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Monitoring of the marine biosphere around Iceland 2009 and 2010

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Öryggi, umhverfi og erfðir

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Report summary

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Ágrip á íslensku:

Í þessari skýrslu eru birtar niðurstöður árlegs vöktunarverkefnis sem styrkt var af umhverfisráðuneytinu og sávarútvegs- og landbúnaðarráðuneytinu. Markmið með þessari vöktun er að uppfylla skuldbindingar Íslands varðandi Oslóar- og Parísarsamninginn (OSPAR), auk AMAP (Arctic Monitoring Assessment Program). Gögnin hafa verið send í gagnabanka Alþjóðahafrannsóknaráðsins (ICES).

Hafrannsóknastofnunin sér um að afla sýna og Matís hefur umsjón með undirbúningi sýna og mælingum á snefilefnum í lífríki hafsins. Sýnin eru mæld á Matís og á Rannsóknastofu Háskóla Íslands í lyfja- og eiturefnafræði.

Mæld voru ýmis ólífræn snefilefni og klórlífræn efni í þorski veiddum í árlegu vorralli Hafró í mars 2010 og í kræklingi sem safnað var á 10 stöðum í kringum landið í ágúst/sept 2009. Vöktun í lífríki sjávar við Ísland hófst 1989 og er sýnasöfnun eins frá ári til árs og unnið eftir alþjóðlegum sýnatökuleiðbeiningum. Gögnunum er safnað saman í gagnagrunn, í skýrslunni eru birtar yfirlitsmyndir fyrir sum efnanna sem fylgst er með. Kadmín er svæðisbundið hærra í íslenskum kræklingi samanborið við kræklingi frá öðrum löndum. Niðurstöður sýna breytingar í mynstri styrks klórlífrænna efna í kræklingi sem safnað var nálægt Hvalstöðinni í Hvalfirði í september 2009, ekki voru sýnilegar breytingar í styrk þessara efna á söfnunarstað kræklings við Hvammsvík í Hvalfirði né á neinum öðrum söfnunarstað í kringum landið sem rannsakaður var 2009. Mikilvægt er að fylgjast með þessum breytingum í mynstri styrks klórlífrænna efna í kræklingi í vöktunarverkefninu á næstu árum til að sjá hvort þær eru enn til staðar. Ítarleg tölfræðigreining á gögnunum er í gangi þ.a. hægt sé að meta með vísindalegum aðferðum aukningu eða minnkun mengandi efna í lífríki sjávar hér við land.

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

Skýrsluágrip Matís ohf
Icelandic Food and Biotech R&D

Report summary

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Summary in English:

This report contains results of the annual monitoring of the biosphere around Iceland in 2009 and 2010. 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 project was funded by Ministry for the Environment and Ministry of Fisheries and Agriculture. The data has been submitted to the ICES databank (ices.dk). The collection of data started 1989. Matís 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 Matís and the Department of Pharmacology and Toxicology at the University of Iceland.

Trace metals and organochlorines were analysed in cod *(Gadus morhua)* caught in March 2010 and in blue mussel *(Mytilus edulis)* collected in August/Sept 2009. Marine monitoring began in Iceland 1989 and the sampling is carried out according to standardized sampling guidelines. Changes were observed in the organochlorine concentration patterns in blue mussels collected year 2009 at the sampling site Hvalstod in Hvalfjordur, no noteworthy increase in organochlorine concentrations was however observed in blue mussels obtained at Hvammsvík in Hvalfjordur nor any of the other sample sites studied year 2009. These results need to be followed up in the annual monitoring of the biosphere around Iceland next year to see if this change in contaminant concentration pattern continues. A thorough statistical evaluation is on-going on all available data from this monitoring program to analyse spatial and temporal trends of pollutants in the Icelandic marine biosphere.

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 along the coast around Iceland in 2009, as well as for cod (*Gadus morhua*), which collected in Icelandic territorial waters in 2010. 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 (1-15). To meet the requirements of the OSPAR (Oslo and Paris agreement) and the AMAP (Arctic Monitoring and Assessment Program), data has been submitted to the ICES databank (www.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 as well as the Ministry of Fisheries and Agriculture and Matís. Matís is the coordinator for the marine biota monitoring and responsible for methods relating to sampling, sample preparation, analysis of samples and writing of this report. The samples were analyzed at Matís and the Department of Pharmacology and Toxicology at the University of Iceland.

II. Sampling and preparation of samples

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

2.1 Sampling

Using standard sampling guidelines (JMP, ICES and OSPAR), the sampling of cod (30-45 cm length, 2 samples (N-NW and NE) was carried out in the annual bottom trawl survey in March 2010. Blue mussel samples, 4-6 cm length, were collected from 10 sites along the coast of the country in August/September 2009. Unfortunately no blue mussel sample was obtained from Eyri in Hvalfjordur as the mussels at this site were all too small. The annual sampling site for the blue mussels taken at Hvítanes in Hvalfjordur (64°21,85-21°29,8) is no longer accessible (private property) and thus had to be moved slightly and is now at Hvammsvík (64°21,64-21°33,53). Sampling sites, i.e. coordinates, for all cod and blue mussel measured are shown in Figure 1. Icelandic waters have been divided into five main locations (N-NW, NE, SE-E, S, and SW) (6).

	Sample	Location
blue mussel	Grímsey	66°33,134-18°01,407
	Hvalstöð, Hvalfjörður	64°23,826-21°27,210
	Hvammsvík, Hvalfjörður	64°21,64-21°33,53
	Hvassahraun	64°01,205-22°09,526
	Straumur,Straumsvík	64°02,541-22°02,700
	Mjóifjörður I,(head)	65°11,28-14°00,48
	Mjóifjörður II,Hofsá	65°12,156-13°47,733
	Mjóifjörður III,Dalatangi	65°16,101-13°34,564
	Úlfsá, Skutulsfj.	66°03,36-23°10,02
	Dvergasteinn, Álftafjordur	66°00,00-23°02,10
cod	Cod N-NW	67°02,55-23°29,93
	Cod NE	67°01,77-15°44,86

Figure 1. Locations for sampling of blue mussel (Mytilus edulis) 2009 and cod (Gadus morhua) 2010.

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 and frozen until analysis was performed.

30-45 cm long cod was selected, each sample containing 25 ± 5 individuals. 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 and frozen until analyses were performed. 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 Matís, as well as analysis of the supporting parameters, dry matter and fat. The following Persistent Organic Pollutants (POP) were analysed at the Department of Pharmacology and Toxicology at the University of Iceland: 11 PCBs, HCB, α-HCH, β-HCH and γ-HCH, p,p'-DDT o,p'-DDT, p,p'-DDE and p,p'-DDD, transnonachlor, α-chlordan, γ-chlordan, oxychlordan, Tox-26, Tox-50, Tox-62,

PBDE-47, PBDE-99, and PBDE-100. Table 1 presents the samples and all the parameters measured in each sample.

Table 1. Parameters measured in different samples.

Species	Number of samples	Number of individuals	Type of sample	Number of group	Inorganic contaminants	Organic contaminants	Other
Mussel, 2009 (*Mytilus edulis*)	11	50			Cu, Zn, As, Se, Cd, Hg, Pb	*	Dry matter and fat
Cod, 2010 (*Gadus morhua*)	2	25	Flesh	1	Hg		Dry matter and fat
			Liver	6	Cu, Zn, As, Se, Cd, Pb	*	Dry matter and fat
Labels: Cod-N-NW(2) Cod-NE							

* PCB # 28, 31, 52, 101, 105, 118, 138, 153, 156, 170, 180, α-, β-, γ-HCH, HCB, p,p'-DDT, o,p'-DDT, p,p'-DDE, p,p'-DDD, *trans*-nonachlor, α-, γ-Chlordan, Oxychlordan, Toxaphene-26, -50, -62, BDE # 47, 99 and 100.

Only three liver groups from each cod sample were analyzed to optimize the project resources compared to 5-6 liver groups in the previous year.

3.2 Methods

Inorganic contaminants (Cd, Cu, Zn, As, Se, Hg, Pb) in the samples were determined by ICP-MS after mineralization of the samples with closed vessel acid digestion. Portions (up to 200 mg weighed to 0.1 mg) of freeze dried samples (cod liver was used wet) together with 3 ml HNO_3 and 1.5 ml H_2O_2 were transferred to 50 ml digestion bombs. Samples were digested in a Mars5 microwave oven (CEM, North Carolina, USA), according to method SV-25-02-SN in Matis Quality manual. The digested sample solutions were quantitatively transferred to 50 ml polypropylene tubes and diluted to 30 ml with Milli-Q water. The concentration of the different elements (Cd, Cu, Zn, As, Se, Hg, Pb) in these digests was determined by ICP-MS (Agilent 7500ce, Waldbronn, Germany). ^{115}In was used as internal standard. The organochlorine compounds were analysed by GC-ECD using HP5890 Series II with an automatic injector (HP7673). A detailed description of the analyses of organic compounds and supporting parameters (dry matter and fat) has been given in a previous report (7) and is presented in details in method SV-22-02-SN-1 in Matis Quality manual.

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. Results for analysis of reference materials 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 Matís has participated in QUASIMEME annually with satisfactory results. Also, Matís participated in SLV test with satisfactory results. The limit of detection (LOD) was calculated as follows: 20 digested blank samples were run and standard deviation (S.D.) calculated. LOD represents 3 x S.D. in blank samples.

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 2009 and 2010, due to budget constrains these results have not been statistically evaluated using present and previous data from the annual monitoring of the biosphere around Iceland in order to evaluate time trend or spatial difference. Compared to previous years some changes in the contaminant concentration patterns were observed in blue mussels collected near the whale processing plant in Hvalfjordur, for details see Figure 5a in Appendix VII, site Hvalstod, Hvalfjordur which is approximately 400m south-west of the processing plant. The results show that the concentration of persistent organochlorine compounds in blue mussels are now highest at the site Hvalstod in Hvalfjordur, this site has until now not been notably different from other sample sites in terms of POP concentrations, while year 2009 an increase was observed for ∑3PCB, p,p´-DDE, HCB and trans-nonachlor in blue mussels from this site (Table 9a in Appendix V and Figure 5a in Appendix VII). Furthermore, the ratio PCB153/DDE has decreased from 2,8 (year 2008) to 0,4 (year 2009). This ratio has typically been 2-4 in blue mussels at other sample sites around Iceland. This decrease in the PCB153/DDE ratio indicates that there is a new source of pollution at the site Hvalstod in Hvalfjordur. The reason for the new source pollution has not been studied, but a possible cause is that during the summer 2009 the whale processing plant in Hvalfjordur started processing fin whales (*Balaenoptera physalus*) again after a 20 year long break in its operation. No noteworthy increase in POP concentrations was observed year 2009 in blue mussels obtained from another annual sampling site in Hvalfjordur i.e. Hvítanes/Hvammsvík (Figure 5a) nor any of the other sample locations studied (Figures 5a and 5b). These results need to be followed up in the annual monitoring of the biosphere around Iceland next year to see if this change in contaminant concentration pattern continues. 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 need to be assessed with statistical models. This work has now started as a Ph.D. project thanks to a project grant from the Icelandic Research Fund obtained January 2011.

