Max	6,41	403,0		35,0	363,0	127,7	3
H 2	TP1-2004-73	102,54	109,88	7,34	281	0	31,0	252	81,5	2
	TP1-2004-73	107,27	115,24	7,97	249	0	31,0	229	72	2
	TP1-2004-73	98,10	106,13	8,03	370	1	34,0	329	108	3
	TP1-2004-73	111,92	121,38	9,46	325	0	33,0	294	96,7	2
	TP1-2004-73	106,81	116,39	9,58	291	0	32,0	265	79,6	2
	TP1-2004-74	98,02	108,79	10,77	365	0	34,0	339	112,7	3
	TP1-2004-73	106,97	119,69	12,72	362	0	35,0	341	129,6	3
			Sum	65,87	2243,0		230,0	2049,0	680,1	17,0
			Average	9,41	320,4		32,9	292,7	97,2	2,4
			STDEV	1,88	47,8		1,6	45,2	20,8	0,5
			Min	7,34	249,0		31,0	229,0	72,0	2
			Max	12,72	370,0		35,0	341,0	129,6	3
H 3	TP1-2004-73	106,03	121,78	15,75	419	0	35,0	380	122,4	3
	TP1-2004-73	106,58	122,64	16,06	606	0	40,0	553	182,6	4
	TP1-2004-73	106,14	122,31	16,17	589	0	41,0	518	165	3
	TP1-2004-73	106,82	124,19	17,37	544	1	38,0	476	168	3
			Sum	65,35	2158,00		154,0	1927,0	638,0	13,0
			Average	16,34	539,50		38,5	481,8	159,5	3,3
			STDEV	0,71	84,48		2,6	74,8	25,9	0,5
			Min	15,75	419,00		35,0	380,0	122,4	3
			Max	17,37	606,00		41,0	553,0	182,6	4
H 4	TP1-2004-73	107,24	130,61	23,37	666	1	41,0	595	214	3
	TP1-2004-73	105,37	131,67	26,30	784	1	43,0	654	208,7	5
	TP1-2004-73	106,46	133,57	27,11	492	0	37,0	402	142,8	3
	TP1-2004-73	102,39	131,18	28,79	718	1	40,0	605	209	3
			Sum	105,57	2660,0		161,0	2256,0	774,5	14,0
			Average	26,39	665,0		40,3	564,0	193,6	3,5
			STDEV	2,27	125,0		2,5	111,0	34,0	1,0
			Min	23,37	492,0		37,0	402,0	142,8	3
			Max	28,79	784,0		43,0	654,0	214,0	5
H 5	TP1-2004-73	102,33	138,54	36,21	873	1	45,0	719	215,2	4
	TP1-2004-73	106,21	149,89	43,68	759	0	41,0	665	231,9	3
			Sum	79,89	1632,00		86,00	1384,00	447,10	7,0
			Average	39,95	816,00		43,00	692,00	223,55	3,5
			STDEV	5,28	80,61		2,83	38,18	11,81	0,7
			Min	36,21	759,00		41,00	665,00	215,20	3
			Max	43,68	873,00		45,00	719,00	231,90	4
H1, H2, H3, H4, H5			**Sum**	340,50	10053,00		788,00	8884,00	2972,20	64,0
			Average	15,48	456,95		35,82	403,82	135,10	2,9
			STDEV	11,08	204,05		4,67	166,05	55,27	0,8
			Min	3,28	206,00		29,00	197,00	67,10	2
			Max	43,68	873,00		45,00	719,00	231,90	5

Species:	**Cod (*Gadus Morhua*)**	**exped./station**			**date**	**n**
Location:	**North-Northwest off Iceland (2)**	TB1-2004-99	664900	192199	11.3.2004	25
Lenght:	30-45cm					
Ship:	Bjartur NK-121					
Expd.leader:	Jónbjörn Pálsson					

Group	exped.-station	Weight jar IFL g	Weight jar and liver g	Weight liver g	Weight ungutted fish, g	Sex 0=female 1=male	Lenght cm	Weight gutted fish, g	Weight fillets g	Age
H 1	TB1-2004-99	101,89	108,82	6,93	241	1	31,0	233	76,2	2
	TB1-2004-99	98,33	105,61	7,28	226	0	30,0	214	68	2
	TB1-2004-99	102,69	112,18	9,49	252	1	30,0	217	68,6	2
	TB1-2004-99	102,82	115,95	13,13	794	1	45,0	716	238,2	4
			Sum	36,83	1513,0		136,0	1380,0	451,0	10,0
			Average	9,21	378,3	0,8	34,0	345,0	112,8	2,5
			STDEV	2,85	277,4		7,3	247,5	83,7	1,0
			Min	6,93	226,0		30,0	214,0	68,0	2
			Max	13,13	794,0		45,0	716,0	238,2	4
H 2	TB1-2004-99	98,98	115,23	16,25	342	1	36,0	309	84,1	4
	TB1-2004-99	98,05	115,27	17,22	335	1	34,0	303	115,8	2
	TB1-2004-99	98,35	116,32	17,97	414	1	38,0	383	127,4	4
	TB1-2004-99	105,79	125,52	19,73	603	1	41,0	544	188,2	3
	TB1-2004-99	106,68	126,99	20,31	431	1	38,0	393	118,1	4
	TB1-2004-99	102,07	122,93	20,86	490	1	41,0	450	120,2	4
	TB1-2004-99	111,37	133,09	21,72	369	1	37,0	330	98,2	5
	TB1-2004-99	112,54	134,97	22,43	473	1	39,0	426	149,1	4
			Sum	156,49	3457,0		304,0	3138,0	1001,1	30,0
			Average	19,56	432,1	1,0	38,0	392,3	125,1	3,8
			STDEV	2,21	89,5		2,4	81,4	31,9	0,9
			Min	16,25	335,0		34,0	303,0	84,1	2
			Max	22,43	603,0		41,0	544,0	188,2	5
H 3	TB1-2004-99	107,25	134,47	27,22	681	0	44,0	630	218,5	4
	TB1-2004-99	102,59	131,50	28,91	433	1	39,0	379	118,2	4
	TB1-2004-99	105,57	135,20	29,63	747	1	45,0	687	231,1	4
	TB1-2004-99	98,33	128,52	30,19	683	1	44,0	625	191,9	4
	TB1-2004-99	101,99	132,49	30,50	595	1	43,0	539	151,0	4
	TB1-2004-99	102,29	133,86	31,57	588	1	41,0	529	159,9	3
	TB1-2004-99	102,80	135,62	32,82	577	0	40,0	508	160,9	4
			Sum	210,84	4304,0		296,0	3897,0	1231,5	27,0
			Average	30,12	614,9	0,7	42,3	556,7	175,9	3,9
			STDEV	1,81	101,7		2,3	101,7	39,9	0,4
			Min	27,22	433,0		39,0	379,0	118,2	3
			Max	32,82	747,0		45,0	687,0	231,1	4
H 4	TB1-2004-99	101,74	137,56	35,82	489	0	38,0	422	128,6	4
	TB1-2004-99	105,13	143,37	38,24	636	0	42,0	555	183,1	4
	TB1-2004-99	110,97	152,17	41,20	521	1	41,0	460	128,2	5
	TB1-2004-99	102,37	144,98	42,61	731	0	43,0	620	190,3	4
			Sum	157,87	2377,0		164,0	2057,0	630,2	17,0
			Average	39,47	594,3	0,3	41,0	514,3	157,6	4,3
			STDEV	3,04	110,9		2,2	90,0	33,8	0,5
			Min	35,82	489,0		38,0	422,0	128,2	4
			Max	42,61	731,0		43,0	620,0	190,3	5
H 5	TB1-2004-99	106,50	164,01	57,51	765	1	45,0	670	219,5	4
	TB1-2004-99	106,11	166,04	59,93	755	1	43,0	637	229,9	4
			Sum	117,44	1520,0		88,0	1307,0	449,4	8,0
			Average	58,72	760,0	1,0	44,0	653,5	224,7	4,0
			STDEV	1,71	7,1		1,4	23,3	7,4	0,0
			Min	57,51	755,0		43,0	637,0	219,5	4
			Max	59,93	765,0		45,0	670,0	229,9	4
H1, H2, H3, H4, H5			**Sum**	679,47	13171,00		988,00	11779,00	3763,20	92,0
			Average	27,18	526,84	0,8	39,52	471,16	150,53	3,7
			STDEV	13,72	174,06		4,53	152,15	53,14	0,9
			Min	6,93	226,00		30,00	214,00	68,00	2
			Max	59,93	794,00		45,00	716,00	238,20	5

Species:	**Cod (*Gadus Morhua*)**	**exped./station**		**date**	**n**
Location:	**Northwest of Iceland**	A2-2002-40	665090 232010	6.3 2002	12
Lenght:	30-45cm	A2-2002-41	665100 230330	6.3 2002	8
Ship:	Árni Friðriksson	A2-2002-49	670630 225904	7.3 2002	5
Expd.leader:	Björn Ævar		**665401 231058**		

Group	exped.-station	Weight jar IFL g	Weight jar and liver g	Weight liver g	Weight ungutted fish, g	Sex 0=female 1=male	Lenght cm	Weight gutted fish, g	Weight fillets g	Age
H 1	49	101,95	109,42	7,47	695	1	43,0	549	172,6	3
	40	106,54	114,88	8,34	478	0	40,0	455	157,9	3
	40	102,07	111,11	9,04	297	0	32,0	254	77,5	2
	41	105,69	114,83	9,14	321	1	33,0	294	86,9	2
	40	105,80	115,74	9,94	593	1	41,0	547	180,7	3
	41	101,56	112,40	10,84	415	1	37,0	386	130,6	3
	40	111,82	122,83	11,01	263	1	31,0	234	76,2	2
	49	101,23	112,34	11,11	508	1	39,0	443	152,8	3
			Sum	76,89	3570,0		296,0	3162,0	1035,2	21,0
			Average	9,61	446,3	0,8	37,0	395,3	129,4	2,6
			STDEV	1,34	151,5		4,5	124,7	43,4	0,5
			Min	7,47	263,0		31,0	234,0	76,2	2
			Max	11,11	695,0		43,0	549,0	180,7	3
H 2	40	106,25	120,61	14,36	434	0	37,0	380	135,2	3
	49	106,78	122,08	15,30	483	1	39,0	425	141,0	3
	40	102,16	117,90	15,74	401	0	37,0	369	125,4	3
	41	101,79	118,73	16,94	493	0	38,0	456	159,3	3
	49	107,68	125,13	17,45	683	0	45,0	602	205,2	3
	40	105,88	123,81	17,93	757	1	45,0	685	241,9	3
			Sum	97,72	3251,0		241,0	2917,0	1008,0	18,0
			Average	16,29	541,8	0,3	40,2	486,2	168,0	3,0
			STDEV	1,38	143,9		3,8	128,5	45,9	0,0
			Min	14,36	401,0		37,0	369,0	125,4	3
			Max	17,93	757,0		45,0	685,0	241,9	3
H 3	49	106,90	128,18	21,28	509	1	39,0	427	135,8	3
	40	102,30	123,95	21,65	674	0	44,0	586	200,4	4
	40	105,42	127,35	21,93	606	1	43,0	534	175,2	3
	40	106,99	131,60	24,61	733	0	44,0	667	226,7	3
			Sum	89,47	2522,0		170,0	2214,0	738,1	13,0
			Average	22,37	630,5	0,5	42,5	553,5	184,5	3,3
			STDEV	1,52	96,2		2,4	100,5	38,7	0,5
			Min	21,28	509,0		39,0	427,0	135,8	3
			Max	24,61	733,0		44,0	667,0	226,7	4
H 4	40	107,18	133,48	26,30	603	0	42,0	549	183,8	3
	41	102,18	130,18	28,00	532	1	38,0	435	105,4	3
	41	102,41	131,19	28,78	552	1	41,0	483	148,7	4
	40	105,50	136,42	30,92	595	0	40,0	524	183,5	3
	41	107,33	138,32	30,99	689	0	45,0	618	207,5	4
			Sum	144,99	2971,0		206,0	2609,0	828,9	17,0
			Average	29,00	594,2	0,4	41,2	521,8	165,8	3,4
			STDEV	2,00	60,7		2,6	69,0	39,7	0,5
			Min	26,30	532,0		38,0	435,0	105,4	3
			Max	30,99	689,0		45,0	618,0	207,5	4
H 6	41	101,53	157,63	56,10	677	0	42,0	536	167,4	4
H1, H2, H3, H4, H6			**Sum**	465,17	12991,0		955,0	11438,0	3777,6	73,0
			Average	19,38	541,3	0,5	39,8	476,6	157,4	3,0
			STDEV	10,86	138,8		4,0	120,1	44,2	0,6
			Min	7,47	263,0		31,0	234,0	76,2	2
			Max	56,10	757,0		45,0	685,0	241,9	4

Appendix III.

Quality assurance in metal analysis and persistent organochlorines analysis

Table 2. Results for trace metals in certified reference materials and recoveries of additions to tissue homogenates of blue mussel *(Mytilus edulis)* for the year 2003.

Analyte	Mussel Tissue BCR278/ 634/413 µg/g	I Z-score*I	TORT-2 NRCC µg/g	I Z-score*I	Recovery,%	MLOD** µg/g
As					99 ± 10	3,8
Measured			23,2 ± 0,5	0,60		
Certified			21,6 ± 1,8			
Cd					110 ± 6	0,19
Measured			29,5 ± 0,9	0,83		
Certified			26,7 ± 0,6			
Cu					102 ± 4	0,88
Measured			97 ± 1	0,68		
Certified			106 ± 10			
Hg					101 ± 1	0,01
Measured	0,191 ± 0,002	0,11				
Certified	0,188 ± 0,007					
Pb					99 ± 4	0,13
Measured			0,38 ± 0,17	0,76		
Certified			0,35 ± 0,13			
Se					92 ± 2	0,64
Measured			5,81 ± 0,53	0,25		
Certified			5,63 ± 0,67			
Zn					93 ± 9	8,6
Measured			196 ± 3	0,71		
Certified			180 ± 6			

* Z-score ((mesarured value-certified value)/certified value*0,125)

** MLOD is on dry weight basis

Table 3. Results for trace metals in certified reference materials and recoveries of additions to tissue homogenates of cod *(Gadus morhua)* for the year 2004.

Analyte	DORM-2 NRCC µg/g	IZI*	DOLT-3 NRCC µg/g		TORT-2 NRCC µg/g	IZI*	Recovery, % Liver	Recovery, % Flesh	MLOD** µg/g Liver	MLOD** µg/g Flesh
As							98 ± 3		1,1	
Measured	17,5 ± 0,5	0,24	10,1 ± 0,2	0,11	23,2 ± 0,9	0,60				
Certified	18,0 ± 1,1		10,2 ± 0,5		21,6 ± 1,8					
Cd							103 ± 3		0,029	
Measured			21,7 ± 0,4	0,95	29,5 ± 0,9	0,83				
Certified			19,4 ± 0,6		26,7 ± 0,6					
Cu							107 ±10		0,41	
Measured	2,28 ± 0,18	0,2	32,9 ± 0,3	0,44	97 ± 1	0,67				
Certified	2,34 ± 0,16		31,2 ± 1		106 ± 10					
Hg								101 ± 9		0,001
Measured	4,28 ± 0,54	0,63								
Certified	4,64 ± 0,26									
Pb							96 ± 7		0,06	
Measured			0,296 ± 0,032	0,57	0,38 ± 0,17	0,76				
Certified			0,319 ± 0,045		0,35 ± 0,13					
Se							120 ± 6		0,17	
Measured					5,81 ± 0,53	0,25				
Certified					5,63 ± 0,67					
Zn							116 ± 11		1,31	
Measured	27,2 ± 0,9	0,51	87,9 ± 5	0,12						
Certified	25,6 ± 2,3		86,6 ± 2,4							

* Z-score ((mesarured value-certified value)/certified value*0,125)

** MLOD is on wet weight basis

Table 4. Quality assurance. Persistent organochlorines (ng/g ww) in a certified mussel sample from quasimeme, that were analysed with the mussel samples from 2003.

Blue mussel 2003								assign				
chemical	**CRM**	**weight basis**	anal. 1	anal. 2	anal. 3	**mean**	**SD**	value	**time**	I Z I	**det. Lim.**	
CB28	**QOR080BT**	**wet weight**	0,17	0,18	0,21	**0,19**	**0,02**	0,19	**2 weeks**	-0,09	0,036	
CB31	**QOR080BT**	**wet weight**	0,13	0,12	0,17	**0,14**	**0,03**	0,15	**2 weeks**	-0,32	0,023	
CB52	**QOR080BT**	**wet weight**	0,55	0,56	0,64	**0,58**	**0,05**	0,56	**2 weeks**	0,28	0,007	
CB101	**QOR080BT**	**wet weight**	2,38	2,40	2,50	**2,43**	**0,06**	2,34	**2 weeks**	0,28	0,007	
CB105	**QOR080BT**	**wet weight**	0,39	0,41	0,42	**0,41**	**0,02**	0,42	**2 weeks**	-0,21	0,001	
CB118	**QOR080BT**	**wet weight**	1,60	1,70	1,78	**1,69**	**0,09**	1,98	**2 weeks**	-1,10	0,003	
CB138	**QOR080BT**	**wet weight**	3,96	3,97	5,11	**4,35**	**0,66**	4,24	**2 weeks**	0,20	0,003	
CB153	**QOR080BT**	**wet weight**	7,05	7,23	7,53	**7,27**	**0,24**	7,02	**2 weeks**	0,28	0,004	
CB156	**QOR080BT**	**wet weight**	0,18	0,18	0,22	**0,19**	**0,02**	0,20	**2 weeks**	-0,18	0,001	
CB180	**QOR080BT**	**wet weight**	0,40	0,41	0,46	**0,42**	**0,03**	0,48	**2 weeks**	-0,77	0,002	
HCB	**QOR080BT**	**wet weight**	0,08	0,08	0,08	**0,08**	**0,00**	0,08	**2 weeks**	0,00	0,001	
a-HCH	**QOR080BT**	**wet weight**	<0,01	<0,01	0,02	**0,02**		0,04	**2 weeks**	-1,22	0,010	
b-HCH	**QOR080BT**	**wet weight**	0,01	0,01	0,02	**0,01**	**0,01**	0,04	**2 weeks**	-1,52	0,010	
g-HCH	**QOR080BT**	**wet weight**	<0,02	0,02	<0,02	**0,02**		0,05	**2 weeks**	-1,64	0,020	
pp'-DDE	**QOR080BT**	**wet weight**	1,13	1,18	1,13	**1,15**	**0,03**	1,22	**2 weeks**	-0,44	0,002	
pp'-DDD	**QOR080BT**	**wet weight**	0,51	0,51	0,48	**0,50**	**0,02**	0,49	**2 weeks**	0,14	0,002	
pp'-DDT	**QOR080BT**	**wet weight**	0,12	0,10	0,16	**0,13**	**0,03**	*0,21**	**2 weeks**	*	0,02	
op'-DDT	**QOR080BT**	**wet weight**	<0,02	<0,02	<0,02	**<0,02**		0,07	**2 weeks**		0,02	
transn-chlor	**QOR080BT**	**wet weight**	0,10	0,12	0,08	**0,10**	**0,02**	0,11	**2 weeks**	-0,38	0,002	
											0,002	a-chlor
* "assigned value" only "indicative". Quasimeme does not assign %error and thus Z-score can not be calculated.											0,002	g-chlor
a- og g-chlordane, oxychlordane and toxaphenes are not certified in this sample by quasimeme											0,002	tox 26
											0,002	tox 50
											0,002	tox 62

Table 5. Quality assurance. Persistent organics (ng/g ww) in samples of certified cod liver from quasimeme analysed with the cod liver from 2004.

Cod liver 2004								assign				
chemical	**CRM**	**weight basis**	anal. 1	anal. 2	anal. 3	**mean**	**SD**	value	**time**	I Z I	**det. Lim.**	
CB28	**QOR063BT**	**wet weight**	12,7	11,6	11,4	**11,9**	**0,70**	11,8	**3 weeks**	0,07	0,45	
CB31	**QOR063BT**	**wet weight**	3,91	3,93	3,93	**3,92**	**0,01**	4,04	**3 weeks**	-0,21	0,33	
CB52	**QOR063BT**	**wet weight**	26,5	25,0	25,9	**25,8**	**0,75**	25,8	**3 weeks**	0,00	0,11	
CB101	**QOR063BT**	**wet weight**	105	101,8	98,6	**101,8**	**3,20**	96,6	**3 weeks**	0,43	0,05	
CB105	**QOR063BT**	**wet weight**	42,4	36,7	39,6	**39,6**	**2,85**	41,1	**3 weeks**	-0,29	0,02	
CB118	**QOR063BT**	**wet weight**	158,9	136,3	153,7	**149,6**	**11,8**	139,0	**3 weeks**	0,61	0,02	
CB138	**QOR063BT**	**wet weight**	279,8	280,1	259,9	**273,3**	**11,6**	259,3	**3 weeks**	0,43	0,02	
CB153	**QOR063BT**	**wet weight**	414,4	363,3	335,3	**371,0**	**40**	358,9	**3 weeks**	0,27	0,02	
CB156	**QOR063BT**	**wet weight**	19,5	17,1	17,9	**18,2**	**1,22**	19,2	**3 weeks**	-0,42	0,02	
CB180	**QOR063BT**	**wet weight**	90,4	80,5	87,0	**86,0**	**5,03**	77,6	**3 weeks**	0,86	0,02	
HCB	**QOR063BT**	**wet weight**	10,3	10,2	10,4	**10,3**	**0,11**	10,4	**3 weeks**	-0,08	0,10	
a-HCH	**QOR063BT**	**wet weight**	1,95	1,97	1,79	**1,90**	**0,10**	1,92	**3 weeks**	-0,06	0,02	
b-HCH	**QOR063BT**	**wet weight**	1,47	1,34	1,35	**1,39**	**0,07**	1,88	**3 weeks**	-1,73	0,02	
g-HCH	**QOR063BT**	**wet weight**	0,62	0,31	0,40	**0,44**	**0,16**	*1,49**	**3 weeks**	*	0,02	
pp'-DDE	**QOR063BT**	**wet weight**	166,8	156,8	160,0	**161,2**	**5,11**	155,5	**3 weeks**	0,29	0,04	
pp'-DDD	**QOR063BT**	**wet weight**	47,6	34,9	43,3	**41,9**	**6,46**	39,3	**3 weeks**	0,53	0,04	
pp'-DDT	**QOR063BT**	**wet weight**	6,61	4,93	5,82	**5,8**	**0,84**	*6,4**	**3 weeks**	*	0,10	
op'-DDT	**QOR063BT**	**wet weight**	<0,5	<0,5	<0,5			*28,5**	**3 weeks**	*	0,50	
transn-chlor	**QOR063BT**	**wet weight**	20,0	18,1	18,6	**18,9**	**0,97**	17,9	**3 weeks**	0,42	0,03	
											0,03	a-chlor
* "assigned value" only "indicative". Quasimeme does not assign %error and thus Z-score can not be calculated.											0,03	g-chlor
a- og g-chlordane, oxychlordane and toxaphenes are not certified in this sample by quasimeme											0,04	tox 26
											0,03	tox 50
											0,03	tox 62

Table 6. Detection limits* (ng/g).

	Detection limits	
chemical	**mussel ng/sample dw**	**Cod liver ng/sample ww**
a-HCH	0,010	0,02
HCB	0,005	0,10
b-HCH	0,010	0,02
g-HCH	0,117	0,02
PCB-31	0,233	0,33
PCB-28	0,361	0,45
PCB-52	0,074	0,11
oxychlordane	0,020	0,31
gamma-Chl.	0,020	0,03
PCB-101	0,074	0,05
alfa-Chl.	0,020	0,03
transnonachlor	0,020	0,03
4,4'-DDE	0,011	0,04
tox 26	0,020	0,04
PCB-118	0,032	0,02
4,4'-DDD	0,011	0,04
2,4'-DDT	0,200	0,50
PCB-153	0,042	0,02
PCB-105	0,010	0,02
4,4'-DDT	0,011	0,10
PCB-138	0,032	0,02
tox 50	0,020	0,03
PCB-156	0,010	0,02
PCB-180	0,021	0,02
tox 62	0,020	0,03
PCB-170	0,020	0,02
*detection limits are 3 x std of blanks, or 3 x noise level.		

Appendix IV.

Results of trace metal analysis for Blue mussel (*Mytilus edulis*) 2003 and Cod (*Gadus Morhua*) 2004

Table 7. Results of trace metals in Blue mussel *(Mytilus edulis)* 2003 (dw)

Samples	Fat		Dry matter		Pb, mg/kg	Cd, mg/kg		Cu, mg/kg		Zn, mg/kg		As, mg/kg		Se, mg/kg		Hg, µg/kg	
	%	±	%	±	dw	dw	±	dw	±	dw	±	dw	±	dw	±	dw	±
Hvassahraun 03	0,25	0,01	8,13	0,02	<MLOD	2,70	0,16	11,18	0,21	141	1	14,0	1,2	3,06	0,08	35,5	3,4
Straumur,Straumsvík 03	0,67	0,06	11,2	0,1	<MLOD	2,56	0,06	6,25	0,21	121	3	9,1	0,4	2,88	0,01	37,3	1,1
Eyri, Hvalfjörður 03	0,51	0,03	12,5	0,09	<MLOD	1,65	0,08	7,93	0,17	117	3	9,39	0,31	2,78	0,11	28,7	3,5
Hvítanes, Hvalfjörður 03	0,42	0,07	10,0	0,01	<MLOD	2,40	0,14	5,48	0,34	146	3	10,3	0,9	3,37	0,16	35,3	1,8
Hvalstöð, Hvalfjörður 03	0,42	0,04	9,35	0,11	<MLOD	2,18	0,19	6,23	0,55	159	3	13,6	1,1	2,25	0,22	43,3	3,1
Dvergasteinn, Álftafjörður 03	0,38	0,06	9,41	0,02	<MLOD	5,54	0,08	6,37	0,25	141	6	20,1	0,6	3,13	0,18	45,5	3,1
Úlfsá, Skutulsfjörður 03	0,15	0,04	6,52	0,1	<MLOD	1,59	0,08	6,91	0,27	148	6	70,7	2,6	2,60	0,09	100,6	0,8
Limit of detection for samples (MLOD)					0,13	0,19		0,88		8,6		3,8		0,64		10,4	

Table 8. Results of trace metals in liver and flesh of Cod (*Gadus morhua*) 2004 (ww)

Sample		Fat %		Dry matter %		Pb, µg/g	Cd, µg/g		Cu,µg/g		Zn, µg/g		As, µg/g		Se, µg/g		Dry matter %		Fat %		Hg, ng/g	
		Liver		Liver	±	Liver	Liver	±	Liver	±	Liver	±	Liver	±	Liver	±	Flesh*	±	Flesh*	±	Flesh*	±
COD N-NW (1) 04																	19,1	0,1	0,07	0,01	16,8	1,7
	Group 1	20,67	0,71	39,19	0,03	<MLOD	0,45	0,02	4,23	0,11	24,8	0,2	6,44	0,25	1,70	0,09						
	Group 2	45,84	0,12	57,78	0,14	<MLOD	0,28	0,01	4,16	0,08	19,1	0,2	4,68	0,09	1,32	0,07						
	Group 3	44,73	0,21	57,47	0,04	<MLOD	0,24	0,01	4,41	0,16	16,8	0,3	5,13	0,24	1,20	0,02						
	Group 4	50,90	0,27	61,53	0,17	<MLOD	0,12	0,01	5,29	0,22	14,9	0,3	4,06	0,08	0,98	0,03						
	Group 5	55,29	0,32	65,15	0,34	<MLOD	0,10	0,01	5,97	0,09	16,0	0,5	4,34	0,10	0,72	0,08						
COD N-NW (2) 04																	19,8	0,2	0,18	0,06	24,4	1,5
	Group 1	31,87	0,51	46,38	0,12	<MLOD	0,57	0,01	6,23	0,05	20,8	0,7	11,5	0,2	1,26	0,11						
	Group 2	49,85	0,05	61,30	0,13	<MLOD	0,56	0,01	2,52	0,2	14,6	0,4	6,74	0,18	0,70	0,13						
	Group 3	53,03	0,06	63,20	0,03	<MLOD	0,31	0,01	3,00	0,06	13,0	0,2	6,35	0,16	0,88	0,13						
	Group 4	53,37	0,17	63,85	0,13	<MLOD	0,62	0,01	2,53	0,11	11,2	0,5	6,84	0,15	0,67	0,11						
	Group 5	58,58	0,01	68,59	0,05	<MLOD	0,15	0,01	2,72	0,12	10,7	0,3	7,56	0,22	0,58	0,04						
COD NE 04																	19,2	0,04	0,1	0,01	18,9	1,6
	Group 1	43,20	0,22	55,85	0,13	<MLOD	0,27	0,01	2,99	0,07	17,6	0,8	6,19	0,25	0,86	0,03						
	Group 2	52,18	0,08	62,62	0,08	<MLOD	0,14	0,01	3,04	0,21	16,4	0,9	6,01	0,07	0,54	0,04						
	Group 3	49,54	0,06	61,27	0,20	<MLOD	0,16	0,01	2,29	0,04	11,3	0,6	5,88	0,24	0,82	0,03						
	Group 4	58,29	0,01	68,52	0,47	<MLOD	0,15	0,01	2,61	0,02	15,5	1,2	5,63	0,49	0,53	0,07						
	Group 5	61,85	0,23	71,27	0,06	<MLOD	0,12	0,01	3,72	0,05	12,1	1,3	5,77	0,20	0,51	0,04						
	Group 6	56,19	0,29	67,32	0,01	<MLOD	0,10	0,01	1,91	0,02	19,4	0,8	6,32	0,11	0,58	0,02						
COD N-NW 02																	19,7	0,2	0,05	0,01	27,0	1,2
	Group 1	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**						
	Group 2	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**						
	Group 3	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**						
	Group 4	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**						
	Group 5	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**						
Average of all measurements							0,27	0,18	3,60	1,33	15,9	3,9	6,22	1,69	0,87	0,34					21,8	4,7
Limit of detection for samples (MLOD)						0,06	0,029		0,41		1,31		1,1		0,17						1,4	

*flesh was pooled into one sample

** analysis of these samples were published 2003

Appendix V.

Results of organochlorine analysis for Blue mussel (*Mytilus edulis*) 2003 and Cod (*Gadus morhua*) 2004

Table 9. Persistent organochlorines in Blue Mussel (Mytilus edulis ng/g dw) 2003.

	Hvassahraun 03			Straumur 03			Dvergasteinn	Hvítanes	Hvalstöð	Hvalfjarðareyri	Skutulsfjörður
	A	B	mean*	A	B	mean*	03	03	03	03	03
PCB28	<0,36	<0,36	**<0,36**	<0,36	<0,36	**<0,36**	**<0,36**	**<0,36**	**<0,36**	**<0,36**	**<0,36**
PCB31	<0,23	<0,23	**<0,23**	<0,23	<0,23	**<0,23**	**<0,23**	**<0,23**	**<0,23**	**<0,23**	**<0,23**
PCB52	0,25	0,18	**0,21**	0,23	0,21	**0,22**	**0,14**	**0,17**	**0,13**	**0,18**	**0,09**
PCB101	0,44	0,42	**0,43**	0,80	0,68	**0,74**	**1,02**	**0,66**	**0,60**	**0,53**	**0,47**
PCB105	0,07	0,07	**0,07**	0,16	0,18	**0,17**	**0,30**	**0,14**	**0,18**	**0,16**	**0,12**
PCB118	0,19	0,24	**0,21**	0,48	0,47	**0,48**	**0,55**	**0,51**	**0,47**	**0,49**	**0,37**
PCB138	0,45	0,45	**0,45**	1,20	1,04	**1,12**	**1,09**	**1,38**	**1,38**	**0,74**	**0,58**
PCB153	0,67	0,61	**0,64**	1,83	1,59	**1,71**	**1,38**	**2,12**	**1,98**	**1,24**	**0,98**
PCB156	0,03	0,02	**0,03**	0,07	0,05	**0,06**	**0,07**	**0,04**	**0,04**	**0,03**	**0,02**
PCB170	0,02	0,01	**0,01**	0,02	0,03	**0,02**	**0,01**	**0,03**	**0,02**	**0,02**	**0,03**
PCB180	0,04	0,05	**0,04**	0,08	0,08	**0,08**	**0,03**	**0,17**	**0,06**	**0,08**	**0,05**
Σ3PCB**	1,31	1,29	**1,30**	3,51	3,09	**3,30**	**3,03**	**4,01**	**3,83**	**2,48**	**1,92**
HCB	0,04	0,05	**0,04**	0,09	0,10	**0,10**	**0,04**	**0,09**	**0,10**	**0,12**	**0,21**
a-HCH	0,11	0,09	**0,10**	0,19	0,18	**0,18**	**0,11**	**0,18**	**0,14**	**0,18**	**0,08**
b-HCH	0,04	0,04	**0,04**	0,05	0,04	**0,04**	**0,03**	**0,02**	**0,02**	**0,02**	**0,03**
g-HCH	0,21	0,12	**0,17**	0,20	0,12	**0,16**	**0,10**	**0,15**	**0,04**	**0,11**	**0,05**
p,p'-DDE	0,22	0,17	**0,20**	0,54	0,47	**0,50**	**0,36**	**0,51**	**0,75**	**0,42**	**0,30**
p,p'-DDD	0,09	0,07	**0,08**	0,32	0,31	**0,31**	**0,06**	**0,15**	**0,15**	**0,15**	**0,15**
p,p'-DDT	0,18	0,18	**0,18**	0,47	0,38	**0,43**	**0,38**	**0,36**	**0,24**	**0,12**	**0,15**
o,p'-DDT***	<0,2	<0,2	**<0,2**	<0,2	<0,2	**<0,2**	**<0,2**	**<0,2**	**0,08**	**<0,2**	**<0,2**
transnonachlor	0,10	0,08	**0,09**	0,18	0,17	**0,18**	**0,39**	**0,17**	**0,24**	**0,16**	**0,20**
a-chlordan	0,07	0,07	**0,07**	0,16	0,14	**0,15**	**0,16**	**0,12**	**0,15**	**0,12**	**0,06**
g-chlordan	<0,10	0,06	**0,06**	<0,10	0,09	**0,06**	**0,12**	**0,17**	**0,20**	**0,16**	**0,08**
oxychlordan	<0,02	<0,02	**<0,02**	<0,02	<0,02	**<0,02**	**<0.02**	**<0,02**	**<0,02**	**<0,02**	**<0,02**
Tox-26	0,14	0,13	**0,13**	0,30	0,29	**0,29**	**0,34**	**0,23**	**0,28**	**0,24**	**0,21**
Tox-50	0,31	0,29	**0,30**	0,63	0,53	**0,58**	**0,71**	**0,36**	**0,47**	**0,37**	**0,30**
Tox-62	0,12	0,09	**0,11**	0,13	0,09	**0,11**	**0,18**	**0,05**	**0,17**	**0,13**	**0,15**
% extracted fat	0,29	0,32	**0,31**	0,73	0,62	**0,68**	**0,36**	**0,41**	**0,35**	**0,47**	**0,15**
% fat (IFL)	0,25		**0,25**			**0,67**	**0,38**	**0,42**	**0,42**	**0,51**	**0,15**
% dw (IFL)	8,13		**8,13**			**11,2**	**9,41**	**10,0**	**9,35**	**12,50**	**6,52**

Mean of two analysis, A and B, performed one weeek apart

****PCB #118, 138 and 153**

***** interferences increase detection limits.**

Table 10. Persistent organochlorines in cod liver from 2004 (ng/g ww).