4.1 Biological variations

Figures 2a-d in appendix VI shows the biological variation in cod *(Gadus morhua)* 1990-2010, (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 (2009) and cod (2010) are presented in Tables 7 and 8 in appendix IV. New data is presented along with data from previous years (1, 4-14) in figures 3a-f 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 19-20 years. It should be noted that results for cod are presented on wet weight basis, while the result for mussel are presented on dry weight basis.

4.2.1 Blue mussel

Year 2009 no blue mussel sample was obtained from Eyri in Hvalfjordur as the mussels at this site were all too small < 4 cm. The annual sampling site for the blue mussel sample taken at Hvítanes in Hvalfjordur (64°21,85-21°29,8) is no longer accessible (private property) and thus had to be moved slightly and is now at Hvammsvík (64°21,64-21°33,53). The name of this sampling station has though not been changed in the figures in appendix VII that illustrate the results obtained for trace metals and organic compounds in blue mussels at the various sample sites around Iceland over the past 21 years.

Figures 3a-f in appendix VII show the average concentration of heavy metals in blue mussel 1990-2009, on 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, 1990-2009. Metal concentrations vary considerably between years and different locations. This year the concentration of cadmium is higher in Grímsey and Dvergasteinn compared to other locations. According to the existing monitoring data (1999-2008) the concentration of arsenic is noticeably higher at Úlfsá, Skutulsfjörður than at any of the other sample locations for blue mussel. The results show low values for mercury in blue mussel when compared with ICES90 75% baseline values. The copper concentrations are generally low in blue mussel, while the zink concentrations are close to the ICES90 75% value. The cadmium levels are high in blue mussels 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 1990-2010. Figures 7a-f in appendix VIII show average concentrations (ww), of heavy metals in cod from different sampling sites, 1990-2010. Mercury is measured in

the flesh as well. Lead concentration was below the limits of detection in all samples. Variations in concentration between years and locations over the time interval is shown in Figures 6a-b and 7a-f in Appendix VIII. 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 coastal 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 (2009) and cod (2010) 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 17-19 year period.

4.3.1 Blue mussel

Figures 5a-b in appendix VII show the concentration on dry-weight basis of organic compounds in blue mussel from different locations in Iceland 1991-2008. The PCB congeners included in the Σ3PCBs are CB-118, CB-138 and CB-153 where the sum ranges from 50-80% of the sum of 11 PCB analysed. The most common organochlorines found in blue mussel are PCBs. As mentioned in results (i.e. section IV above) changes were observed in the organochlorine concentration patterns in blue mussels collected September 2009 at the sampling site Hvalstod in Hvalfjordur, for details see Figure 5a in Appendix VII and discussions in section Results IV. 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, concentrations of HCH, HCB and DDE are low, close to the limit of detection.

4.3.2 Cod

Figure 8 in appendix VIII shows the average concentration on wet-weight basis of organic compounds in livers of 30-45 cm cod, caught in Icelandic waters in March every year between 1991 and 2010. Figures 9a-e in appendix VIII show the average concentrations (w.w.) of some organic compounds in cod from different sampling sites, 1991-2008. The sum of seven PCBs (CB-28, CB-52, CB-101, CB-118, CB-138, CB-153 and CB-180) is 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 2009 and 2010. 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**.**

This data has not been statistically evaluated using present and previous results in order to evaluate time trend or spatial difference. However, there are apparently no obvious changes in contaminant concentrations pattern seen in previous years. **A full statistical analysis of all data is needed to confirm changes if any.** This was done in 1998 (6) but additional data collected over the last 12 years calls for a new methodical statistical evaluation of the existing Icelandic monitoring data, this work has now started as a Ph.D. project thanks to a project grant from the Icelandic Research Fund obtained January 2011. In addition, when comparing data of livers it is necessary to keep in mind the factors (i.e. fat, age, d.w.) 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

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Appendix I.

Biological measurements of Blue mussel (*Mytilus edulis*)

2009

Species:	**Blue mussel (*Mytilus edulis*)**	Date of sampling:	**07.09.2009**
Length:	4-6 cm	Sampled by:	Marine Inst.
Location:	**Ulfsa**	Date of preparation:	16.09.2010
Coordinates:	660336 231002	IFL#:	R10-1593-6

	Length (mm)	Width (mm)	Height (mm)	Total weight (g)	Weight soft body (g)	Weight shell (g)
1	48,1	22,3	20,7	12,71	6,36	6,03
2	50,1	26,5	21,2	14,58	7,91	6,30
3	46,0	21,5	24,1	15,21	6,79	8,20
4	47,9	21,7	19,7	11,46	5,94	5,29
5	51,5	23,1	23,9	18,16	7,61	10,30
6	50,9	24,5	23,0	14,15	7,26	6,31
7	50,4	23,8	21,8	15,37	7,29	7,87
8	52,2	22,7	23,1	17,75	7,57	10,06
9	53,7	25,5	24,8	20,04	10,40	9,35
10	63,0	27,4	27,2	27,73	13,54	13,83
11	47,6	23,0	19,9	12,48	6,51	5,92
12	47,6	26,1	16,3	10,80	5,63	4,82
13	49,1	24,1	21,2	10,18	3,64	6,40
14	49,5	24,6	19,8	14,14	6,89	6,85
15	47,5	24,8	19,7	10,27	6,00	4,01
16	55,9	24,1	22,5	16,63	9,11	7,31
17	54,0	23,2	21,3	15,92	7,19	7,71
18	59,0	25,5	27,2	25,18	11,92	12,83
19	42,8	21,1	16,6	8,37	4,33	3,88
20	43,9	21,7	17,2	9,39	5,02	4,25
21	46,1	22,3	22,2	13,27	6,31	6,87
22	44,4	21,1	17,2	10,01	5,22	4,70
23	52,2	23,9	22,8	17,93	8,28	9,29
24	52,3	23,3	21,1	15,27	7,63	7,31
25	54,4	26,1	23,4	19,41	9,84	9,14
26	50,0	22,2	20,6	13,27	6,77	6,40
27	50,6	25,0	23,9	18,91	9,57	8,96
28	52,3	23,9	20,0	15,57	8,16	7,24
29	58,3	25,5	28,9	26,12	11,67	13,97
30	59,9	26,6	28,3	27,52	14,90	12,32
31	47,7	23,7	19,5	11,96	5,72	6,13
32	45,9	20,3	19,0	10,29	5,36	4,74
33	46,3	22,9	18,3	10,68	5,33	5,06
34	48,2	22,6	21,9	14,07	7,21	6,7
35	47,8	25,4	18,6	11,31	6,37	4,79
36	51,0	23,9	23,3	18,53	8,44	9,71
37	53,3	24,5	22,7	16,76	9,06	7,59
38	56,6	27,0	22,2	16,80	9,76	6,89
39	54,5	25,2	23,9	19,24	9,54	9,54
40	57,5	27,1	22,5	19,99	9,87	9,94
41	41,6	22,2	17,1	7,51	4,37	3,06
42	43,9	21,7	19,3	9,83	5,26	4,42
43	43,5	19,0	18,8	10,59	4,53	5,78
44	49,4	23,6	19,8	13,62	7,21	6,27
45	47,9	23,0	17,2	9,87	5,69	4,11
46	53,5	23,5	23,3	17,89	9,20	8,53
47	50,6	26,4	21,7	16,40	8,70	7,46
48	50,8	24,8	21,7	13,95	7,55	6,27
49	51,5	22,0	22,1	14,51	7,79	7,52
50	53,4	25,3	20,5	17,15	8,32	8,60
	Length	**Width**	**Height**	**Total weight**	**Weight soft body**	**Weight shell**
Average	50,52	23,82	21,46	15,18	7,61	7,34
Stdev	4,62	1,89	2,89	4,75	2,32	2,53
Min	41,60	19,00	16,30	7,51	3,64	3,06
Max	63,00	27,40	28,90	27,73	14,90	13,97

Species:	**Blue mussel (*Mytilus edulis*)**	Date of sampling:	**1.9.2009**
Length:	4-6 cm	Sampled by:	Marine Inst.
Location:	**Hvassahraun**	Date of preparation:	8.9.2010
Coordinates:	6401205 2209526	Matis#:	R10-1593-1