	COD N-NW(1)	COD N-NW(1)	COD N-NW(1)		COD N-NW(1)	COD N-NW(1)	COD N-NW(1)
	H1	**H2**	H3 A	H3 B	**H3***	**H4**	**H5**
PCB28	1,0	1,5	1,6	1,6	1,6	1,6	1,3
PCB31	0,32	0,80	0,81	0,81	0,81	0,83	0,57
PCB52	2,2	3,0	3,5	3,5	3,5	3,0	2,1
PCB101	7,4	7,8	8,4	8,8	8,6	8,1	7,0
PCB105	2,9	2,5	2,9	2,9	2,9	3,0	2,4
PCB118	10,3	8,8	9,5	9,6	9,5	10,3	8,8
PCB138	14,2	11,6	12,7	13,1	12,9	13,8	10,4
PCB153	25,6	19,5	19,8	21,9	20,8	23,8	19,2
PCB156	1,3	0,79	0,98	1,11	1,05	1,1	0,85
PCB170	2,3	2,0	2,1	2,3	2,2	2,5	1,9
PCB180	6,2	4,4	5,3	5,6	5,4	6,4	5,1
Σ7PCB**	66,8	56,5	60,8	64,1	62,4	67,0	53,9
HCB	4,3	8,9	8,8	9,4	9,1	9,2	8,7
a-HCH	1,3	2,9	2,7	2,8	2,8	3,1	3,3
b-HCH	0,18	0,48	0,48	0,47	0,48	0,50	0,50
g-HCH	0,22	0,46	0,45	0,46	0,46	0,50	0,53
p,p'-DDE	28,2	23,0	31,0	32,9	32,0	23,4	17,5
p,p'-DDD	6,2	8,3	10,8	10,8	10,8	7,6	5,3
p,p'-DDT	4,4	4,7	5,8	7,1	6,5	5,8	4,9
o,p'-DDT	2,5	4,8	5,1	5,6	5,3	4,0	2,9
ΣDDT	41,3	40,8	52,7	56,3	54,5	40,8	30,5
transnonachlor	15,2	14,0	16,3	16,4	16,3	14,5	11,7
a-chlordan	6,5	9,4	10,2	10,3	10,2	8,6	5,3
g-chlordan	1,5	2,8	2,6	2,7	2,6	2,5	1,8
oxychlordan	3,6	4,3	4,1	4,6	4,4	4,9	4,6
ΣCHL	26,9	30,5	33,1	33,9	33,5	30,5	23,4
Tox-26	11,5	15,5	16,7	17,0	16,8	14,9	11,9
Tox-50	19,2	26,2	32,3	32,8	32,5	26,0	18,5
Tox-62	3,2	5,5	7,0	8,0	7,5	5,4	2,9
% extracted fat	20,4	46,6	44,6	45,2	44,9	50,3	56,6

*Mean of two different analysis performed one week apart.
**PCB #28, 52, 101, 118, 138, 153 ,180.

Table 10. Persistent organochlorines in cod liver from 2004 (ng/g ww).

	COD N-NW(2)	COD N-NW(2)		COD N-NW(2)	COD N-NW(2)	COD N-NW(2)	COD N-NW(2)
	H1	H2 A	H2 B	**H2***	**H3**	**H4**	**H5**
PCB28	1,2	1,7	2,1	1,9	1,6	1,6	1,5
PCB31	0,5	1,0	1,3	1,1	1,0	1,1	1,1
PCB52	3,2	4,3	4,5	4,4	4,6	4,4	3,9
PCB101	7,2	8,5	8,6	8,6	8,5	7,4	6,7
PCB105	3,4	3,8	3,8	3,8	3,6	3,5	2,7
PCB118	11,4	11,7	12,3	12,0	11,5	10,8	8,7
PCB138	14,8	14,5	15,7	15,1	13,7	13,7	11,0
PCB153	24,1	21,9	22,1	22,0	20,5	18,7	15,8
PCB156	1,2	1,4	1,5	1,5	1,2	1,3	0,90
PCB170	2,6	2,8	2,9	2,8	2,5	2,5	1,8
PCB180	6,4	6,8	7,1	7,0	6,2	5,9	4,5
Σ7PCB**	68,3	69,4	72,4	70,9	66,5	62,6	52,2
HCB	7,7	12,0	13,1	12,6	11,8	12,7	12,7
a-HCH	3,2	5,0	4,7	4,9	5,0	5,1	6,1
b-HCH	0,52	0,76	0,68	0,72	0,78	0,77	0,93
g-HCH	0,71	1,1	1,0	1,0	1,1	1,1	1,3
p,p'-DDE	39,1	43,2	43,4	43,3	43,1	42,2	32,1
p,p'-DDD	11,3	17,4	17,5	17,4	16,9	18,3	14,1
p,p'-DDT	8,3	13,7	15,8	14,8	14,7	18,0	12,4
o,p'-DDT	4,8	8,5	9,9	9,2	8,1	10,9	8,5
ΣDDT	63,5	82,7	86,6	84,7	82,8	89,4	67,1
transnonachlor	20,9	23,7	24,7	24,2	23,9	21,6	18,8
a-chlordan	9,8	11,7	12,0	11,9	13,0	11,0	12,6
g-chlordan	3,1	4,1	4,2	4,1	4,3	4,1	4,7
oxychlordan	4,6	5,8	6,8	6,3	5,4	5,9	5,1
ΣCHL	38,4	45,2	47,8	46,5	46,6	42,6	41,2
Tox-26	15,7	21,6	23,7	22,6	21,4	21,4	20,5
Tox-50	27,1	35,1	38,5	36,8	37,4	37,9	36,8
Tox-62	4,8	8,5	10,7	9,6	7,4	9,0	8,3
% úrhlutuð fita	32,6	50,9	51,0	51,0	53,2	54,2	56,9

*Mean of two different analysis performed one week apart.
**PCB #28, 52, 101, 118, 138, 153 ,180.

Table 10. Persistent organochlorines in cod liver from 2004 (ng/g ww).

	COD NE	COD NE	COD NE		COD NE	COD NE	COD NE	COD NE
	H1	**H2**	H3 A	H3 B	**H3***	**H4**	**H5**	**H6**
PCB28	1,9	2,3	1,8	1,9	1,8	2,1	2,0	1,9
PCB31	1,3	1,5	1,2	1,3	1,2	1,3	1,3	1,5
PCB52	5,0	5,6	5,0	4,7	4,9	5,7	4,9	4,2
PCB101	8,9	9,7	7,9	7,5	7,7	8,4	6,2	5,9
PCB105	3,0	3,4	2,7	2,6	2,7	2,8	2,0	2,0
PCB118	10,0	11,5	8,7	8,5	8,6	9,0	6,8	6,5
PCB138	13,3	15,2	11,1	10,9	11,0	11,9	9,1	8,8
PCB153	17,6	21,5	15,3	14,8	15,1	15,4	11,1	10,1
PCB156	1,1	1,3	0,99	0,86	0,93	0,97	0,61	0,57
PCB170	2,1	2,3	1,7	1,6	1,6	1,6	1,1	1,1
PCB180	5,7	6,4	4,5	4,3	4,4	4,3	3,0	3,1
Σ7PCB**	62,3	72,1	54,3	52,6	53,4	56,8	43,0	40,3
HCB	12,6	15,0	13,7	13,8	13,8	15,8	14,8	13,5
a-HCH	4,7	5,4	4,9	5,1	5,0	5,8	6,1	5,6
b-HCH	0,69	0,81	0,75	0,74	0,75	0,85	0,84	0,77
g-HCH	1,1	1,2	1,1	1,1	1,1	1,3	1,3	1,2
p,p'-DDE	42,8	46,1	34,7	33,1	33,9	38,3	26,2	25,8
p,p'-DDD	15,7	18,1	15,5	15,2	15,4	18,1	14,7	13,8
p,p'-DDT	12,8	15,0	13,4	12,4	12,9	15,2	12,1	11,8
o,p'-DDT	9,8	11,1	11,7	10,8	11,2	13,5	10,4	9,4
ΣDDT	81,1	90,3	75,4	71,5	73,4	85,1	63,4	60,9
transnonachlor	23,8	26,6	20,1	19,5	19,8	21,6	16,9	15,9
a-chlordan	18,1	20,3	18,0	17,2	17,6	19,9	16,7	15,3
g-chlordan	5,9	6,5	6,0	5,9	6,0	4,4	6,1	5,4
oxychlordan	5,0	5,9	4,6	4,5	4,6	2,2	4,6	3,9
ΣCHL	52,8	59,1	48,7	47,1	47,9	48,1	44,3	40,6
Tox-26	22,3	25,6	21,5	21,0	21,2	24,5	21,1	19,4
Tox-50	39,4	45,4	39,9	40,1	40,0	46,1	40,6	37,1
Tox-62	10,8	12,2	10,5	9,6	10,0	14,0	10,6	10,9
% úrhlutuð fita	44,2	52,8	49,5	49,8	49,7	57,0	59,5	55,5

*Mean of two different analysis performed one week apart.
**PCB #28, 52, 101, 118, 138, 153 ,180.

Appendix VI.

Graphs of biological variation in Cod (*Gadus morhua*) 1990-2004

Biological variation in 30-45 cm Cod (Gadus morhua) from Icelandic waters in March 1990-2004

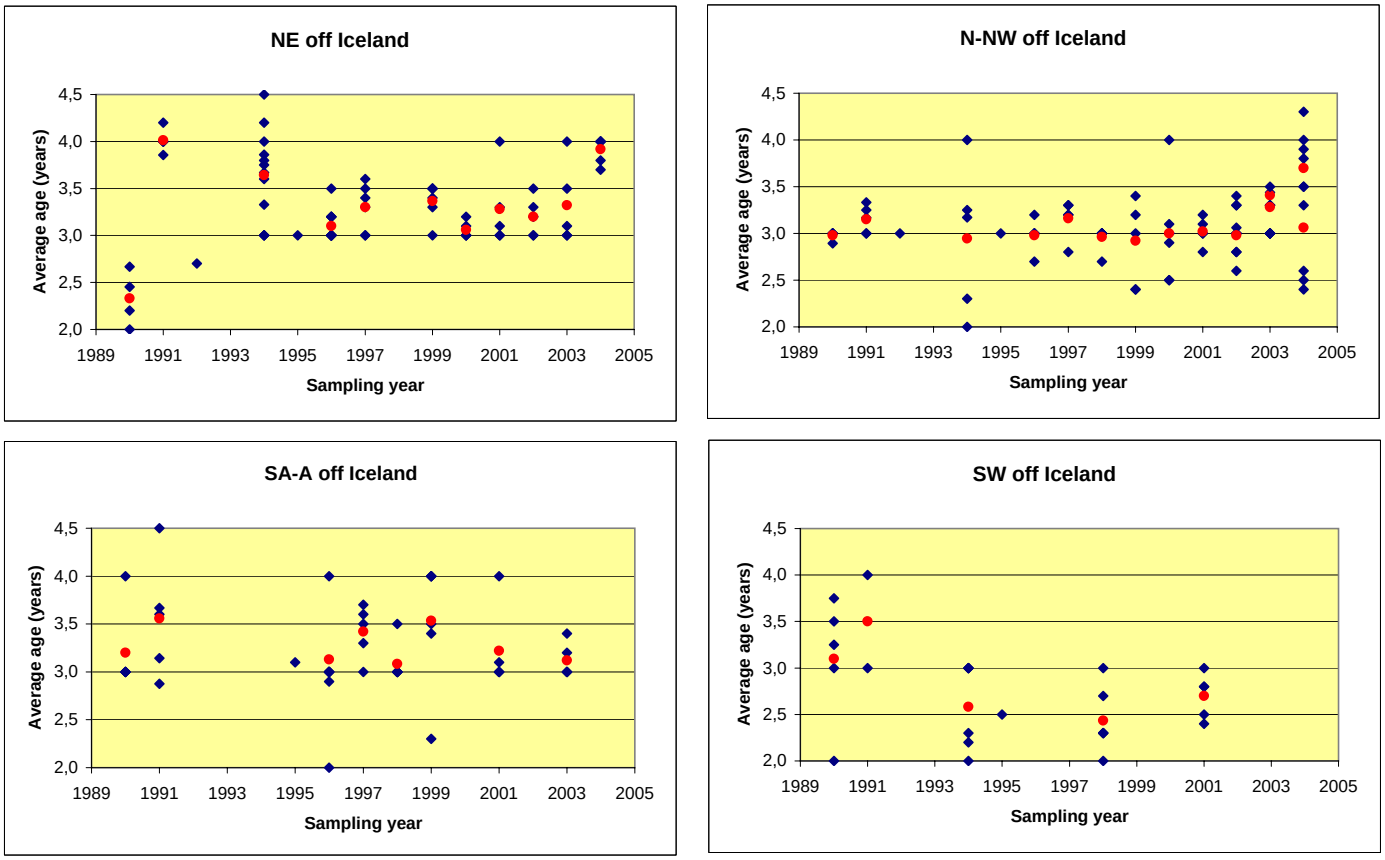


Figure 2a. Average age in 30-45 cm Cod (Gadus morhua) from Icelandic waters in March 1990-2004.The red dots represent the average values.

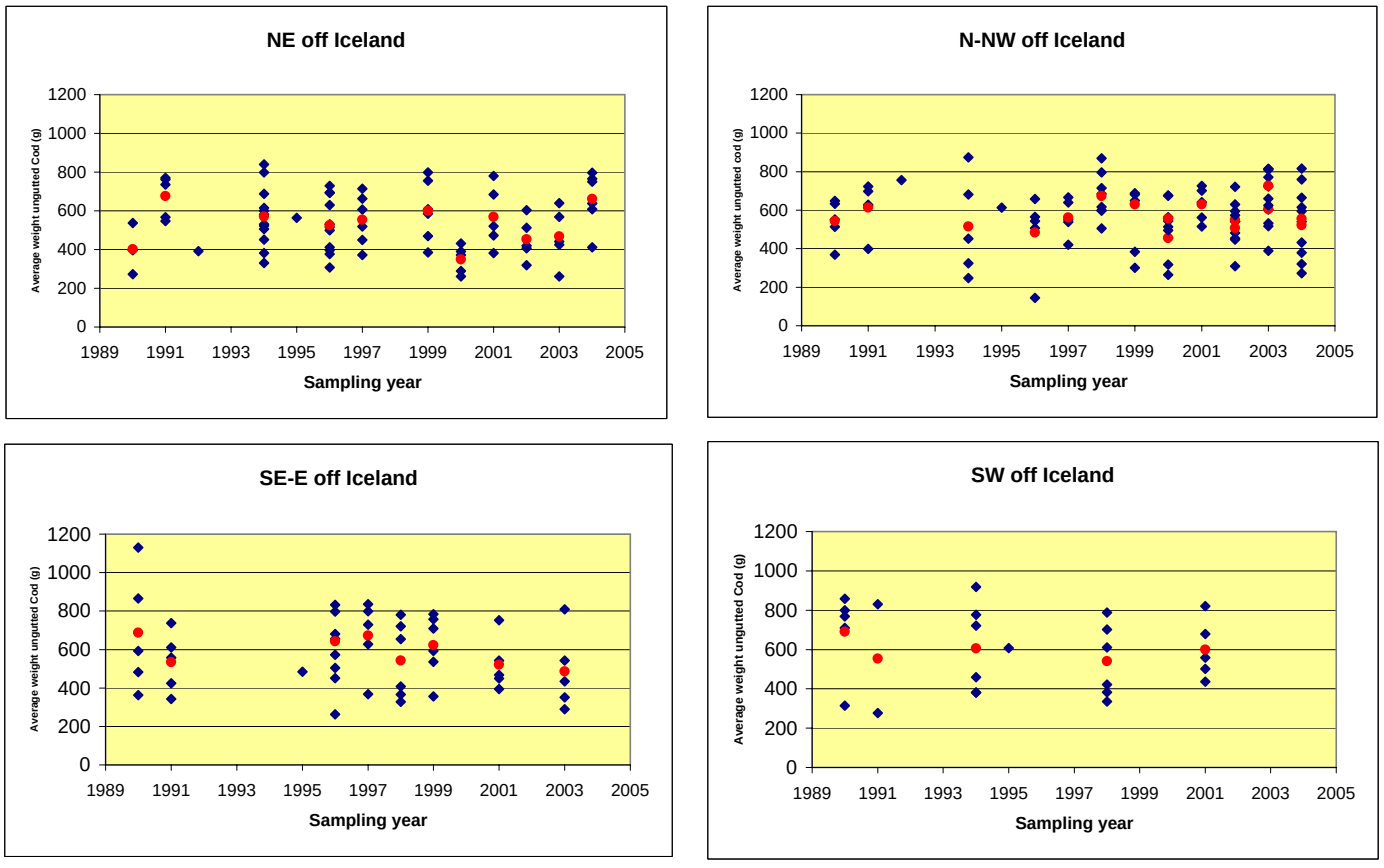


Figure 2b. Average weight ungutted Cod (Gadus morhua), 30-45 cm, from Icelandic waters in March 1990-2004.The red dots represent the average values.