	Length (mm)	Width (mm)	Height (mm)	Total weight (g)	Weight soft body (g)	Weight shell (g)
1	42,9	22,6	18,0	9,18	5,31	3,76
2	45,3	22,5	19,4	10,11	5,97	4,04
3	49,6	25,3	21,6	14,05	7,72	6,12
4	49,1	26,9	19,9	13,82	7,75	5,87
5	48,3	24,6	20,3	13,20	7,53	5,59
6	50,0	26,3	22,5	15,49	8,62	6,30
7	48,2	25,7	20,0	13,18	7,09	5,88
8	48,0	27,4	19,7	13,51	7,23	5,96
9	56,4	25,0	21,6	16,31	9,16	6,86
10	48,9	28,1	20,2	14,38	8,58	5,42
11	42,8	23,2	18,5	9,86	5,59	4,41
12	47,3	20,3	20,0	10,88	6,10	4,46
13	43,2	20,4	19,6	9,51	4,61	4,75
14	46,6	25,1	20,3	11,65	6,40	4,67
15	47,7	25,3	22,0	14,60	8,42	5,97
16	52,2	23,2	22,5	13,88	6,54	7,16
17	52,2	25,8	24,8	18,49	10,70	7,64
18	54,5	25,0	23,6	18,11	10,51	7,46
19	53,5	26,8	22,7	15,10	7,82	7,08
20	53,8	27,0	23,9	19,47	10,80	8,49
21	47,2	23,9	17,7	12,30	6,27	5,99
22	52,6	30,9	21,6	18,47	9,75	8,57
23	48,8	25,0	20,6	13,16	7,61	5,48
24	46,1	23,9	20,4	12,28	7,23	4,96
25	45,6	25,6	17,8	12,01	6,40	5,55
26	50,0	25,0	19,9	12,05	6,91	6,00
27	50,1	27,8	12,2	14,15	8,13	5,90
28	48,0	22,3	22,3	15,96	9,35	5,53
29	48,3	24,5	20,5	12,37	6,85	5,40
30	50,4	26,7	21,6	16,95	9,75	7,18
31	42,5	23,1	19,1	9,14	4,91	4,01
32	43,6	25,3	20,0	12,13	6,43	5,51
33	45,3	23,3	20,2	11,93	6,47	5,15
34	45,7	23,6	21,3	13,85	7,36	6,31
35	43,6	21,9	19,3	9,55	5,05	4,17
36	45,9	24,0	19,5	12,24	6,39	5,35
37	45,8	25,1	18,7	11,01	6,16	4,60
38	48,5	24,7	21,1	14,04	8,02	5,92
39	49,4	24,3	21,9	15,45	8,14	7,13
40	52,0	25,4	22,0	15,55	8,63	6,78
41	43,3	27,2	18,3	10,41	5,63	4,61
42	42,7	24,4	17,7	12,05	6,32	5,60
43	49,9	27,8	20,4	14,20	8,13	5,71
44	49,9	24,4	21,1	14,54	9,25	4,90
45	52,2	26,2	22,7	12,74	5,60	7,03
46	43,4	24,4	16,1	10,28	5,93	4,35
47	44,5	22,2	20,9	11,21	5,43	5,63
48	46,7	23,3	19,9	12,97	6,28	5,75
49	46,1	22,8	20,4	11,92	6,22	5,63
50	42,8	26,1	18,3	13,28	7,18	6,03
	Length	**Width**	**Height**	**Total weight**	**Weight soft body**	**Weight shell**
Average	47,83	24,83	20,29	13,26	7,28	5,77
Stdev	3,50	2,01	2,09	2,49	1,54	1,10
Min	42,50	20,30	12,20	9,14	4,61	3,76
Max	56,40	30,90	24,80	19,47	10,80	8,57

Species:	**Blue mussel (*Mytilus edulis*)**	Date of sampling:	**1.9.2009**
Length:	4-6 cm	Sampled by:	Marine Inst.
Location:	**Straumur, Straumsvík**	Date of preparation:	1.9.2010
Coordinates:	6402541 2202700	Matis#:	R10-1593-2

	Length (mm)	Width (mm)	Height (mm)	Total weight (g)	Weight soft body (g)	Weight shell (g)
1	50,1	21,5	23,7	14,74	7,97	6,63
2	55,6	25,0	19,9	15,21	7,63	7,45
3	53,1	25,9	20,4	15,21	8,19	6,80
4	50,8	21,9	20,5	13,17	7,48	5,56
5	55,6	25,4	27,0	21,75	10,97	10,60
6	52,3	23,8	21,2	15,27	7,70	7,47
7	55,9	24,5	22,7	19,66	9,28	10,18
8	60,4	27,6	25,6	23,65	13,93	9,43
9	60,8	26,7	28,2	27,50	13,92	13,37
10	63,7	31,4	27,6	30,99	15,50	14,92
11	49,9	24,0	20,9	13,72	7,67	5,80
12	53,4	24,0	23,2	17,71	9,22	8,26
13	51,5	21,8	20,5	13,55	7,39	6,06
14	56,2	23,7	23,5	17,58	9,93	7,51
15	63,4	27,6	23,3	16,90	9,04	7,70
16	51,8	24,6	20,9	13,47	8,01	5,07
17	55,5	24,2	24,3	17,38	10,59	6,47
18	56,1	24,9	22,5	15,81	7,09	8,60
19	54,9	24,2	22,5	16,20	8,70	7,25
20	61,6	25,1	29,3	25,99	14,52	11,19
21	51,1	20,9	23,4	15,55	7,82	7,51
22	53,3	21,7	25,4	17,29	8,55	8,51
23	58,3	24,3	22,9	18,16	9,31	8,68
24	59,2	23,8	23,0	15,74	7,56	7,95
25	59,5	26,0	25,4	22,45	13,97	8,22
26	61,1	25,0	25,6	21,87	12,94	8,77
27	59,8	26,3	24,4	19,86	11,11	8,49
28	62,6	25,8	24,1	22,79	12,77	9,71
29	59,5	25,8	25,7	22,26	11,48	10,70
30	64,0	28,5	27,0	22,25	10,90	11,12
31	43,2	21,8	18,4	8,40	4,57	3,62
32	43,3	19,5	17,2	7,79	3,77	3,8
33	47,0	21,0	18,3	8,95	5,36	3,46
34	52,4	21,7	21,8	12,16	5,36	6,61
35	50,6	18,5	22,5	13,20	6,46	6,44
36	47,5	23,7	18,8	11,00	5,36	5,37
37	51,0	25,3	22,4	16,47	7,74	8,54
38	52,9	25,9	19,8	14,09	7,72	6,02
39	53,0	25,0	22,4	15,34	8,46	6,62
40	64,5	28,2	30,2	27,73	17,25	10,25
41	43,0	22,2	16,9	7,51	4,12	3,23
42	44,1	18,7	18,5	8,77	4,37	3,78
43	43,9	22,8	17,3	8,49	4,82	3,60
44	41,3	22,5	17,8	7,88	4,32	3,36
45	44,4	25,0	17,3	8,91	5,59	3,06
46	46,0	21,2	19,2	11,23	6,37	4,73
47	41,6	19,3	17,5	8,34	4,59	3,48
48	46,5	19,1	18,6	10,19	5,91	4,13
49	45,6	23,4	19,3	8,95	4,46	4,30
50	52,7	22,3	22,0	15,13	7,67	7,35
	Length	**Width**	**Height**	**Total weight**	**Weight soft body**	**Weight shell**
Average	53,11	23,86	22,22	15,88	8,51	7,15
Stdev	6,57	2,68	3,37	5,80	3,27	2,72
Min	41,30	18,50	16,90	7,51	3,77	3,06
Max	64,50	31,40	30,20	30,99	17,25	14,92

Species:	**Blue mussel (*Mytilus edulis*)**	Date of sampling:	**7.9.2009**
Length:	4-6 cm	Sampled by:	Marine Inst.
Location:	**Mjoifjordur I (head)botn**	Date of preparation:	10.9.2010
Coordinates:	651128 140048	Matis#:	R10-1593-10

	Length (mm)	Width (mm)	Height (mm)	Total weight (g)	Weight soft body (g)	Weight shell (g)
1	46,4	19,9	18,5	9,33	6,00	3,22
2	48,3	21,9	21,4	13,58	5,81	6,94
3	46,0	23,5	18,9	11,30	5,30	5,65
4	59,5	22,7	18,5	11,45	6,48	4,68
5	51,4	23,9	20,7	14,29	7,46	6,60
6	53,0	25,8	23,1	18,64	9,65	8,78
7	54,7	24,4	23,0	16,91	9,70	6,93
8	59,1	26,6	21,2	19,13	10,28	8,62
9	55,1	24,8	26,3	22,46	12,21	9,74
10	57,0	25,7	22,1	18,64	10,90	7,57
11	45,1	23,7	18,9	10,45	5,40	4,92
12	45,8	25,2	20,4	12,06	6,59	5,38
13	48,8	24,2	21,4	13,33	7,58	5,61
14	49,0	27,3	21,3	11,83	5,51	6,19
15	52,6	25,1	20,0	13,90	7,40	6,29
16	51,7	24,2	20,4	13,41	7,54	5,70
17	55,1	25,5	21,6	16,72	9,42	7,16
18	57,2	26,5	23,0	20,02	10,61	9,14
19	55,0	27,5	23,4	16,73	10,65	5,94
20	58,0	27,5	23,1	18,65	12,04	6,53
21	46,2	23,0	20,9	11,36	6,21	4,98
22	45,0	24,0	19,5	10,36	6,71	3,60
23	49,1	24,3	19,1	11,34	6,00	5,07
24	54,2	25,2	23,1	17,30	9,55	7,65
25	53,8	24,1	23,8	16,07	9,92	6,06
26	55,7	24,6	23,4	16,96	8,47	8,26
27	57,1	26,3	22,9	18,21	9,59	8,39
28	56,4	25,6	25,4	21,35	10,77	10,55
29	60,0	28,8	24,2	21,75	11,93	9,50
30	55,8	27,0	25,9	20,08	11,89	8,11
31	39,8	19,5	15,8	6,36	3,62	2,55
32	39,7	21,0	17,8	7,55	4,05	3,67
33	43,6	21,7	16,2	8,47	4,81	3,62
34	43,2	19,9	17,6	8,52	4,91	3,6
35	42,1	19,8	19,5	9,31	4,55	4,65
36	41,2	19,0	18,1	9,06	4,39	4,52
37	44,0	21,9	19,5	9,71	5,41	4,22
38	45,4	22,5	22,8	13,38	7,40	5,81
39	49,1	24,5	20,0	13,18	7,17	5,85
40	41,5	24,1	21,5	14,39	7,98	6,30
41	43,4	21,9	22,2	8,96	4,84	3,90
42	43,5	22,2	18,5	7,01	3,16	3,70
43	43,6	21,7	18,3	9,46	4,91	4,32
44	47,1	21,0	18,5	10,68	5,29	5,32
45	47,8	21,6	18,4	9,34	5,68	3,61
46	52,0	23,1	19,0	11,41	6,42	4,87
47	45,1	20,6	22,7	11,06	4,77	6,09
48	50,1	23,6	21,4	12,86	6,89	5,89
49	53,3	27,0	21,1	15,53	8,66	6,73
50	56,0	26,6	24,9	19,90	11,70	8,11
	Length	**Width**	**Height**	**Total weight**	**Weight soft body**	**Weight shell**
Average	49,87	23,84	20,98	13,68	7,48	6,02
Stdev	5,79	2,40	2,46	4,29	2,54	1,89
Min	39,70	19,00	15,80	6,36	3,16	2,55
Max	60,00	28,80	26,30	22,46	12,21	10,55