Biological variation in 30-45 cm Cod (Gadus morhua) from Icelandic waters in March 1990-2004

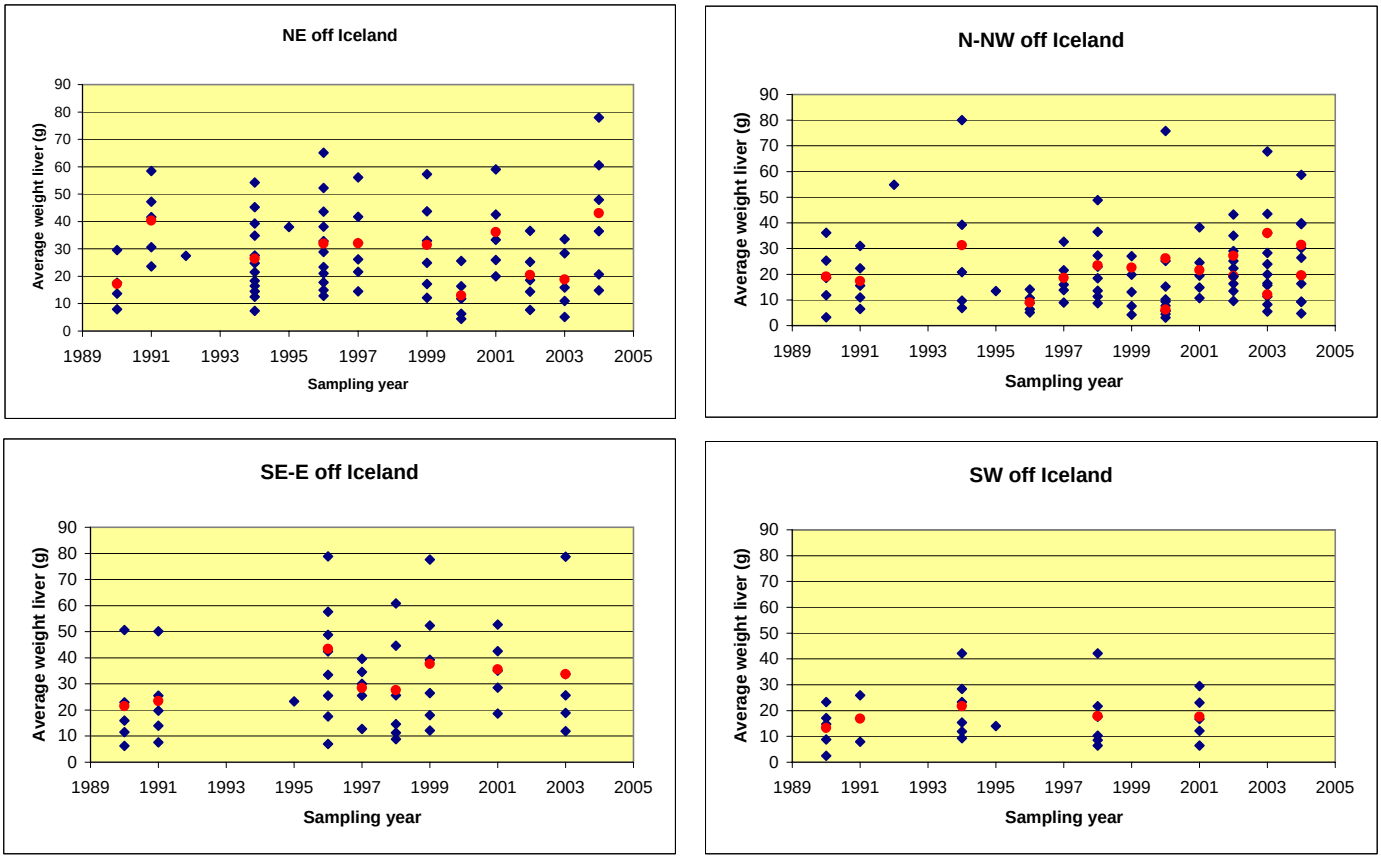


Figure 2c. Average weight liver of Cod (Gadus morhua), 30-45 cm, from Icelandic waters in March 1990-2004.The red dots represent the average values.

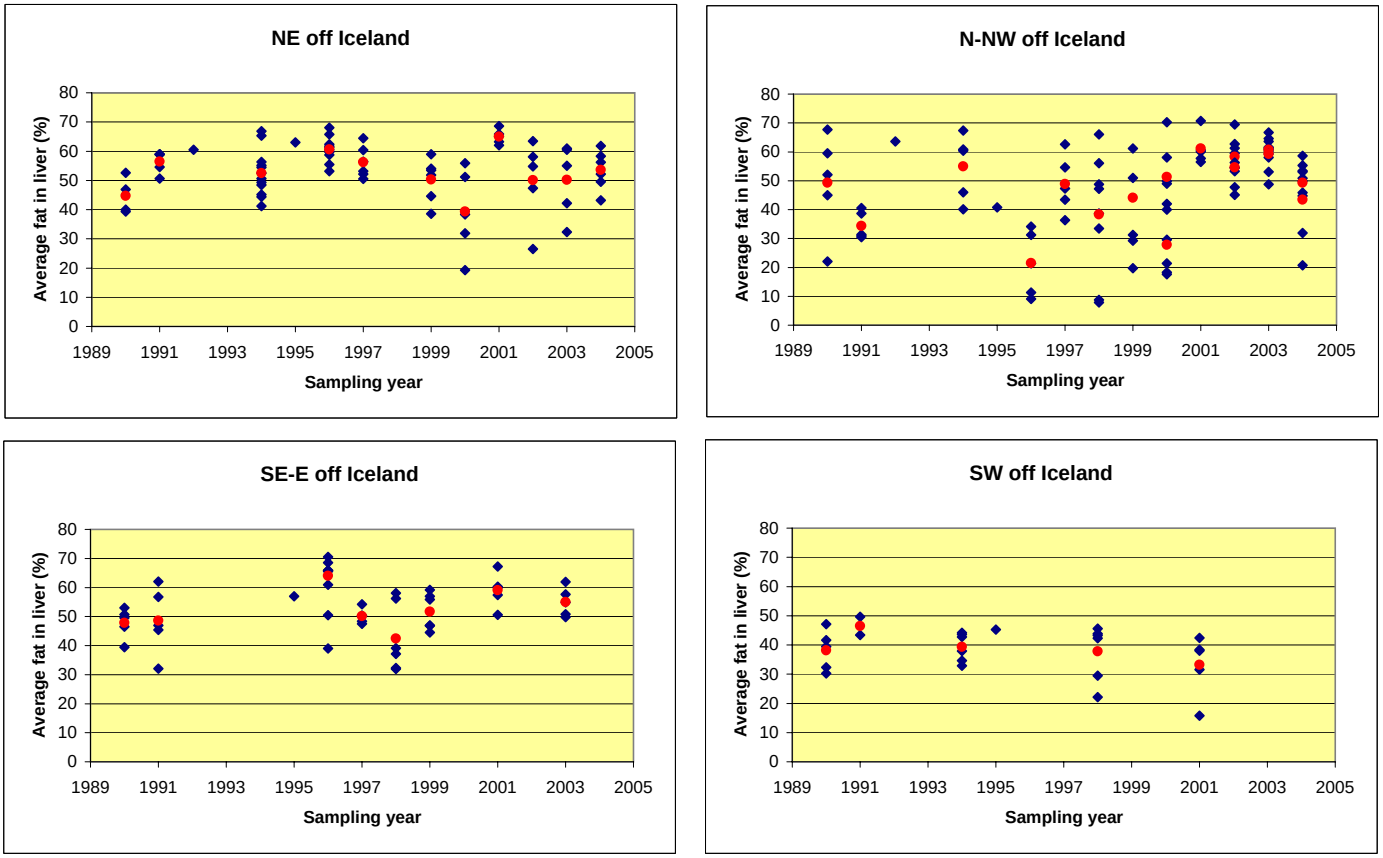


Figure 2d. Average fat (%) in liver of Cod (Gadus morhua), 30-45 cm, from Icelandic waters in March 1990-2004.The red dots represent the average values.

Appendix VII.

Graphs of metals and organic compounds in Blue mussel (*Mytilus edulis*) 1990-2003

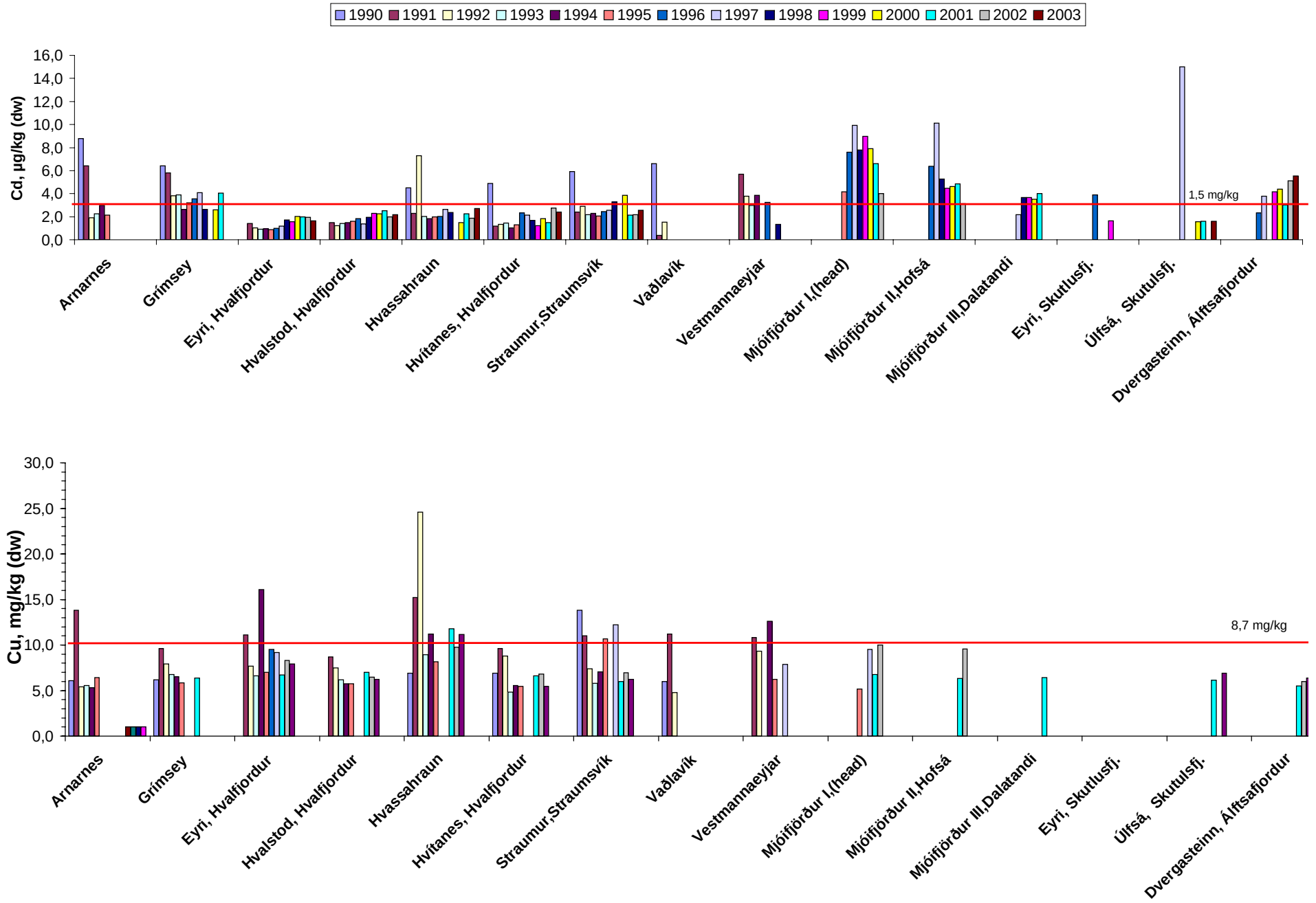


Figure 3a. Cadmium and copper concentration (dw) in Blue mussel (Mytilus edulis) around Iceland 1990-2003. Red line indicates ICES 90 75% baseline (11).

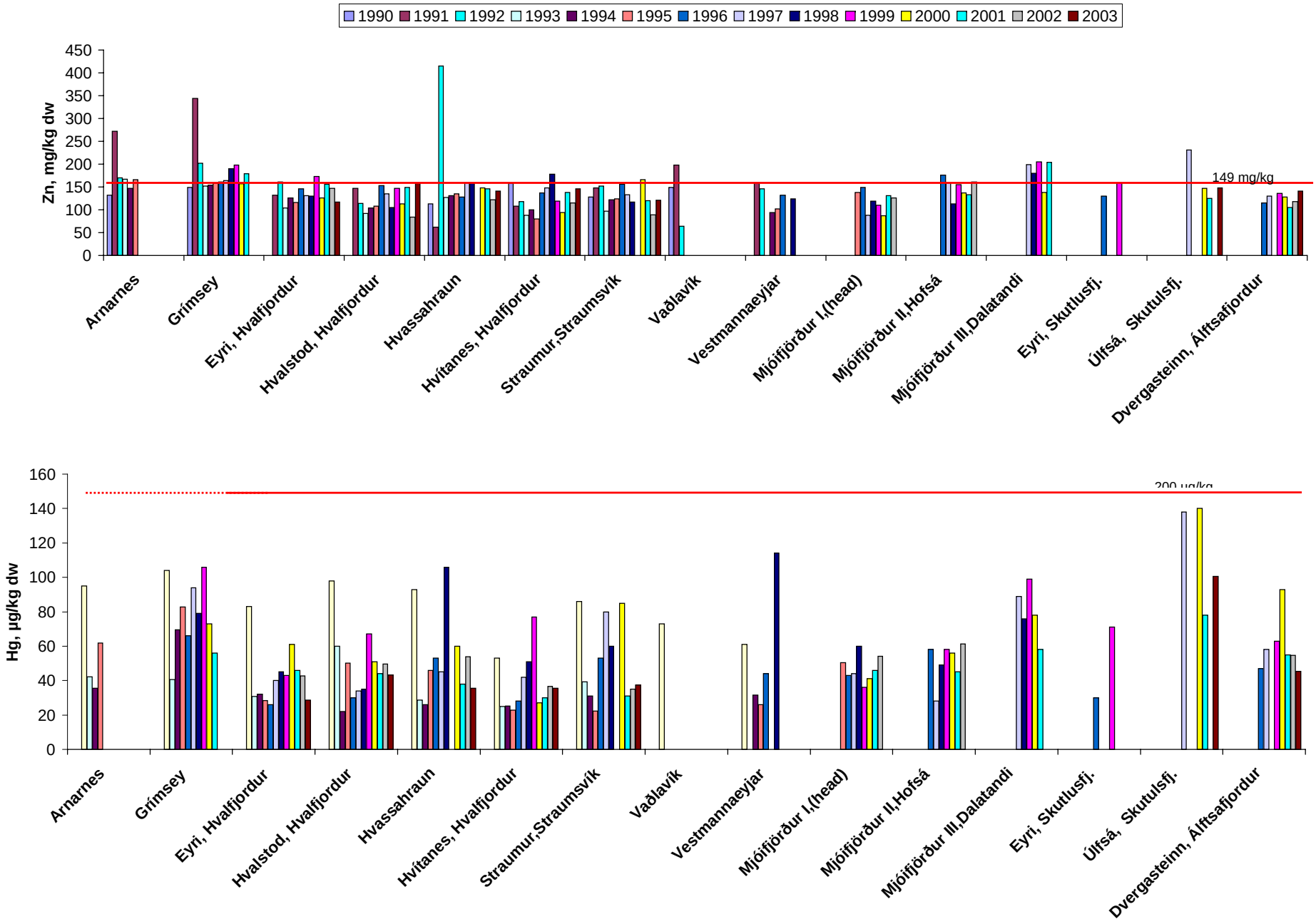


Figure 3b. Zinc and mercury concentration (dw) in Blue mussel (Mytilus edulis) around Iceland 1990-2003. Red line indicates ICES 90 75% baseline (11).

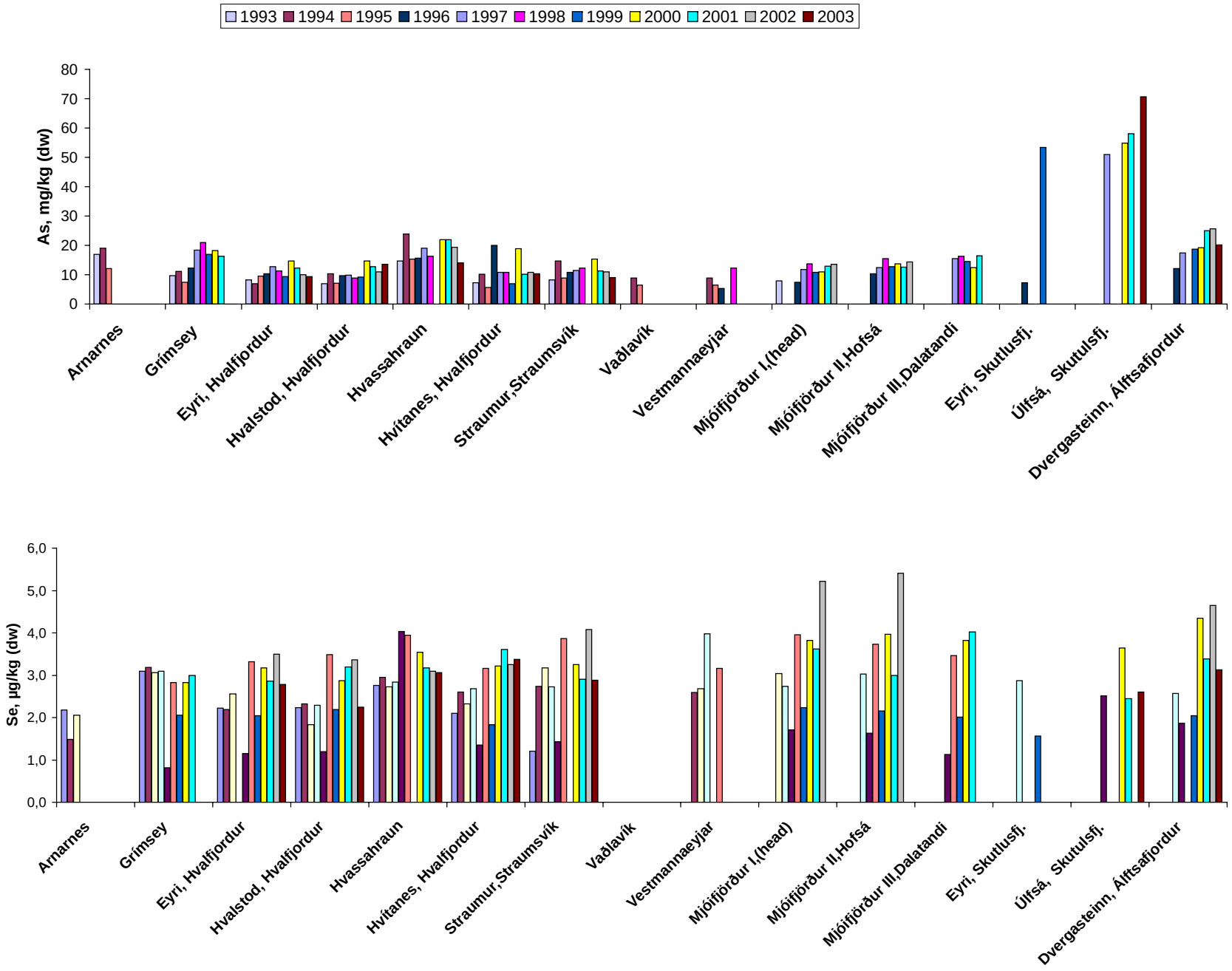


Figure 3c. Arsen and selenium concentration (dw) in Blue mussel (Mytilus edulis) around Iceland 1990-2003.

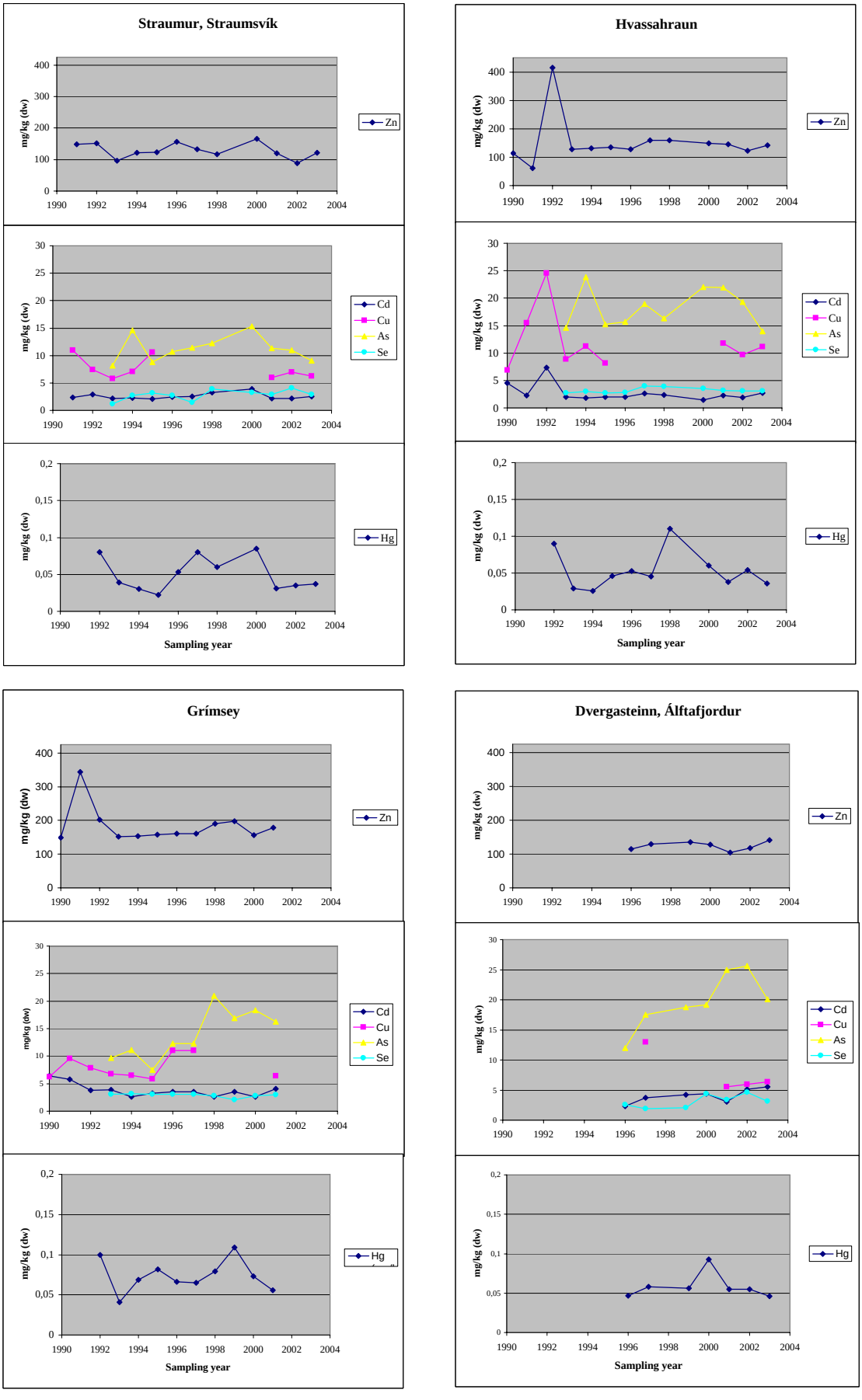


Figure 4a. Concentration of heavy metals (dry weight) in Blue mussel from different sampling sites around Iceland, 1991-2003.

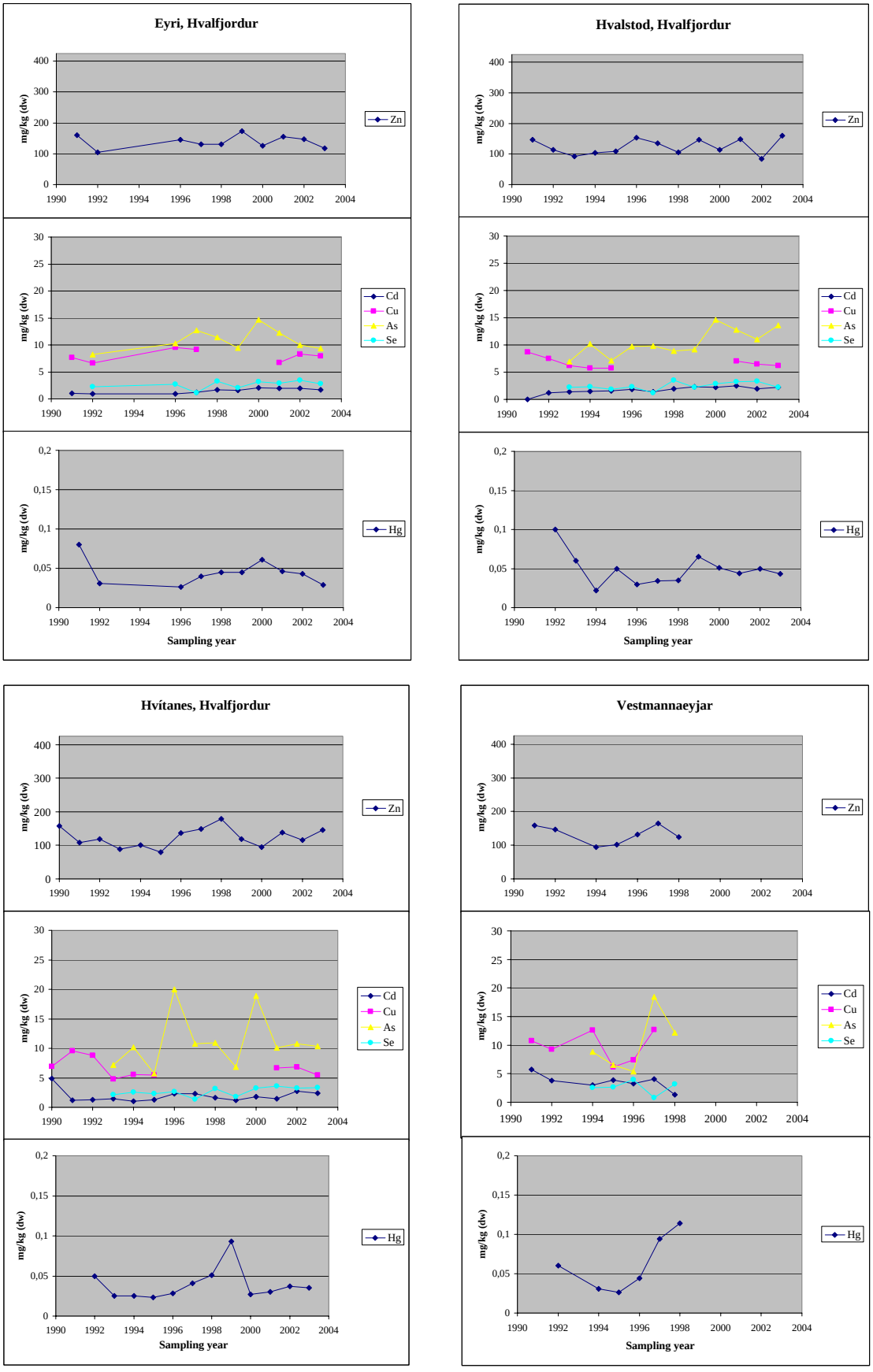


Figure 4b. Concentration of heavy metals (dry weight) in blue mussel from different sampling sites around Iceland, 1991-2003.

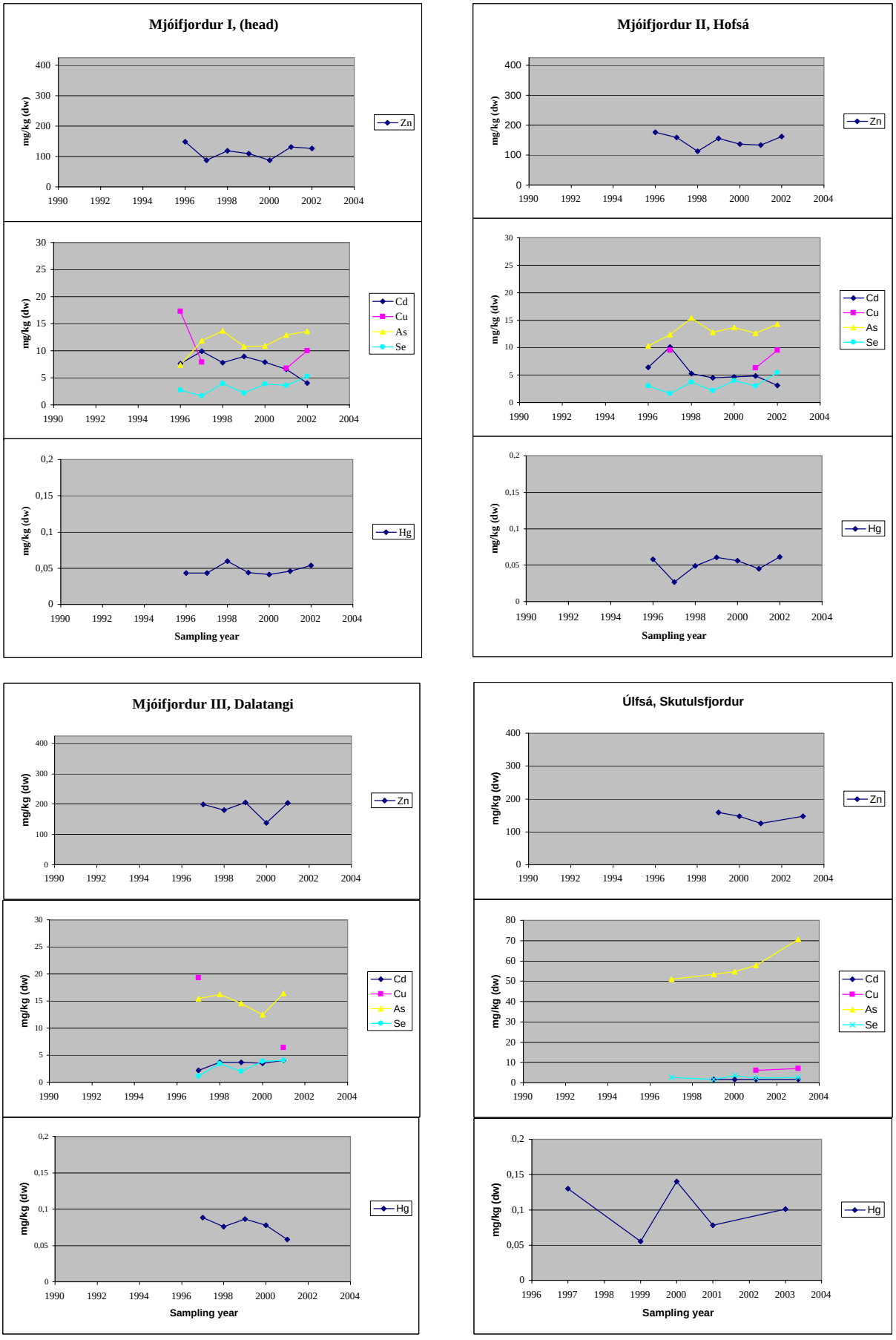


Figure 4c. Concentration of heavy metals (dry weight) in blue mussel from different sampling sites around Iceland, 1991-2003.