Species:	**Blue mussel (*Mytilus edulis*)**	Date of sampling:	**07.09.2009**
Length:	4-6 cm	Sampled by:	Marine Inst.
Location:	**Hofsá**	Date of preparation:	13.09.2010
Coordinates:	6512156 1347733	IFL#:	R10-1593-9

	Length (mm)	Width (mm)	Height (mm)	Total weight (g)	Weight soft body (g)	Weight shell (g)
1	42,7	21,1	15,6	6,07	2,76	3,21
2	41,2	20,0	16,1	8,37	4,31	3,93
3	42,2	20,0	15,0	7,03	3,31	3,66
4	43,9	22,2	17,2	9,51	5,27	3,96
5	45,0	20,6	15,6	8,68	4,67	3,86
6	49,9	21,2	15,6	9,79	5,45	4,20
7	48,9	22,7	19,9	11,29	6,74	4,45
8	53,9	23,9	20,6	16,33	7,59	9,60
9	56,7	27,8	22,2	19,26	10,86	8,44
10	58,3	25,0	21,2	18,61	9,67	8,79
11	46,1	20,0	15,5	8,34	4,47	3,79
12	43,9	20,0	15,6	8,41	4,41	3,80
13	42,8	17,7	14,5	5,89	3,04	2,77
14	40,1	19,9	16,1	6,63	3,08	3,48
15	41,7	21,1	16,2	9,97	4,88	5,05
16	42,7	18,3	16,o	8,56	4,02	4,48
17	41,7	21,6	15,6	9,26	4,42	4,79
18	45,6	22,2	17,2	11,28	5,34	5,87
19	50,5	22,3	17,8	11,85	5,40	6,43
20	50,4	21,7	17,8	10,60	6,04	4,49
21	41,6	20,0	15,6	8,15	4,35	3,75
22	43,3	20,0	16,6	9,15	4,76	4,23
23	42,8	20,0	17,8	9,27	4,56	4,66
24	45,0	20,6	17,8	10,56	5,36	5,14
25	43,9	22,2	19,9	10,19	4,21	5,85
26	42,2	19,9	13,8	6,87	4,08	2,72
27	42,2	20,0	15,0	8,24	4,42	3,78
28	40,6	19,4	14,4	6,60	3,33	3,16
29	48,3	21,7	15,6	9,45	4,68	4,67
30	51,7	25,0	21,1	15,77	8,39	7,22
31	41,7	20,5	16,7	8,81	4,42	4,41
32	42,2	20,0	17,8	8,73	4,33	4,38
33	45,6	20,0	17,8	11,67	5,34	5,99
34	43,3	21,1	17,8	10,50	4,93	5,54
35	42,2	18,9	15,0	7,82	4,10	3,69
36	39,4	20,5	17,2	9,89	4,17	5,63
37	48,3	21,6	21,7	14,58	7,40	7,10
38	43,3	18,9	15,6	8,05	3,67	4,36
39	40,6	21,1	17,8	10,32	4,62	5,66
40	39,9	17,2	15,0	7,78	3,51	4,21
41	42,3	18,9	15,6	7,86	4,26	3,55
42	39,5	19,8	14,5	6,13	3,38	2,71
43	42,8	20,0	17,3	8,71	4,03	4,50
44	42,8	20,0	18,9	10,04	5,08	4,88
45	43,3	20,0	13,9	8,15	4,60	3,52
46	45,5	20,0	20,0	10,56	5,28	5,17
47	45,0	18,3	16,2	9,31	4,68	4,66
48	46,7	20,5	18,3	12,66	5,49	7,11
49	45,0	23,3	20,6	13,89	6,94	6,91
50	51,6	25,5	20,6	15,70	8,42	6,92
	Length	**Width**	**Height**	**Total weight**	**Weight soft body**	**Weight shell**
Average	44,82	20,88	17,17	10,02	5,05	4,90
Stdev	4,30	2,00	2,22	3,05	1,66	1,56
Min	39,40	17,20	13,80	5,89	2,76	2,71
Max	58,30	27,80	22,20	19,26	10,86	9,60

Species:	**Blue mussel (*Mytilus edulis*)**	Date of sampling:	**07.09.2009**
Length:	4-6 cm	Sampled by:	Marine Inst.
Location:	**Dalatangi**	Date of preparation	13.09.2010
Coordinates:	6516101 1334564	IFL#:	R10-1593-8

	Length (mm)	Width (mm)	Height (mm)	Total weight (g)	Weight soft body (g)	Weight shell (g)
1	42,3	19,9	18,8	8,85	4,25	4,45
2	41,9	18,4	17,8	9,26	3,87	5,18
3	41,2	21,3	19,2	11,44	4,46	6,59
4	43,5	19	19	11,69	4,16	7,41
5	47,2	21,3	17,3	10,26	5,14	5,04
6	43,5	21,1	17,8	9,96	4,86	4,82
7	43,5	18,3	17,8	8,52	4,11	4,22
8	49,2	23	19,5	13,33	6,23	7,01
9	46,2	22,5	20,2	12,73	5,49	6,9
10	54,6	25,6	21,3	17,6	8,23	9,17
11	42,3	21,2	16,7	8,3	5,98	4,11
12	40,9	19,5	17,2	7,94	3,9	3,95
13	41,3	21,8	15,9	8,83	4,18	4,47
14	44	18,8	17,7	7,94	3,7	3,96
15	45	21,8	16,1	7,94	3,49	4,2
16	42,9	21,6	18	9,47	5,38	4,07
17	45,90	21,7	19,8	10,76	5,75	4,9
18	47,9	22,5	19,1	9,18	4,16	4,83
19	47,2	22,2	17,5	9,59	3,58	5,69
20	46	23,8	22,4	13,83	6,73	6,76
21	41,6	20,5	16,1	8,36	4,4	3,81
22	40,5	20	14,9	6,81	3,56	3,07
23	39,5	18,8	15,1	7,73	4,11	3,54
24	44,4	20,5	17,8	9,8	4,78	4,76
25	46,1	21,6	15,1	6,87	1,77	5,03
26	40,6	17,8	17,8	8,86	3,77	4,91
27	41,6	21,7	17,8	10,08	5,1	5
28	43,9	22,8	20	9,89	3,61	6,26
29	50,6	24,5	20	15,46	7,07	8,27
30	50	25	21,7	13,16	5,97	7,14
31	39,9	17,8	15,5	6,08	2,23	3,78
32	41,7	18,3	16,7	6,32	2,21	4,05
33	42,8	20,5	16,7	8,69	3,38	5,18
34	40	21,1	16,6	8,55	4	4,5
35	45	19,9	15,6	9,03	4,4	4,56
36	40	20,6	16,6	8,3	3,05	5,14
37	45	20,5	17,8	9,92	5,18	4,68
38	47,2	22,8	17,8	9,12	4,48	4,5
39	46,7	19,4	19,4	13,13	5,95	7,01
40	50,5	24,4	19,4	13,13	7,63	5,38
41	40,5	17,2	14,5	6,78	3,88	2,75
42	43,3	19,4	17,2	9,25	4,44	4,86
43	42,7	19,5	16,7	9,36	4,05	5,08
44	42,7	20	14,5	6,87	3,5	3,21
45	43,8	20,2	14,5	8,56	4	4,37
46	43,9	21,6	17,8	10,31	5,03	5,21
47	42,2	19,4	16,7	8,26	3,78	4,45
48	44,4	21,1	18,3	10,25	5,14	4,95
49	42,2	21,1	17,2	9,72	5,38	4,4
50	45	24,4	19,5	11,69	6,08	5,43
	Length	**Width**	**Height**	**Total weight**	**Weight soft body**	**Weight shell**
Average	44,10	20,95	17,69	9,76	4,59	5,06
Stdev	3,21	1,96	1,86	2,35	1,30	1,31
Min	39,50	17,20	14,50	6,08	1,77	2,75
Max	54,60	25,60	22,40	17,60	8,23	9,17

Species:	**Blue mussel (*Mytilus edulis*)**	Date of sampling:	**3.9.2009**
Length:	4-6 cm	Sampled by:	Marine Inst.
Location:	**Hvalstod, Hvalfjordur**	Date of preparation:	9.9.2010
Coordinates:	6423826 2127210	Matis#:	R10-1593-4

	Length (mm)	Width (mm)	Height (mm)	Total weight (g)	Weight soft body (g)	Weight shell (g)
1	43,4	21,2	18,8	10	5,08	4,59
2	42,2	20,8	18,2	8,63	4,71	3,79
3	48,3	25	20,3	13,17	6,06	6,69
4	45	23,2	19,7	11,07	5,29	5,32
5	47	27,4	25,6	13,43	6,14	6,02
6	45,6	23,7	19,6	10,92	6,12	4,67
7	47	24,3	19,6	11,36	6,09	5,04
8	52,6	26,2	20,5	15,33	8,33	6,89
9	57,1	24,9	23,9	20,9	10,38	10,38
10	60,1	27,7	26,8	24,4	12,77	11,46
11	41,7	21,7	17,2	8,35	4,67	3,55
12	45	21,6	19,9	9,88	5,62	4,18
13	40,6	21,1	16,6	8,44	3,94	4,29
14	42,2	22,2	17,8	10,46	5,66	4,53
15	42,8	21,1	20,4	10,25	5,35	4,6
16	45,6	21,1	20	11,29	6,04	5,23
17	49,90	24,9	20	14,88	7,35	7,25
18	49,9	21,6	18,9	12	6,09	5,8
19	55,6	27,2	22,8	19,83	10,56	9,11
20	62,8	28,9	27,2	23,7	9,69	13,94
21	41,7	21,6	16,7	8,33	4,28	3,99
22	42,7	20	17,2	8,37	4,16	4,11
23	45,6	24	20	11,33	5,99	5,23
24	41,7	22,8	16,7	9,59	5,06	4,43
25	46,7	23,9	19,9	11,03	5,98	4,73
26	43,9	21,7	17,2	9,32	5,19	4,18
27	45	22,8	21,2	11,69	4,93	6,47
28	44	23,3	18,3	10,48	5,29	5,05
29	41,7	20,6	17,2	9,47	4,72	4,7
30	46,7	22,8	21,7	12,34	6,8	5,23
31	43,8	23	17,3	8,37	4,95	3,18
32	43	23,6	17	9,06	4,53	4,36
33	45,9	23,3	18,9	10,1	5,54	4,4
34	46,3	23,4	19	10,83	5,83	4,81
35	46,4	23,4	18,8	9,66	5,65	3,71
36	43,6	21,3	21,8	10,88	5,76	4,68
37	43,3	24,2	17,9	9,4	5,12	4,12
38	46,5	23,6	20,4	11,33	6,36	4,91
39	47,4	25,2	19,4	11,65	6,35	5,23
40	59,7	26,7	24	20,89	10,77	9,97
41	42,4	22,1	16,2	6,66	2,75	4,04
42	45,5	23,5	17,8	9,84	5,34	4,3
43	44,4	22,2	17,6	9,81	4,62	4,99
44	49,8	23,7	22,5	14,01	7,18	6,58
45	47,4	22,6	23	12,67	6,77	5,65
46	44	23,3	20,1	10,31	5,61	4,59
47	51,4	25,3	21	14,69	8,09	6,31
48	46,6	23,8	19,7	12,34	4,9	6,14
49	43,5	23,6	21,7	12,49	6,06	6,26
50	51,5	24,3	22,2	14,56	8,04	6,11
	Length	**Width**	**Height**	**Total weight**	**Weight soft body**	**Weight shell**
Average	46,73	23,43	19,92	12,00	6,17	5,60
Stdev	5,04	1,96	2,59	3,88	1,91	2,10
Min	40,60	20,00	16,20	6,66	2,75	3,18
Max	62,80	28,90	27,20	24,40	12,77	13,94