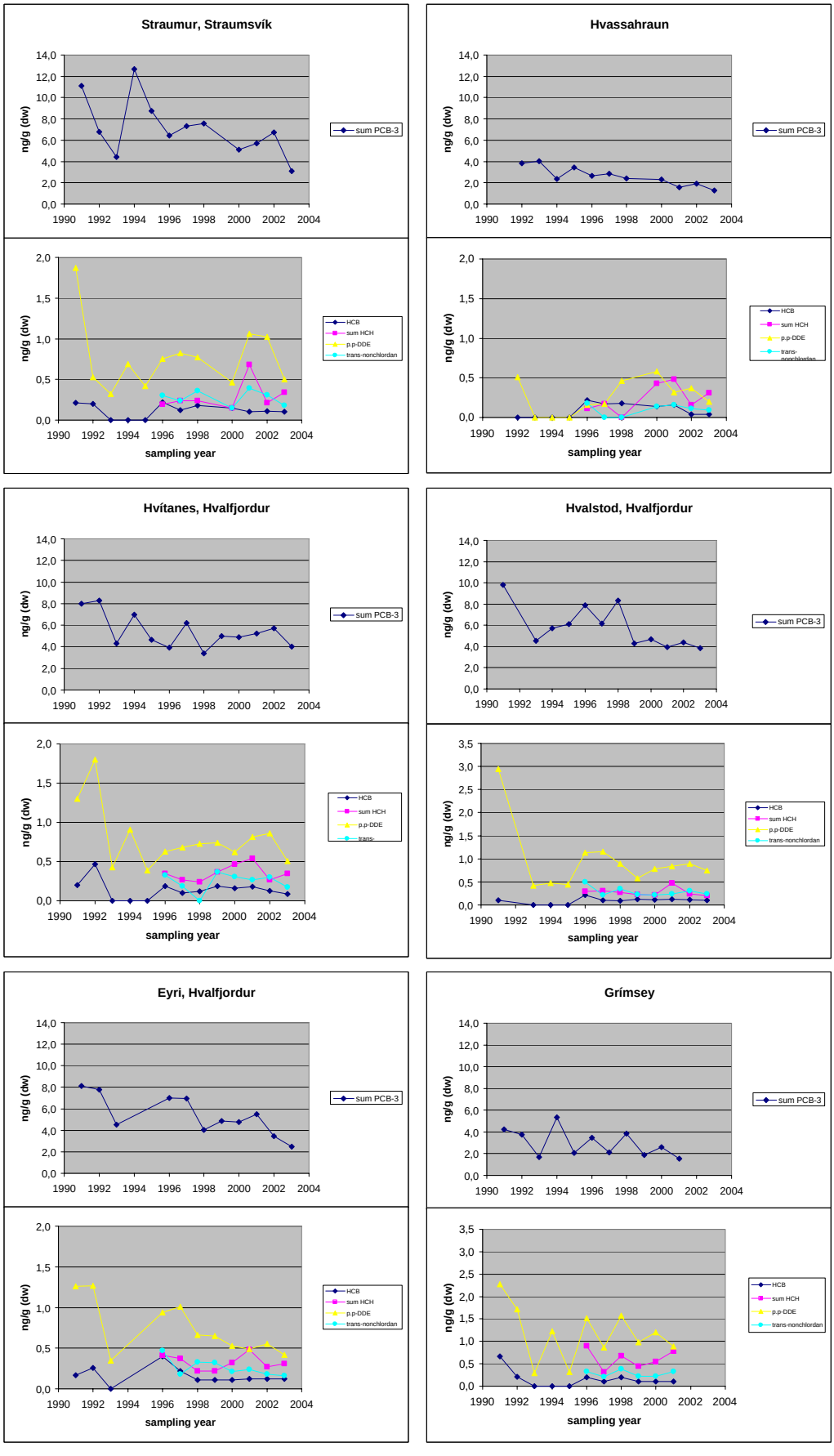


Figure 5a. Concentration of organochlorine compounds (dw) in Blue mussel (Mytilus edulis) at different locations 1991-2003

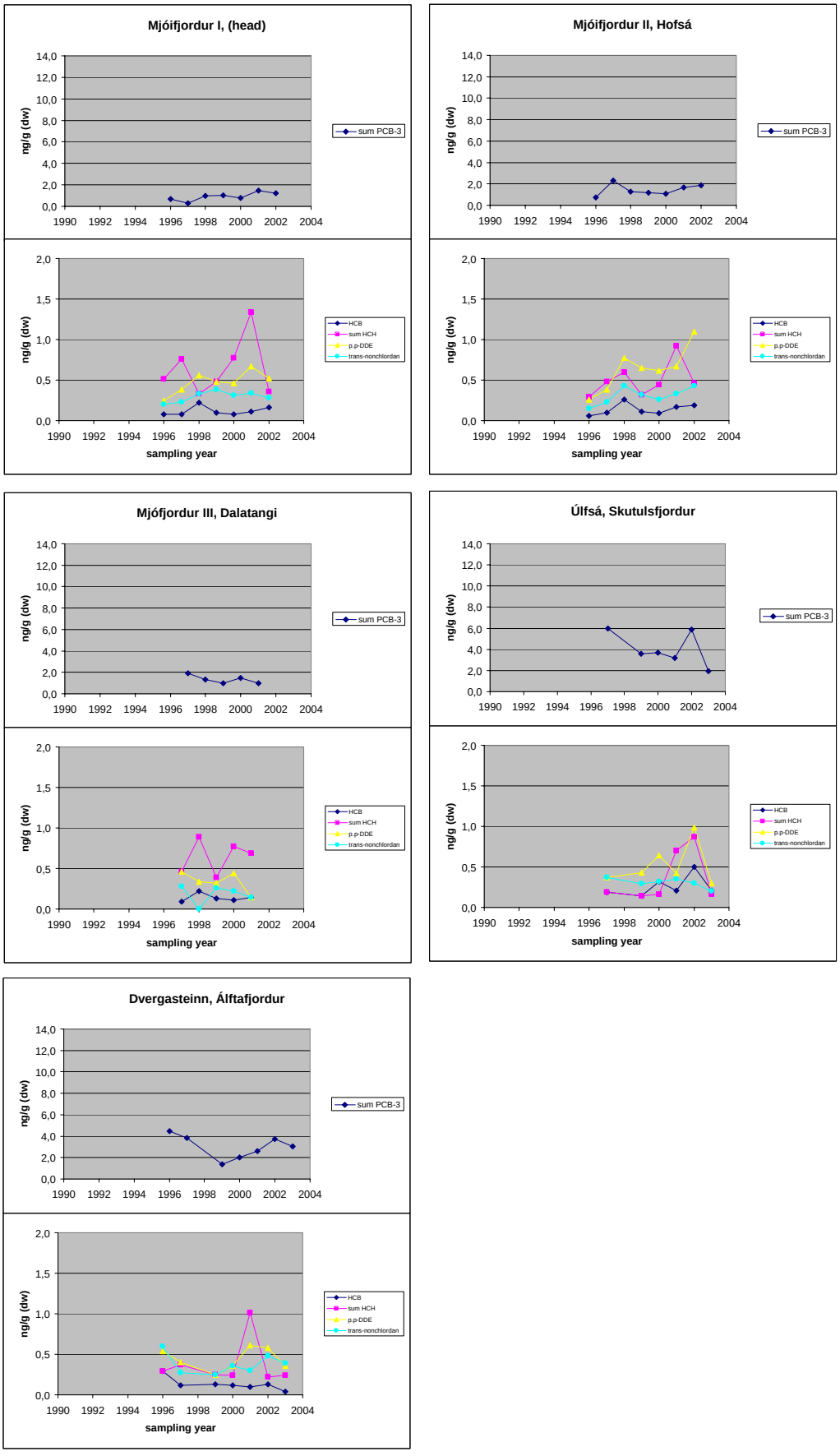


Figure 5b. Concentration of organochlorine compounds (dw) in Blue mussel (Mytilus edulis) at different locations 1991-2003.

Appendix VIII.

Graphs of metals and organic compounds in Cod (*Gadus morhua*) 1990-2004

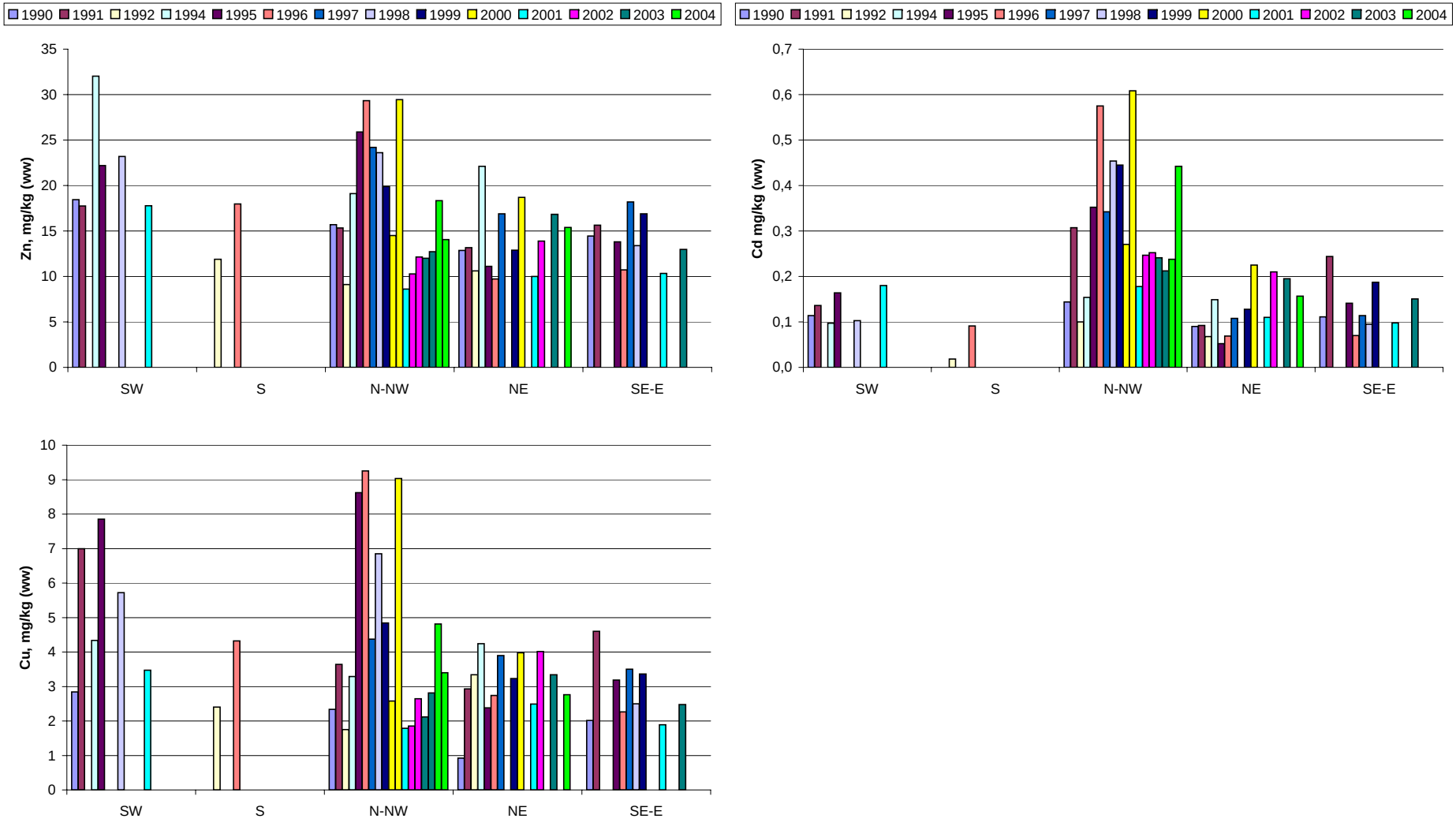


Figure 6a. Heavy metal consentration (ww) in livers of 30-45cm cod (Gadus morhua) from Icelandic waters in March 1990-2004.

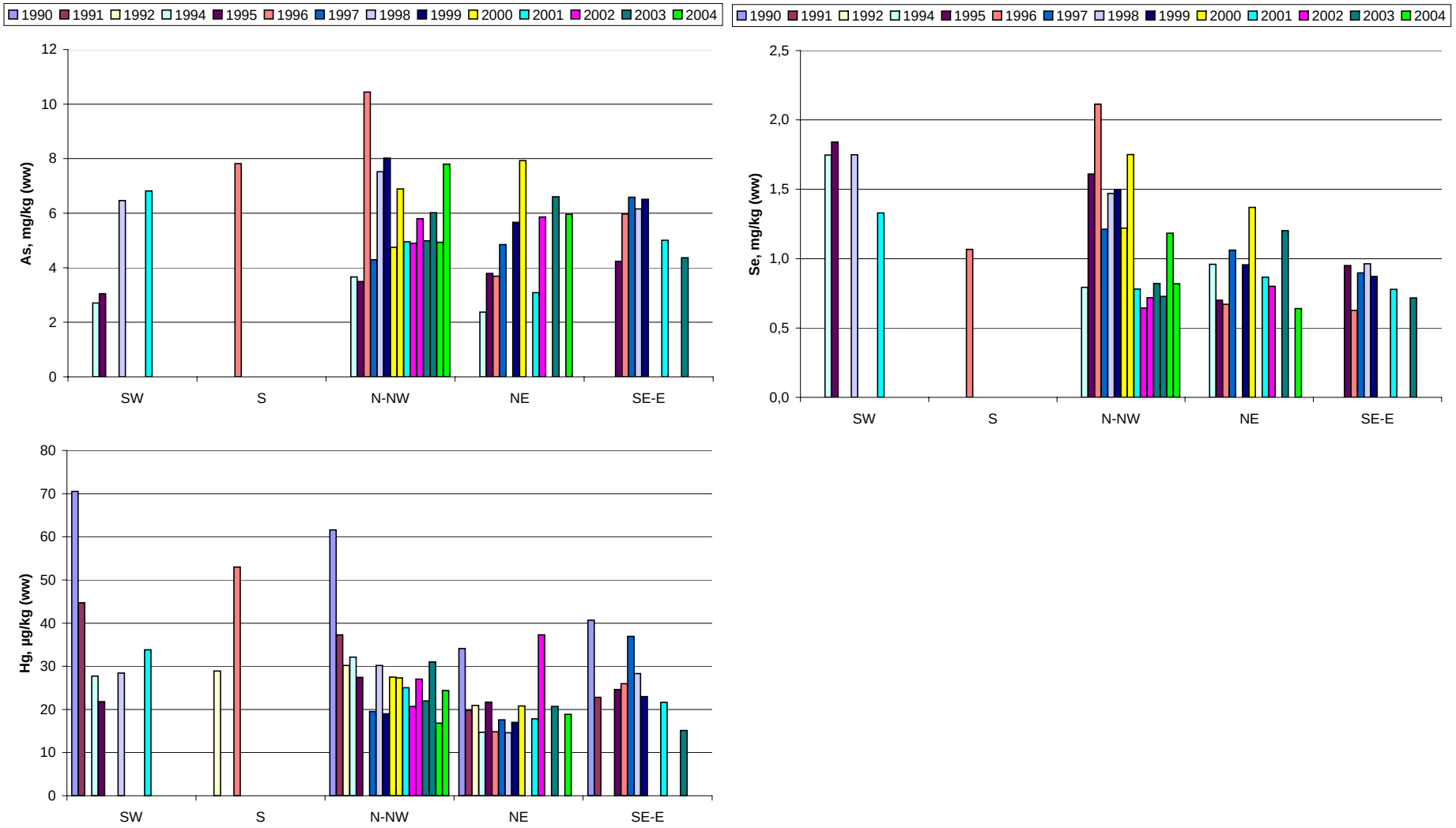


Figure 6b. Heavy metal consentration (ww) in livers of 30-45cm cod (Gadus morhua) from Icelandic waters in March 1990-2004. Mercury (Hg) was analysed in the flesh

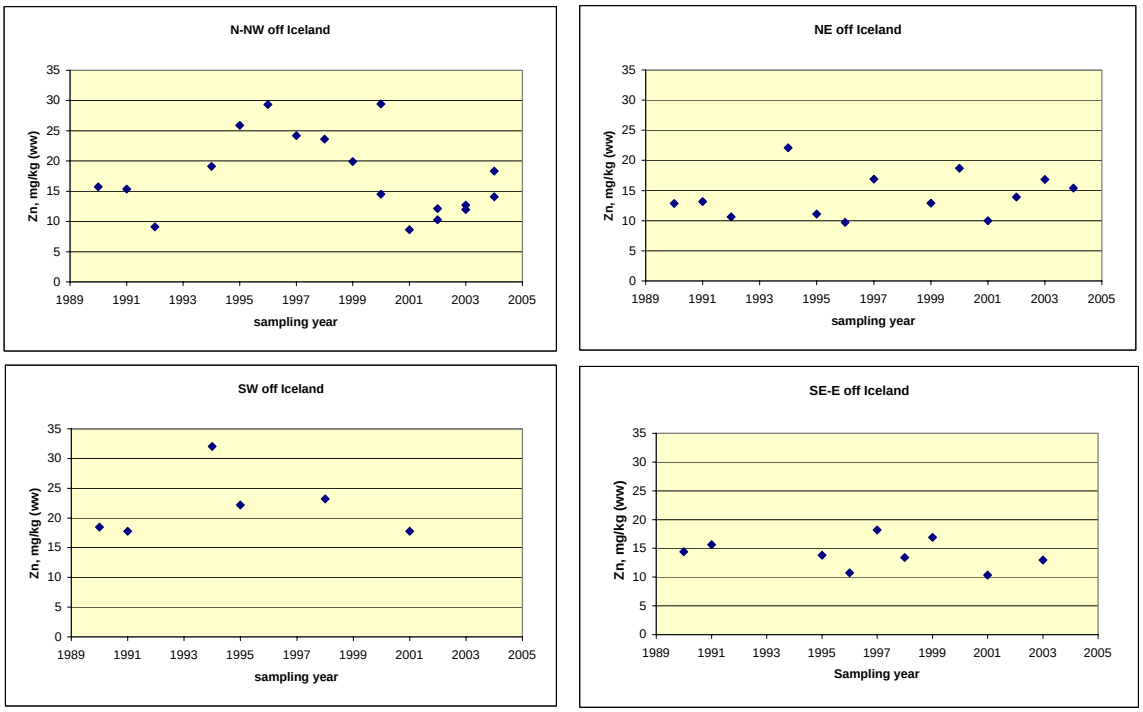


Figure 7a. Average concentration of Zinc (ww) in livers of 30-45 cm Cod (Gadus morhua) from different locations in Icelandic waters in March 1990-2004.

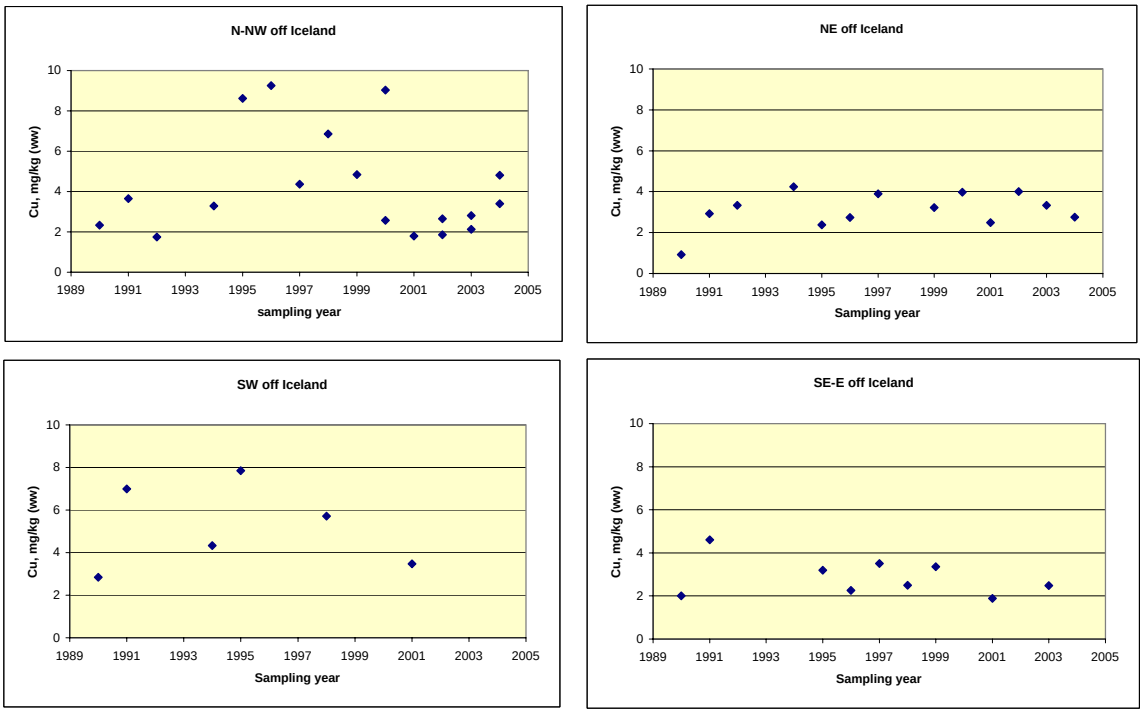


Figure 7b. Average concentration of Copper (ww) in livers of 30-45 cm Cod (Gadus morhua) from different locations in Icelandic waters in March 1990-2004.

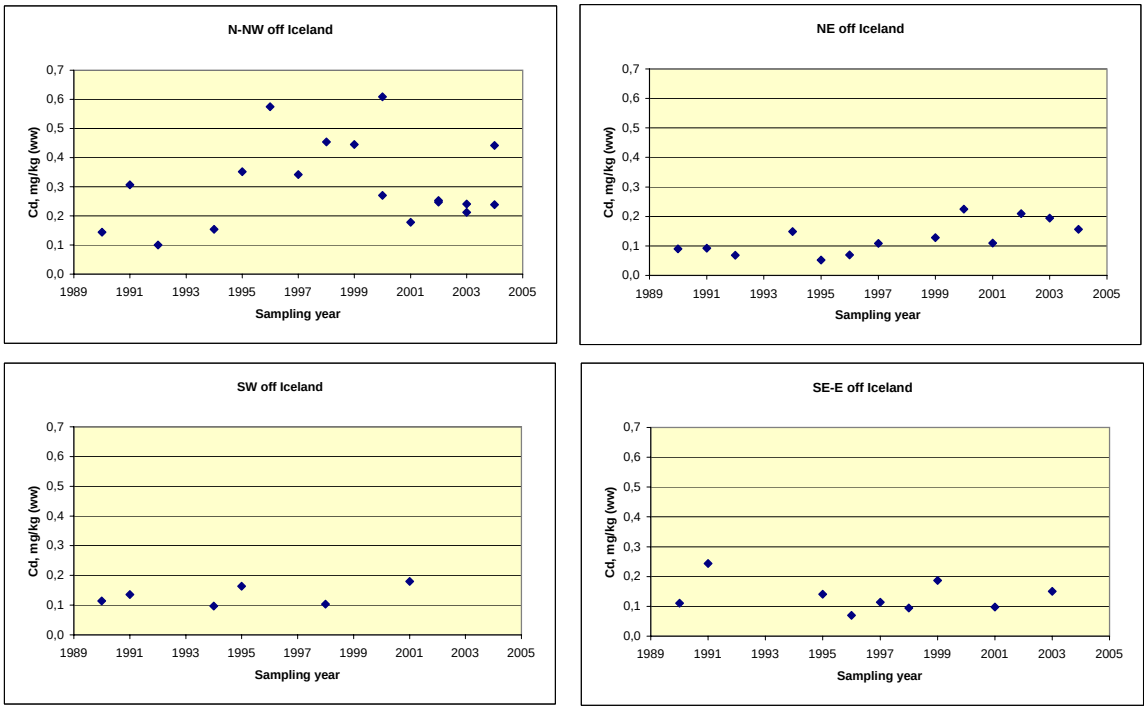


Figure 7c. Average concentration of Cadmium (ww) in livers of 30-45 cm Cod (Gadus morhua) from different locations in Icelandic waters in March 1990-2004.

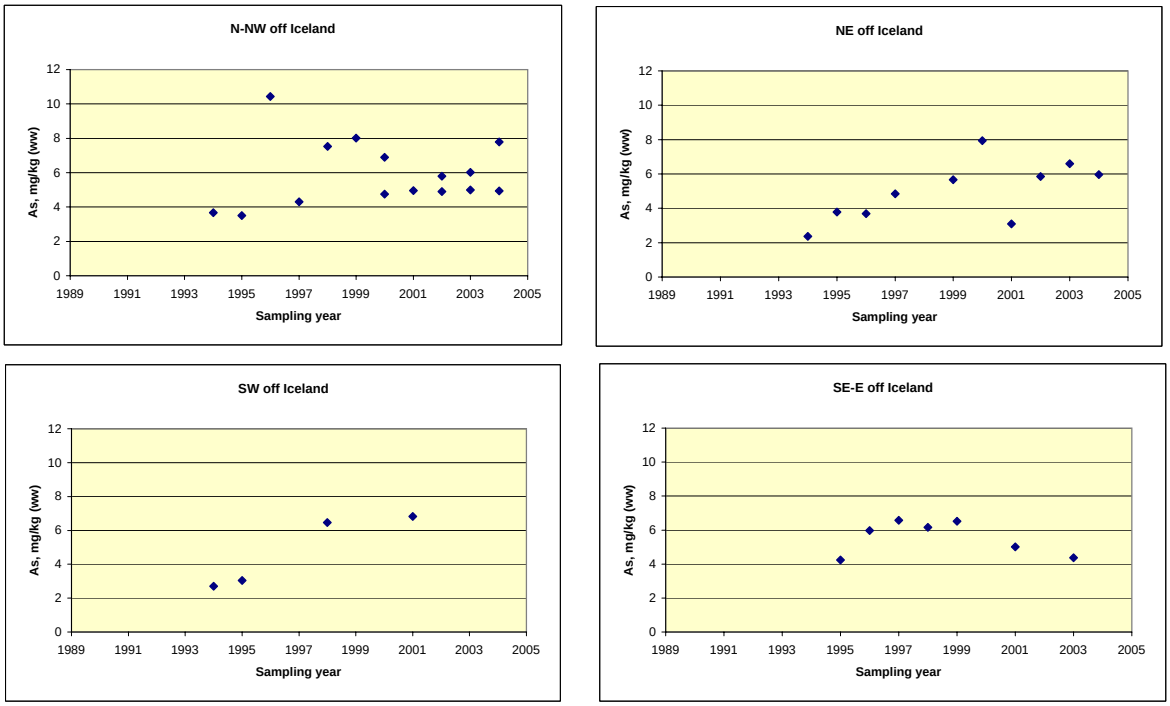


Figure 7d. Average concentration of Arsenic (ww) in livers of 30-45 cm Cod (Gadus morhua) from different locations in Icelandic waters in March 1990-2004.

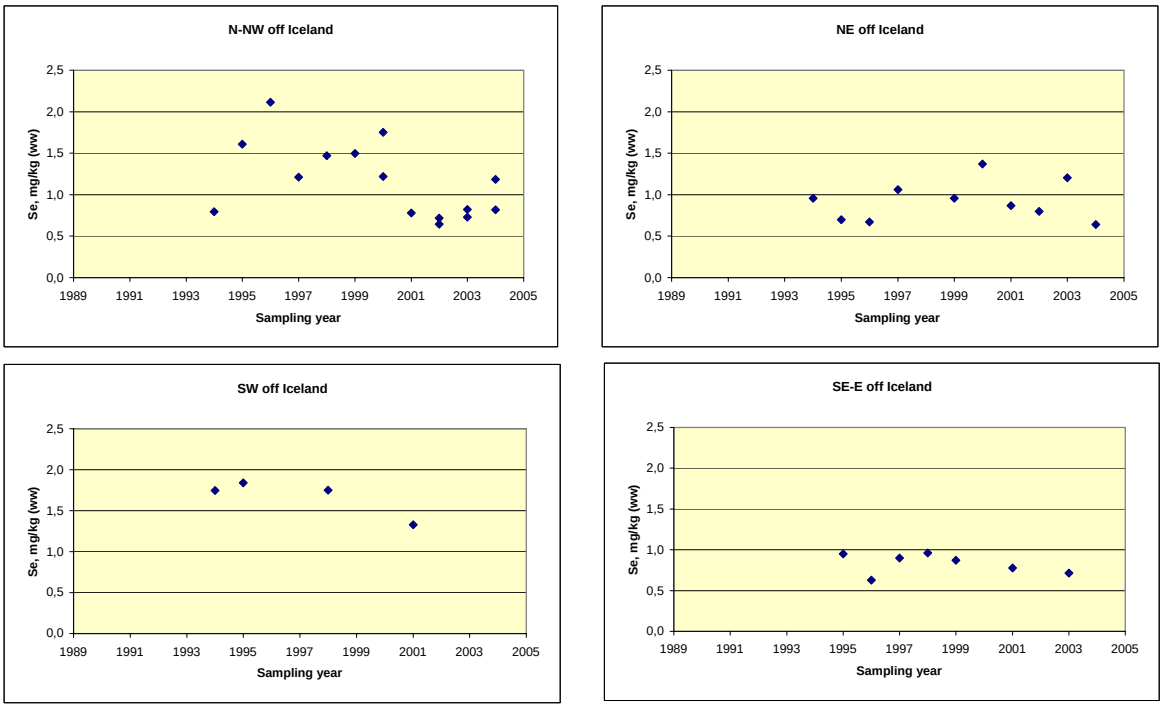


Figure 7e. Average concentration of Selenium (ww) in livers of 30-45 cm Cod (Gadus morhua) from different locations in Icelandic waters in March 1990-2004.

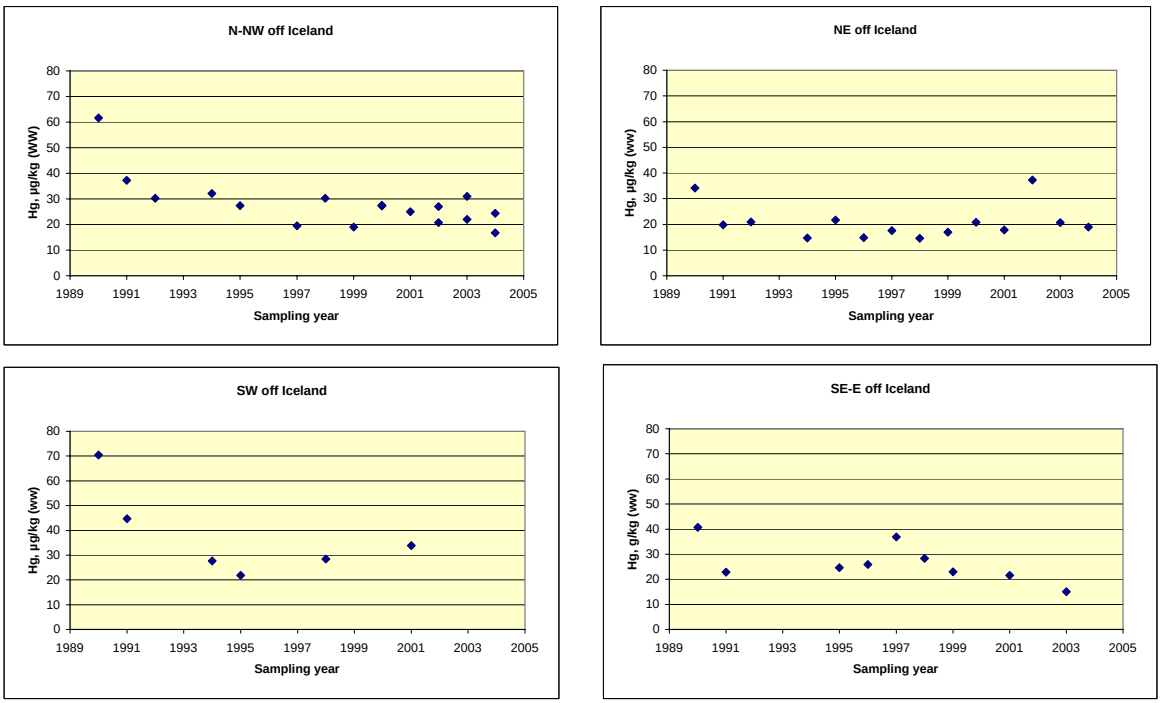
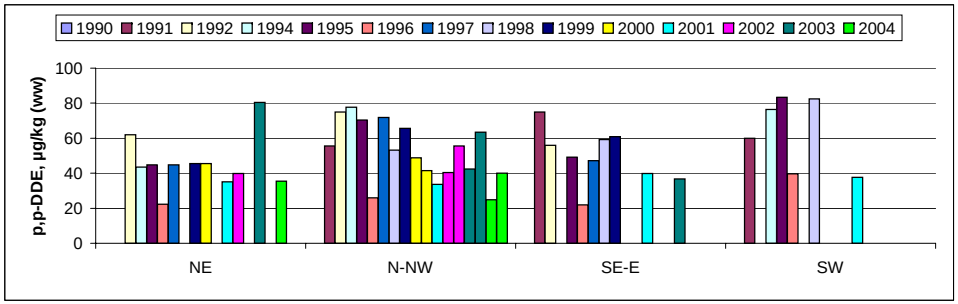
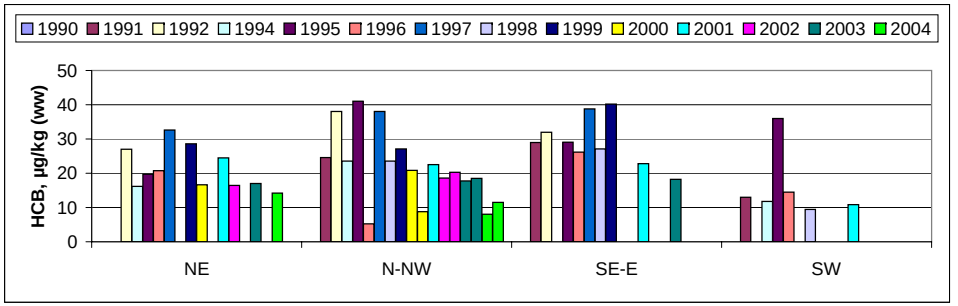
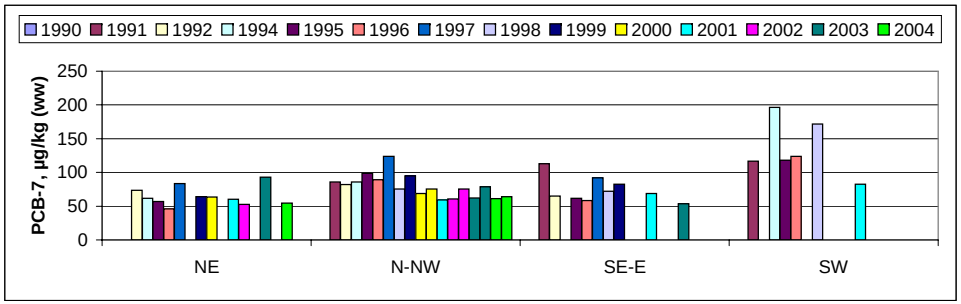
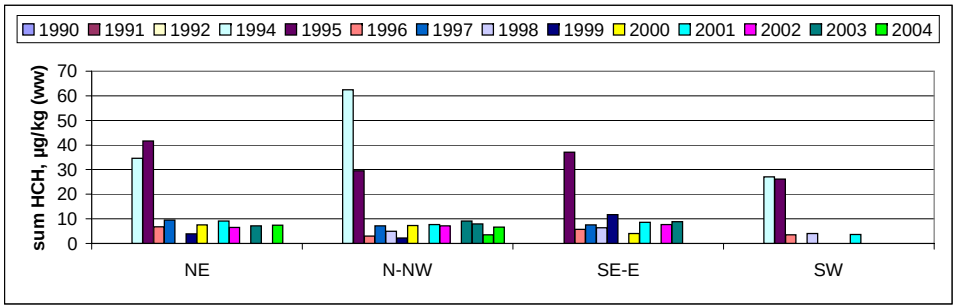


Figure 7f. Average concentration of Mercury (ww) in flesh of 30-45 cm Cod (Gadus morhua) from different locations in Icelandic waters in March 1990-2004.