Species:	**Blue mussel (*Mytilus edulis*)**	Date of sampling:	**2.9.2009**
Length:	4-6 cm	Sampled by:	Marine Inst.
Location:	**Dvergasteinn, Álftafjörður**	Date of preparation	31.8.2010
Coordinates:	660000 230210	Matis#:	R10-1593-5

	Length (mm)	Width (mm)	Height (mm)	Total weight (g)	Weight soft body (g)	Weight shell (g)
1	41,4	22,9	17,7	8,41	4,16	3,88
2	50,4	24,1	18,1	7,15	3,51	3,18
3	51,5	24,6	19,2	11,15	6,23	4,48
4	49	25,8	20,5	9,92	2,91	6,85
5	47,9	24,8	20	11,75	6,74	4,94
6	44,2	22,2	21,2	7,58	3,75	3,31
7	47,2	21,8	18,5	10,24	5,79	4,19
8	51,2	22,9	20,2	12,49	6,27	5,73
9	47,4	22,8	17,9	11,03	6,02	4,87
10	53,8	24,4	24,2	16,22	8,9	7,08
11	44,2	21,1	17	7,56	4,43	2,97
12	43,9	20	18,4	8,36	4,87	3,27
13	47,5	24,9	21,1	11,6	6,9	4,38
14	43,2	22,6	15,7	6,76	3,77	2,73
15	51,6	26,3	21,8	13,69	8	5,2
16	48,2	22,6	18	10,77	5,98	4,5
17	47,40	22,7	17,3	9,47	4,88	4,18
18	50,4	20,2	18,1	10,79	5,89	4,44
19	52,3	24,3	23,1	15,58	7,97	7,22
20	51,9	23,7	13,2	13,03	6,85	5,15
21	40,2	17,5	12,1	6,62	3,87	2,62
22	43,5	21,3	15,8	7,29	4,5	2,63
23	44,9	20,9	16,8	8,58	5,03	3,41
24	43,9	21,3	16,9	8,27	4,56	3,59
25	42,8	19,8	18,1	8,26	4,71	3,3
26	47	24	19,1	10,17	6,3	3,67
27	49,4	23,2	20,1	12,78	7,31	5,3
28	48,3	23,6	20,2	11,96	6,96	4,83
29	50,3	24,1	20,1	13,41	6,77	6,4
30	50,4	24,2	20	11,2	4,81	5,99
31	43,3	23	16,9	8,37	4,86	3,3
32	45,2	20,5	18,7	9,72	5,35	4,24
33	47,7	23,4	19,3	11,58	6,27	4,86
34	46,7	19,8	19,5	10,63	6,54	4,83
35	47,5	23,4	20	10,99	6,3	4,48
36	48,4	24,2	18,3	10,67	6,28	4,23
37	47,1	22,6	17,9	10,7	5,85	4,26
38	51,3	24,3	18,5	11,88	6,76	4,98
39	50,8	23,8	21,4	13,75	7,44	6
40	53,2	25,2	19,8	9,73	3,54	6,01
41	45,4	24,3	19,7	10,8	6,12	4,46
42	48,6	23,8	19,5	11,67	6,34	4,66
43	46,2	22,6	19,4	10,48	5,85	4,49
44	52,3	26,6	20,6	15,24	8,47	6,4
45	52,1	25,7	19,9	13,65	8,05	5,29
46	49	23,7	18,2	10,99	6,24	4,62
47	46,9	23,3	18,6	10,98	6,01	4,79
48	50,2	26,4	20,1	13,11	7,21	5,65
49	46,4	21,9	20,9	10,36	5,73	4,2
50	51	26,4	20,4	15,19	8,25	6,51
	Length	**Width**	**Height**	**Total weight**	**Weight soft body**	**Weight shell**
Average	47,89	23,19	18,96	10,85	5,92	4,65
Stdev	3,26	1,93	2,13	2,34	1,40	1,16
Min	40,20	17,50	12,10	6,62	2,91	2,62
Max	53,80	26,60	24,20	16,22	8,90	7,22

Species:	**Blue mussel (*Mytilus edulis*)**	Date of sampling:	**2.9.2009**
Length:	4-6 cm	Sampled by:	Marine Inst.
Location:	**Grimsey**	Date of preparation:	21.09.2010
Coordinates:	6633134 1801407	IFL#:	R10-1593-7

	Length (mm)	Width (mm)	Height (mm)	Total weight (g)	Weight soft body (g)	Weight shell (g)
1	49,9	24,9	18,7	14,61	7,4	6,88
2	46,7	25,8	20,5	15,19	7,92	7,02
3	55	23,2	23,2	19,48	8,42	11,03
4	52,1	24,6	24,7	14,76	4,46	10,19
5	50,2	25,8	22,1	17,58	8,82	8,61
6	53,1	23,8	20	13,17	5,28	7,73
7	56,8	24,5	18,7	21,84	10,82	10,7
8	54,4	27,9	24,5	15,64	6,64	8,87
9	57,6	25,8	23,1	20,3	10,7	9,45
10	59	26,5	21,2	19,33	9,8	9,22
11	43,2	20,5	17,4	9,67	4,53	4,99
12	40,5	22	17,7	9,72	4,21	5,31
13	55	25,1	23,5	12,74	2,07	10,57
14	48	23,8	15,3	10,87	3,89	6,82
15	46,9	21,8	20,5	13,63	6,2	7,11
16	47,8	23,6	22,8	13,22	5,11	7,91
17	46,2	22,7	19	11,5	6,24	5,14
18	57,8	28,2	24,6	17,87	7,09	10,61
19	40,8	21,7	19	9,44	4,57	4,74
20	40,5	17,8	16,7	7,94	4,1	3,77
21	39,5	18,9	15	6,14	2,56	3,52
22	41,1	20	15	7,66	3,87	3,66
23	43,9	19,4	17,2	9,01	4,48	4,39
24	47,2	21,7	18,3	11,76	5,12	6,55
25	42,8	20,5	17,8	10,81	3,43	7,16
26	44,4	21,6	16,1	8,41	3,04	5,35
27	45	21,1	20,5	12,23	6,06	6,02
28	53,9	27,2	19,9	15,98	8,18	7,53
29	57,8	24,4	26,1	27,44	11,29	15,92
30	59,4	27,7	24,4	27,11	12,08	14,84
31	41,7	18,9	17,8	10,14	4,42	5,64
32	44,4	21,7	15,6	8,6	3,82	4,68
33	49,9	21,7	17,8	6,4	2,05	4,32
34	39,9	20,5	15,1	7,49	3,44	3,93
35	40,6	19,5	16,7	8,82	4,05	4,67
36	45,6	16,1	18,3	12,97	6,58	6,3
37	46,7	22,2	16,7	10,45	5,46	4,87
38	48,3	20,6	19,4	11,11	5,63	5,41
39	52,8	23,9	22,8	15,46	3,95	11,33
40	52,2	23,9	20,5	14,46	7,17	7,19
41	41,1	20,5	18,9	9,25	4,81	4,33
42	42,2	20	17,2	9,89	4,39	5,36
43	41,7	20	16,1	8,55	4,17	4,24
44	40	19,4	17,8	7,49	2,93	4,48
45	39,9	20	15	7,66	3,39	4,19
46	42,2	19,5	17,2	8,76	3,62	5,03
47	43,9	19,5	20	11,12	2,79	8,09
48	42,8	21,6	20	11,01	3,44	7,46
49	49,9	23,9	17,2	9,04	3,41	5,51
50	49,5	23,8	20,6	16,4	7,18	9,2
	Length	**Width**	**Height**	**Total weight**	**Weight soft body**	**Weight shell**
Average	47,44	22,39	19,28	12,60	5,50	6,96
Stdev	5,99	2,80	2,96	4,87	2,48	2,80
Min	39,50	16,10	15,00	6,14	2,05	3,52
Max	59,40	28,20	26,10	27,44	12,08	15,92

Species:	**Blue mussel (*Mytilus edulis*)**	Date of sampling:	**3.9.2009**
Length:	4-6 cm	Sampled by:	Marine Inst.
Location:	**Hvammsvík**	Date of preparation:	9.9.2010
Coordinates:	642146 213353	IFL#:	R10-1593-3