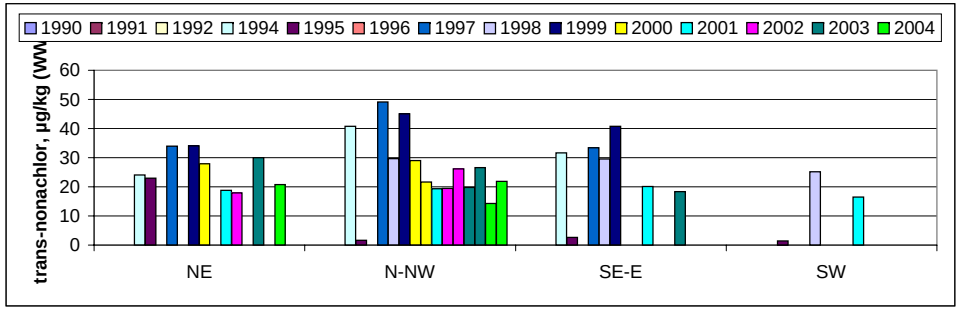


Figure 8. Organochlorine compounds (ww) in livers of 30-45 cm Cod (Gadus morhua) from different locations in Icelandic waters in March 1991-2004

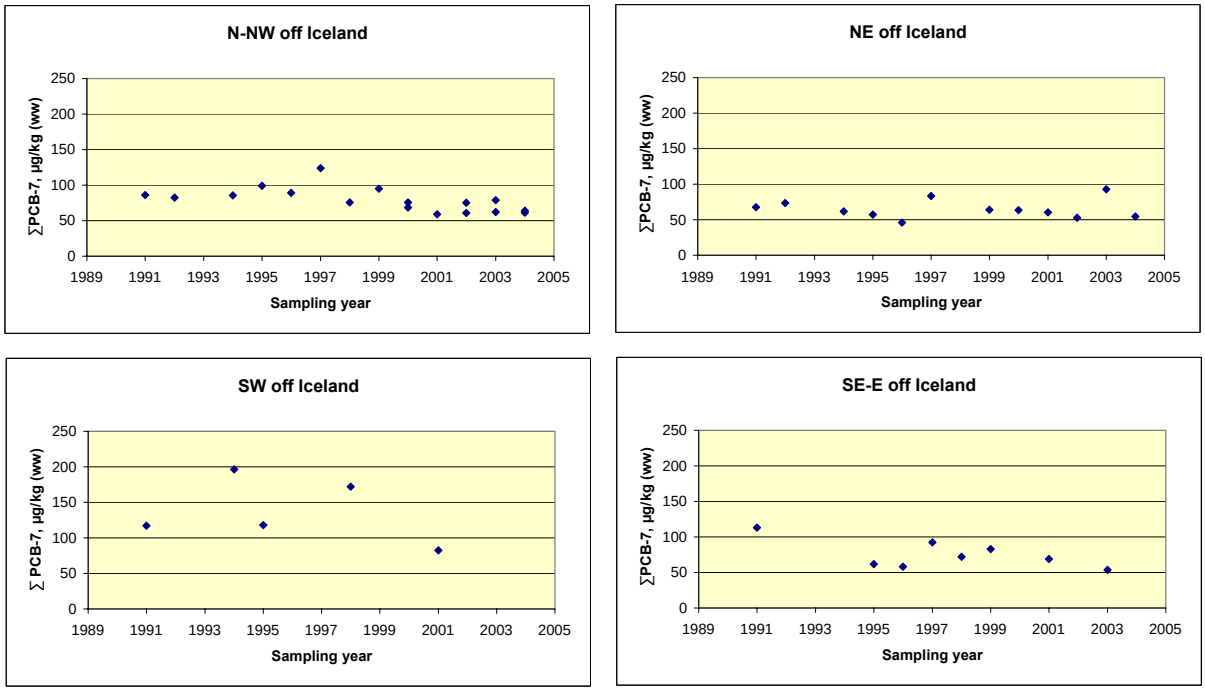


Figure 9a. Average concentration of ∑PCB-7 (ww) in livers of 30-45 cm Cod (Gadus morhua) from different locations in Icelandic waters in March 1991-2004

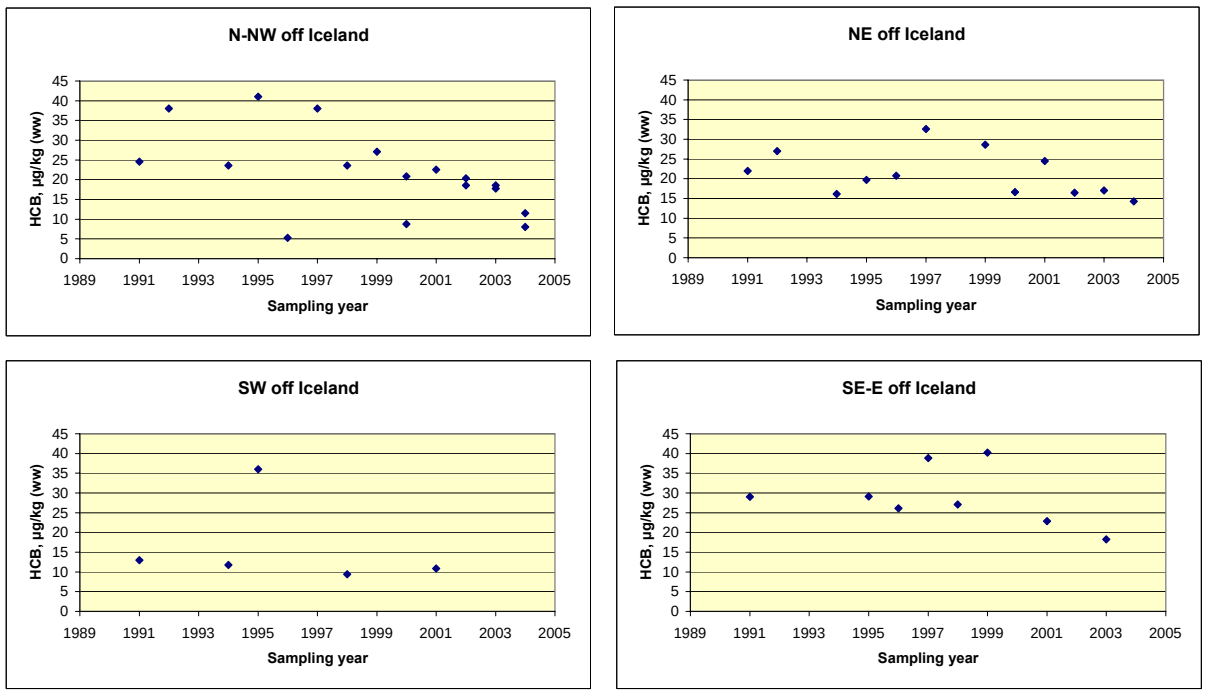


Figure 9b. Average concentration of HCB (ww) in livers of 30-45 cm Cod (Gadus morhua) from different locations in Icelandic waters in March 1991-2004

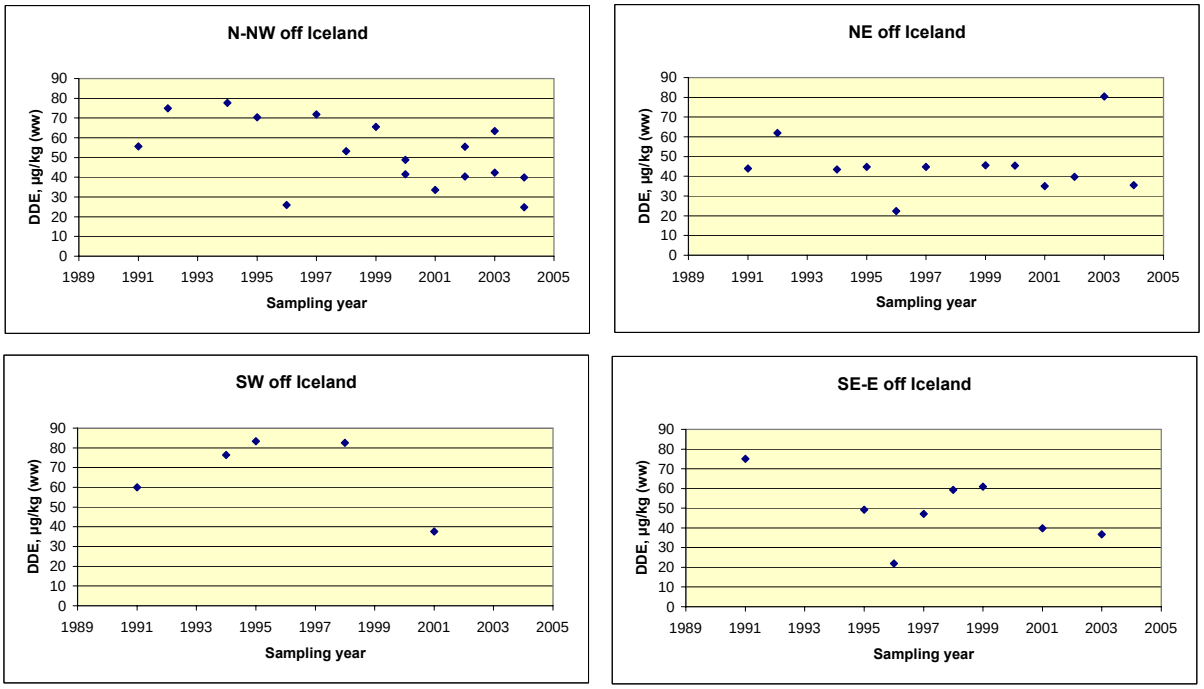


Figure 9c. Average concentration of DDE (ww) in livers of 30-45 cm Cod (Gadus morhua) from different locations in Icelandic waters in March 1991-2004

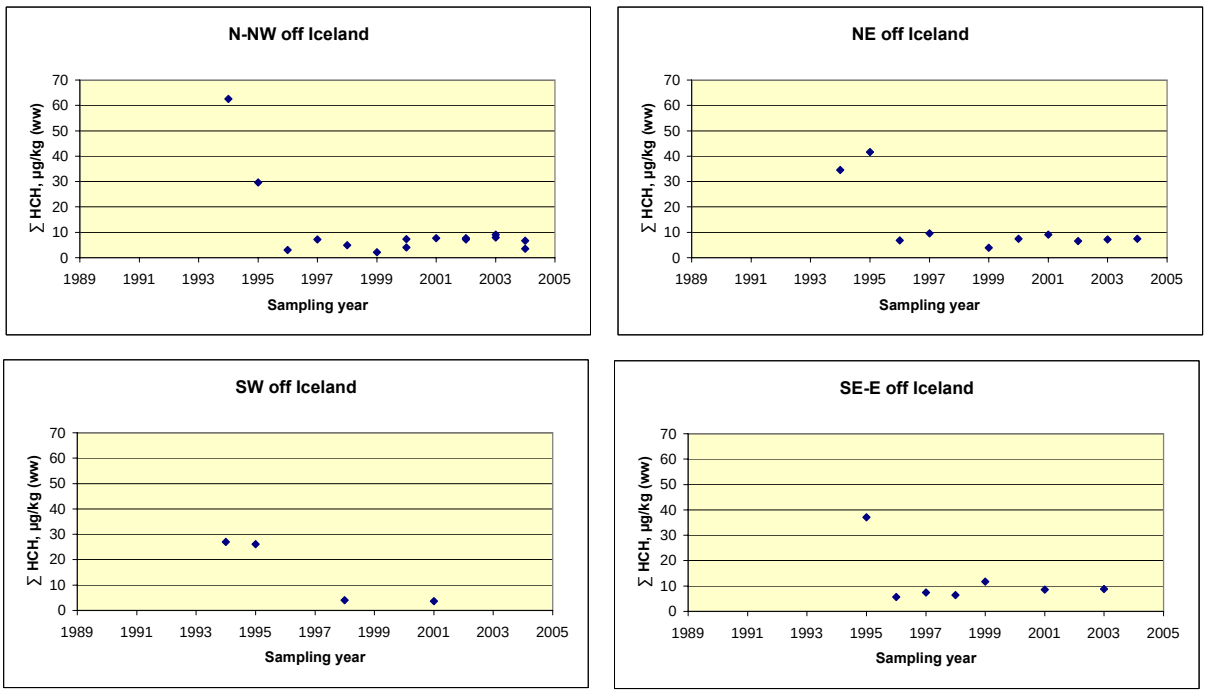


Figure 9d. Average concentration of ∑HCH (ww) in livers of 30-45 cm Cod (Gadus morhua) from different locations in Icelandic waters in March 1991-2004

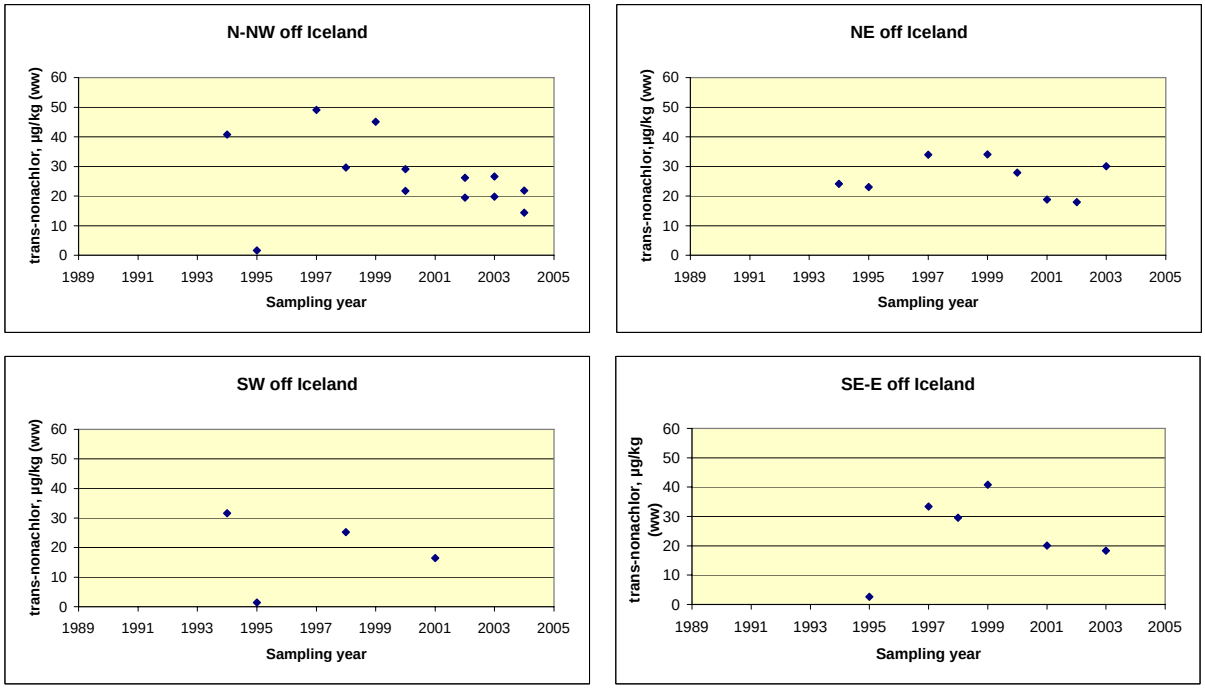


Figure 9e. Average concentration of transnonachlor (ww) in livers of 30-45 cm Cod (Gadus morhua) from different locations in Icelandic waters in March 1991-2004