	Length (mm)	Width (mm)	Height (mm)	Total weight (g)	Weight soft body (g)	Weight shell (g)
1	49,4	24	19,5	11,26	5,86	4,75
2	46,3	22,7	18,8	9,96	5,29	4,46
3	49,8	23,2	20,4	11,71	5,89	5,41
4	51,8	23,4	24,2	14,79	7,58	6,89
5	54,9	26	21,6	15,37	9,28	5,97
6	50,4	25	21,4	12,98	7,23	5,4
7	55,4	23,2	24	18,43	9,61	8,31
8	53,1	25,5	22,5	16,36	8,84	6,36
9	52,7	25,7	20,2	18,12	10,07	8,05
10	55,3	25,2	26,7	20,53	9,47	10,52
11	48,9	20,5	20,5	8,87	3,55	5,11
12	47,2	23,9	20,6	11,75	6,5	5,2
13	52,2	24,9	21	11,65	6,01	5,53
14	46,1	22,5	20,5	12,22	6,01	6,06
15	55	21,7	24,5	17,61	9,2	8,3
16	46,7	25,1	20	11,69	5,96	5,6
17	54,9	26,1	23,3	18,29	9,93	8,21
18	52,3	25,1	23,3	17,01	9,93	7,02
19	56,2	24,9	22,8	16,02	9,62	6,29
20	58,3	24,9	26,1	23,39	12,4	10,91
21	46,5	22,9	21,2	12,33	6,19	6
22	49,3	23	21,6	14,66	6,68	7,75
23	47,8	22,7	20,6	12,83	6,46	6,2
24	50,6	25,1	21,8	11,04	6,04	4,89
25	53,9	24,4	22	15,58	8,15	7,22
26	51,3	25,7	20,2	13,01	7,68	5,07
27	53,2	23	24,8	15,62	6,43	9,07
28	59,1	25,4	26,6	19,43	10,24	9
29	60,8	30	24,2	22,17	12,68	9,23
30	62,5	29,5	28,7	23,95	13,27	10,29
31	45,6	21,1	18,3	9,91	5,71	4,04
32	45,6	21,1	19,9	9,84	4,45	5,03
33	48,3	21,1	22,8	14,19	7,91	6,19
34	52,7	26,1	21,1	13,68	6,56	7,09
35	52,2	26,7	20	14,23	8,93	5,18
36	55	24,5	19,9	14,55	8,18	6,25
37	50,6	23,4	24	16,02	8,69	7,1
38	55,6	26,2	23,9	19,2	10,2	8,94
39	57,2	21,7	25,5	21,88	11,4	10,16
40	43,9	20	16,1	7,48	3,82	3,64
41	40	20	19,9	9,3	4,2	5,01
42	44,5	20	17,2	9,92	4,78	5,05
43	45	20	22,2	11,99	5,57	6,25
44	45,5	22,2	16,7	9,12	4,01	5,01
45	54	23,4	20,1	13,19	7,01	6,17
46	46,7	20,5	16,2	7,48	3,62	3,83
47	47,2	24,4	20	11,4	5,7	5,55
48	50,4	25,6	25,1	19,26	9,27	9,74
49	56,6	24,4	26,7	17,7	7,56	10,14
50	57,7	24,9	25,6	21,98	11,01	10,81
	Length	**Width**	**Height**	**Total weight**	**Weight soft body**	**Weight shell**
Average	51,32	23,85	21,90	14,62	7,61	6,81
Stdev	4,83	2,27	2,86	4,24	2,44	2,00
Min	40,00	20,00	16,10	7,48	3,55	3,64
Max	62,50	30,00	28,70	23,95	13,27	10,91

Appendix II.

Biological measurements of Cod (*Gadus morhua*) 2010

Species:	**Cod (*Gadus Morhua*)**		**exped./station**			**date**	**n**
Location:	**North- Northwest of Iceland (2)**		TJ1-2010			9.3.2010	25
Lenght:	30-45cm	n	station	°N	°W		
Ship:	Jón Vídalín	17	88	670255	232993		
Expd.leader:	Hjalti Karlsson	3	73	664466	231654		
		2	72	665313	230161		
		3	71	665487	230527		

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	71	89,40	93,94	4,54	272	1	31	216	63	2
	72	88,87	95,31	6,44	300	1	33	254	57	2
	73	88,99	96,03	7,04	639	1	42	571	173	3
			Sum	18,02	1211,0		106,0	1041,0	293,0	7,0
			Average	6,01	403,7		35,3	347,0	97,7	2,3
			STDEV	1,31	204,3		5,9	194,9	65,3	0,6
			Min	4,54	272,0		31,0	216,0	57,0	2,0
			Max	7,04	639,0		42,0	571,0	173,0	3,0
H 2	73	89,30	100,26	10,96	487	1	38	418	109	3
	88	89,44	106,31	16,87	439	1	37	381	110	3
	88	89,39	106,44	17,05	432	1	34	356	93	3
	73	89,38	106,47	17,09	494	0	39	423	123	3
			Sum	61,97	1852,0		148,0	1578,0	435,0	12,0
			Average	15,49	463,0		37,0	394,5	108,8	3,0
			STDEV	3,02	32,0		2,2	31,8	12,3	0,0
			Min	10,96	432,0		34,0	356,0	93,0	3,0
			Max	17,09	494,0		39,0	423,0	123,0	3,0
H 3	88	93,23	116,75	23,52	719	1	43	649	163	3
	88	89,46	114,37	24,91	527	0	38	440	125	3
	88	89,28	115,44	26,16	606	1	40	523	159	3
	88	89,20	115,85	26,65	581	1	40	509	170	3
	88	89,48	116,15	26,67	405	0	36	346	122	3
			Sum	127,91	2838,00		197,0	2467,0	739,0	15,0
			Average	25,58	473,00		39,4	493,4	147,8	3,0
			STDEV	1,36	114,74		2,6	111,7	22,6	0,0
			Min	23,52	405,00		36,0	346,0	122,0	3,0
			Max	26,67	719,00		43,0	649,0	170,0	3,0
H 4	88	89,53	117,53	28,00	600,0	0	38	475	142,0	3
	88	89,57	121,57	32,00	515,0	1	39	427	116,0	3
	88	88,97	121,16	32,19	605,0	0	40	513	151,0	3
	71	89,55	126,70	37,15	691,0	0	44	564	139,0	3
			Sum	129,34	2411,0		161,0	1979,0	548,0	12,0
			Average	32,34	602,8		40,3	494,8	137,0	3,0
			STDEV	3,75	71,9		2,6	58,0	14,9	0,0
			Min	28,00	515,0		38,0	427,0	116,0	3,0
			Max	37,15	691,0		44,0	564,0	151,0	3,0
H5	88	88,32	129,85	41,53	606	1	40	496	174,0	3
	88	89,34	131,41	42,07	773	0	44	669	197,0	3
	88	97,30	142,47	45,17	653	1	41	546	180,0	3
	72	89,13	134,95	45,82	669	1	40	496	148,0	3
	88	89,06	135,18	46,12	691	0	41	592	175,0	3
	88	89,07	137,70	48,63	840	1	43	687	207,0	3
			Sum	269,34	4232,0		249,0	3486,0	1081,0	18,0
			Average	44,89	705,3		41,5	581,0	180,2	3,0
			STDEV	2,67	85,8		1,6	83,4	20,5	0,0
			Min	41,53	606,0		40,0	496,0	148,0	3,0
			Max	48,63	840,0		44,0	687,0	207,0	3,0
H6	88	89,12	**143,80**	54,68	721,0	1,0	42	580	173,0	3
	71	89,43	**146,88**	57,45	880,0	0,0	44	683	195,0	4
	88	92,48	**158,15**	65,67	741,0	1,0	42	615	166,0	4
			Sum	177,80	2342,00		128,0	1878,00	534,00	11,00
			Average	59,27	780,67		42,67	626,00	178,00	3,67
			STDEV	5,72	86,6		1,2	52,37	15,13	0,6
			Min	54,68	721,0		42,0	580,0	166,0	3,0
			Max	65,67	880,00		44,00	683,00	195,00	4,0
H1, H2, H3, H4, H5, H6			**Sum**	784,38	14886,00		989,0	12429,00	3630,00	75,00
			Average	31,38	595,44		39,56	497,16	145,20	3,00
			STDEV	16,74	153,6		3,4	126,0	39,4	0,4
			Min	4,54	272,0		31,0	216,0	57,0	2,0
			Max	65,67	880,00		44,00	687,00	207,00	4,0

Species:	**Cod (*Gadus Morhua*)**	**exped./station**			**date**	**n**
Location:	**Northeast of Iceland**	TB1-2010-3(	670177	154486	5.3.2010	25
Lenght:	30-45cm					
Ship:	Bjartur NK					
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	30	89,11	93,46	4,35	284	1	33	258	83	3
	30	88,98	94,02	5,04	222	1	31	179	35	4
	30	89,01	95,31	6,30	351	1	36	308	92	3
	30	89,26	95,79	6,53	401	1	35	342	115	3
	30	88,94	96,58	7,64	317	1	34	257	97	3
			Sum	29,86	1575,0		169,0	1344,0	422,0	16,0
			Average	5,97	315,0		33,8	268,8	84,4	3,2
			STDEV	1,29	67,6		1,9	61,7	30,0	0,4
			Min	4,35	222,0		31,0	179,0	35,0	3
			Max	7,64	401,0		36,0	342,0	115,0	4
H 2	30	89,50	97,62	8,12	263	0	32	235	66	3
	30	88,95	97,61	8,66	289	1	34	258	87	3
	30	89,60	98,55	8,95	427	1	38	377	134	3
	30	89,04	98,12	9,08	357	0	36	313	90	3
	30	89,32	98,69	9,37	270	1	32	226	61	3
	30	93,24	102,81	9,57	386	0	35	345	115	3
	30	89,37	99,27	9,90	341	0	35	304	108	3
	30	89,44	99,39	9,95	402	1	37	351	117	3
			Sum	73,60	2735,0		279,0	2409,0	778,0	24,0
			Average	9,20	341,9		34,9	301,1	97,3	3,0
			STDEV	0,63	62,4		2,2	56,3	25,7	0,0
			Min	8,12	263,0		32,0	226,0	61,0	3
			Max	9,95	427,0		38,0	377,0	134,0	3
H 3	30	90,56	100,56	10,00	295	1	33	244	65	3
	30	88,72	98,86	10,14	338	0	34	292	98	3
	30	95,64	107,06	11,42	577	0	42	515	171	4
	30	89,83	102,18	12,35	391	1	36	349	111	3
	30	89,14	102,02	12,88	465	1	38	414	150	3
	30	89,30	103,11	13,81	461	0	36	393	147	3
	30	88,88	103,68	14,80	490	0	38	433	167	3
			Sum	85,40	3017,00		257,0	2640,0	909,0	22,0
			Average	12,20	431,00		36,7	377,1	129,9	3,1
			STDEV	1,80	96,26		3,0	90,8	39,5	0,4
			Min	10,00	295,00		33,0	244,0	65,0	3
			Max	14,80	577,00		42,0	515,0	171,0	4
H 4	30	89,17	106,03	16,86	507,0	0	39	457	166,0	3
	30	89,12	107,74	18,62	536,0	1	39	483	148,0	4
	30	88,36	107,26	18,90	430,0	0	37	366	104,0	3
			Sum	54,38	1473,0		115,0	1306,0	418,0	10,0
			Average	18,13	491,0		38,3	435,3	139,3	3,3
			STDEV	1,11	54,8		1,2	61,4	31,9	0,6
			Min	16,86	430,0		37,0	366,0	104,0	3
			Max	18,90	536,0		39,0	483,0	166,0	4
H5	30	90,22	115,91	25,69	640	0	42	544	198	4
	30	89,20	119	29,8	556	1	40	485	180	4
			Sum	55,49	1196,0		82	1029,0	378,0	8
			Average	27,75	598,0		41	514,5	189,0	4
			STDEV	2,91	59,4		1,4	41,7	12,7	0
			Min	25,69	556,0		40	485,0	180,0	4
			Max	29,8	640		42	544,0	198,0	4
H1, H2, H3, H4, H5			**Sum**	298,73	9996,00		902,00	8728,00	2905,00	80,00
			Average	11,95	399,84		36,08	349,12	116,20	3,20
			STDEV	6,1	108,7		3,0	97,8	41,4	0,4
			Min	4,3	222,0		31,0	179,0	35,0	3,0
			Max	29,80	640,00		42,00	544,00	198,00	4,00

Appendix III.

Quality assurance in metal analysis and persistent organochlorines analysis

Table 2. Results for trace metals in certified reference materials (DOLT-3 and Quasimeme R89) for the year 2010.

Analyte		QTM089BT Quasimeme R64 µg/g	I Z-scoreI	DOLT-3 NRC-CNRC mg/kg	I Z-score*I	MLOD** mg/kg
As						
	Measured	2050,0		10,04		
	Certified	1953,0	0,30	10,2	-0,14	0,002
Cd						
	Measured	30,2		16,94		
	Certified	39,3	-0,60	19,4	-1,24	0,03
Cu						
	Measured	6300,0		25,61		
	Certified	7616,0	-1,30	31,2	-1,88	0,002
Hg						
	Measured	32,75		2,79		
	Certified	29,31	0,30	3,37	-1,29	0,06
Pb						
	Measured	44,3		0,29		
	Certified	57,7	-1,40	0,32	-0,47	0,04
Se						
	Measured	472,7		7,88		
	Certified	495,4	-0,30	7,06	0,97	0,07
Zn						
	Measured	1757,0		86,89		
	Certified	2029,0	-0,80	86,6	0,04	0,002

* Z-score (calculated accoding to method SV-22-02 SN-1 in Matís quality manual)

** MLOD is on dry weight basis

NA: not analyzed

Table 3. Results for trace metals in certified reference materials (DORM-3 and Quasimeme R64) for the year 2010.

Analyte		QTM090BT Quasimeme R64 µg/g	I Z-scoreI	DORM-3 NRC-CNRC mg/kg	I Z-score*I	MLOD** mg/kg
As						
	Measured	2670,0		7,41		
	Certified	2473,0	0,7	6,88	0,64	0,002
Cd						
	Measured	147,7		0,265		
	Certified	162,7	-0,5	0,29	-0,45	0,03
Cu						
	Measured	1010,0		12,218		
	Certified	1147,0	-1,0	15,5	-2,00	0,002
Hg						
	Measured	17,24		0,319		
	Certified	-	-	0,382	-0,89	0,06
Pb						
	Measured	117,3		0,279		
	Certified	140,1	-1,1	0,395	-0,22	0,04

* Z-score (calculated accoding to method SV-22-02 SN-1 in Matís quality manual)

** MLOD is on dry weight basis

NA: not analyzed

Table 4. Qualitative assurance. Persistent organochlorines (ng/g ww) in a certified mussel sample from QUASIMEME, that were analysed with the mussel samples from 2009

Blue mussel control								assign			
chemical	CRM	weight basis	anal. 1	anal. 2	anal.3	mean	SD	value	time	I Z I**	det. Lim.
CB28	QOR101BT	wet weight	0,16			0,16		0,15		0,32	0,02
CB31	QOR101BT	wet weight	0,1			0,10		0,1		0,00	0,02
CB52	QOR101BT	wet weight	0,26			0,26		0,26		0,00	0,02
CB101	QOR101BT	wet weight	1,16			1,16		1,1		0,40	0,01
CB105	QOR101BT	wet weight	0,22			0,22		0,21		0,26	0,01
CB118	QOR101BT	wet weight	0,96			0,96		0,92		0,31	0,01
CB138	QOR101BT	wet weight	2,24			2,24		2,28		-0,13	0,01
CB153	QOR101BT	wet weight	3,58			3,58		3,52		0,13	0,01
CB156	QOR101BT	wet weight	0,07			0,07		0,08		-0,43	0,01
CB180	QOR101BT	wet weight	0,16			0,16		0,16		0,00	0,02
HCB	QOR101BT	wet weight	0,05			0,05		0,06		-0,50	0,01
a-HCH	QOR101BT	wet weight	<0,02			<0,02		0,03		c	0,02
b-HCH	QOR101BT	wet weight	0,01			0,01		0,02		-0,67	0,02
g-HCH	QOR101BT	wet weight	0,025			0,03		0,03		-0,31	0,02
pp'-DDE	QOR101BT	wet weight	0,69			0,69		0,66		0,32	0,01
pp'-DDD	QOR101BT	wet weight	0,29			0,24		0,22		0,49	0,01
pp'-DDT	QOR101BT	wet weight	<0,2			<0,2				*	0,05
op'-DDT	QOR101BT	wet weight	<0,1			<0,1				*	0,05
transn-chlor	QOR101BT	wet weight	0,05			0,05		0,06		-0,5	0,01

* no assigned value in this sample

**Z=(assigned value-mean)/assigned value*%error by the quasimeme laboratories

a- and g-chlordane, oxychlordane, toxaphenes and PBDEs are not certified in this sample by quasimeme

Table 5. Qualitative assurance. Persistent organochlorines (ng/g ww) in a certified cod liver sample from QUASIMEME, that were analysed with the cod liver samples from 2010

Cod liver control								assign			
chemical	CRM	weight basis	anal. 1	anal. 2	anal. 3	mean	SD	value	time	I Z I	det. Lim.
CB28	QOR094BT	wet weight	10,5	10,5		10,5	0,00	10,10	2 weeks	0,31	0,20
CB31	QOR094BT	wet weight	3,20	3,25		3,23	0,04	3,62	2 weeks	-0,85	0,20
CB52	QOR094BT	wet weight	23,0	23,1		23,1	0,07	23,0	2 weeks	0,02	0,10
CB101	QOR094BT	wet weight	64,4	63,2		63,8	0,85	62,2	2 weeks	0,21	0,20
CB105	QOR094BT	wet weight	16,2	16,5		16,4	0,21	15,7	2 weeks	0,33	0,05
CB118	QOR094BT	wet weight	68,7	69,9		69,3	0,85	67,5	2 weeks	0,21	0,05
CB138	QOR094BT	wet weight	139	138		138	0,6	138	2 weeks	0,03	0,05
CB153	QOR094BT	wet weight	216	220		217,9	2,7	212	2 weeks	0,21	0,05
CB156	QOR094BT	wet weight	8,46	8,66		8,56	0,14	8,40	2 weeks	0,15	0,05
CB180	QOR094BT	wet weight	43,8	43,1		43,5	0,49	42,5	2 weeks	0,18	0,12
HCB	QOR094BT	wet weight	13,7	14,0		13,9	0,21	13,8	2 weeks	0,03	0,05
a-HCH	QOR094BT	wet weight	1,40	1,41		1,41	0,01	1,33	2 weeks	0,43	0,05
b-HCH	QOR094BT	wet weight	1,80	1,86		1,83	0,04	1,91	2 weeks	-0,30	0,05
g-HCH	QOR094BT	wet weight	0,86	0,87		0,87	0,01	0,843	2 weeks	0,19	0,16
pp'-DDE	QOR094BT	wet weight	87,5	89,4		88,5	1,34	85,5	2 weeks	0,28	0,10
pp'-DDD	QOR094BT	wet weight	27,9	29,0		28,5	0,78	26,2	2 weeks	0,69	0,12
pp'-DDT	QOR094BT	wet weight						*0,38*	2 weeks	*	0,20
op'-DDT	QOR094BT	wet weight						*0,71*	2 weeks	*	0,20
transn-chlor	QOR094BT	wet weight	8,06	8,29		8,18	0,16	7,96	2 weeks	0,21	0,05

*** "assigned value" only "indicative". Quasimeme does not assign %error and thus Z-score can not be calculated.**

a- and g-chlordane, oxychlordane, toxaphenes and PBDEs are not certified in this sample by quasimeme

Table 6. Detection limits* (ng/g)

	Detection limits	
chemical	**mussel ng/g sample dw**	**Cod liver ng/g sample ww**
a-HCH	0,05	0,05
HCB	0,02	0,05
b-HCH	0,10	0,05
g-HCH	0,10	0,16
PCB-31	0,20	0,20
PCB-28	0,25	0,20
PCB-52	0,10	0,10
oxychlordane	0,10	0,20
gamma-Chl.	0,20	0,05
PCB-101	0,10	0,20
alfa-Chl.	0,05	0,05
transnonachlor	0,05	0,05
4,4'-DDE	0,10	0,10
tox 26	0,05	0,10
PCB-118	0,10	0,05
4,4'-DDD	0,05	0,12
2,4'-DDT	0.1-0.2	0,20
PCB-153	0,05	0,05
PCB-105	0,05	0,05
4,4'-DDT	0.2-0.4	0,20
PCB-138	0,05	0,05
tox 50	0,10	0,10
PCB-156	0,05	0,05
PCB-180	0,05	0,12
tox 62	0,10	0,20
PCB-170	0,05	0,05
PBDE-47	0,05	0,20
PBDE-100	0,10	0,20
PBDE-99	0,10	0,20

***detection limits are 3 x std of blanks, or 3 x noise level or higher when other peaks interfer.**

Appendix IV.

Results of trace metal analysis for Blue mussel (*Mytilus edulis*) 2009 and Cod (*Gadus morhua*) 2010

Table 7. Results of trace metals in Blue mussel *(Mytilus edulis)* 2009 (dw)

Samples	Fat		Dry matter		Pb, mg/kg		Cd, mg/kg		Cu, mg/kg		Zn, mg/kg		As, mg/kg		Se, mg/kg		Hg, mg/kg	
	%	±	%	±	dw	±	dw	±	dw	±	dw	±	dw	±	dw	±	dw	±
Grímsey	0,32	0,03	7,46	0,3	0,43	0,02	2,98	0,1	5,19	0,15	185,03	6	10,62	0	2,04	0,1	0,063	0,002
Hvassahraun	0,17	0,01	7,82	0,3	0,20	0,01	0,87	0,01	6,79	0,4	96,65	2	12,54	0,3	2,25	0,1	0,028	0,202
Hvalstöd, Hvalfjörður	0,77	0,06	13,3	0,5	0,024	0,002	0,77	0,02	2,86	0,1	85,07	1	6,39	0,1	2,18	0,0	0,036	0,001
Mjóifjörður, Hofsá (Brekka)	0,32	0,03	7,75	0,3	0,113	0,002	2,14	0,0	3,99	0,1	116,39	3	8,84	0,4	2,65	0,2	0,048	0,001
Mjóifjörður, Dalatangi	0,15	0,01	6,27	0,3	0,116	0,001	1,43	0,0	3,85	0,1	118,96	2	13,69	0	2,34	0,0	0,063	0,001
Úlfsá, Skutulsfjördur	0,20	0,02	6,79	0,3	0,38	0,005	0,99	0,03	6,71	0,2	115,96	3,6	65,10	1	2,33	0,1	0,068	0,002
Dvergasteinn, Álftafjördur	1,06	0,08	11,17	0,4	0,105	0,004	2,76	0,02	4,97	0,2	78,35	0,4	8,01	0	2,55	0,1	0,028	0,001
Straumur, Straumsvík	0,56	0,04	8,81	0,4	0,07	0,002	1,60	0,002	2,91	0,1	80,89	1,4	9,07	0,2	2,63	0,0	0,032	0,002
Hvammsvík	0,37	0,03	9,56	0,4	0,03	0,002	1,13	0,02	2,90	0,04	97,66	1,6	7,61	0	2,07	0,0	0,025	0,001
Fjörður	0,25	0,02	6,43	0,3	0,070	0,002	1,90	0,07	3,05	0,1	81,11	3,6	9,12	0,5	2,28	0,2	0,045	0,001
Limit of detection for samples (MLOD)					0,04		0,03		0,002		0,002		0,002		0,07		0,06	

Table 8. Results of trace metals in liver and flesh of Cod (*Gadus morhua*) 2010 (ww)

Sample	Fat %		Dry matter %		Pb, mg/kg		Cd, mg/kg		Cu,mg/kg		Zn, mg/kg		As, mg/kg		Se, mg/kg		Dry matter %		Fat %		Hg, mg/kg	
	Liver	±	Liver	±	Liver		Liver	±	Liver	±	Liver	±	Liver	±	Liver	±	Flesh*	±	Flesh*	±	Flesh*	±
Cod N-NW (2) 10																						
Group 2	47,9	4	61,5	3	<0,04		0,29	0,06	3,5	0,70	14	0,4	9,1	2,00	1,0	0,0						
Group 4	50,6	4	63,8	3	<0,04		0,14	0,03	3,1	0,60	13,0	0,1	8,2	2,0	0,81	0,01						
Group 5	59,9	5	70,3	3	<0,04		0,12	0,02	2,4	0,5	11,5	0,3	6,8	1,00	0,70	0,02						
Average	***52,8***		***65,2***				***0,18***		***3,0***		***13,0***		***8,0***		***0,84***		***19***	***0,8***	***0,05***	***0,003***	***0,02***	***0,004***
Cod NA 10																						
Group 3	44,1	4	56,3	2	<0,04		0,23	0,05	3,7	0,70	18	4,0	8,7	2,0	1,2	0,04						
Group 4	53,0	4	64,3	3	<0,04		0,14	0,03	2,9	0,6	12,6	3,0	4,9	1,00	0,86	0,04						
Group 5	56,7	5	67,3	3	<0,04		0,11	0,02	1,9	0,4	11	2	5,1	1,0	0,71	0,02						
Average	***51,3***		***62,6***				***0,16***		***2,8***		***14***		***6,2***		***0,94***		***18,8***	***0,8***	***0,04***	***0,003***	***0,020***	***0,002***
Average of all measurements					<0,04		0,17		2,9		13,5		7,1		0,89						0,02	
Limit of detection for samples (MLOD)					0,04		0,030		0,002		0,002		0,002		0,07						0,06	

*Flesh was pooled into one sample

Appendix V.

Results of organochlorine analysis for Blue mussel (*Mytilus edulis*) 2009 and Cod (*Gadus morhua*) 2010

Table 9 a. Persistent organochlorines in Blue mussel (Mytulis edulis, ng/g dw) 2009

	Grímsey 09	Hvammsvík 09	Hvalstöð 09	Úlfsá 09	Dvergasteinn 09	Hvassahraun 09
PCB28	<0,25	<0,25	<0,25	<0,25	<0,25	<0,25
PCB31	<0,20	<0,20	<0,20	<0,20	<0,20	<0,23
PCB52	<0,1	0,24	0,77	0,22	0,17	0,3
PCB101	0,11	0,3	1,21	0,69	0,5	0,25
PCB105	0,09	0,08	0,1	0,1	0,1	<0,05
PCB118	<0,1	0,26	1,52	0,48	0,38	0,13
PCB138	0,09	0,77	2,99	1,22	0,52	0,31
PCB153	0,25	1,18	4,37	2,07	0,62	0,46
PCB156	<0,05	<0,05	0,09	<0,05	<0,05	<0,05
PCB170	0,05	<0,05	0,14	<0,05	<0,05	<0,05
PCB180	0,05	0,07	0,67	0,2	<0,05	<0,05
S3PCB**	0,39	2,2	8,9	3,8	1,52	0,9
HCB	0,09	0,11	0,31	0,25	0,08	0,07
a-HCH	<0,05	0,08	0,13	<0,05	<0,05	<0,05
b-HCH	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
g-HCH	0,15	0,17	0,18	<0,1	<0,1	<0,25
p,p'-DDE	0,32	0,57	10,6	0,59	0,27	0,2
p,p'-DDD	0,07	0,15	1,35	0,12	0,08	0,08
p,p'-DDT	<0,2	<0,2	<0,4	<0,4	<0,2	<0,2
o,p'-DDT***	<0,1	<0,1	0,11	<0,1	<0,1	<0,1
PCB153/DDE	0,8	2,1	0,4	3,5	2,3	2,3
transnonachlor	0,09	0,18	2,33	0,45	0,18	0,07
a-chlordan	0,07	0,12	0,38	0,11	0,14	<0,05
g-chlordan	<0,2	<0,2	<0,2	<0,2	<0,2	<0,2
oxychlordan	<0,1	<0,1	0,28	<0,1	<0,1	<0,1
Tox-26	0,14	0,19	0,59	0,31	0,26	0,09
Tox-50	0,2	0,37	0,86	0,38	0,44	0,16
Tox-62	0,14	<0,1	<0,1	0,25	<0,1	<0,1
PBDE-47	0,49	0,08	0,84	0,83	0,07	0,11
PBDE-99	0,12	0,11	0,4	0,46	<0,1	<0,1
PBDE-100	<0,1	<0,1	0,18	0,23	<0,1	<0,1
% extracted fat	0,26	0,50	0,98	0,43	0,61	0,27
% dw (Matis)	7,46	9,56	13,28	6,79	11,17	7,82

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

*****Values are highly suspect and these are not certified in QUASIMEME blue mussel**

Table 9 b. Persistent organochlorines in Blue mussel (Mytulis edulis, ng/g dw) 2009

	Straumur 09	Dalatangi 09	Brekka 09	Fjörður 09
PCB28	<0,25	<0,25	0,30	<0,25
PCB31	<0,20	0,21	0,26	<0,20
PCB52	0,28	0,33	0,40	0,23
PCB101	0,59	0,67	0,94	0,11
PCB105	0,08	0,12	0,17	<0,05
PCB118	0,44	0,36	0,63	<0,1
PCB138	1,47	0,46	3,11	0,13
PCB153	20,5	0,53	3,2	0,24
PCB156	<0,05	0,11	0,20	<0,05
PCB170	<0,05	<0,05	<0,05	<0,05
PCB180	0,09	0,06	0,50	0,09
S3PCB**	4,0	1,4	6,9	0,42
HCB	0,13	0,09	0,13	0,12
a-HCH	0,07	<0,05	0,07	<0,05
b-HCH	<0,1	<0,1	<0,1	<0,1
g-HCH	0,2	0,41	0,44	0,35
p,p'-DDE	0,78	0,12	0,77	0,23
p,p'-DDD	0,31	0,07	0,16	<0,05
p,p'-DDT	<0,4	<0,2	<0,2	<0,2
o,p'-DDT***	0,2	<0,1	<0,1	<0,1
PCB153/DDE	2,6	4,4	4,2	1,0
transnonachlor	0,20	0,19	0,28	0,11
a-chlordan	0,15	0,05	0,19	0,09
g-chlordan	<0,2	<0,2	<0,2	<0,2
oxychlordan	<0,1	<0,1	<0,1	<0,1
Tox-26	0,25	0,09	0,31	0,17
Tox-50	0,4	0,24	0,56	0,36
Tox-62	<0,1	0,14	<0,1	0,17
PBDE-47	0,52	0,11	0,16	0,10
PBDE-99	0,28	<0,1	<0,1	<0,1
PBDE-100	0,22	<0,1	<0,1	<0,1
% extracted fat	0,58	0,25	0,37	0,20
% dw (Matis)	8,81	6,27	7,75	6,43

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

*****Values are highly suspect and these are not certified in QUASIMEME blue mussel**

Table 10 a. Persistent organochlorines in cod liver 2010 (ng/g ww)

	COD NE	COD NE	COD NE
	H3	H4	H5*
PCB28	2,0	1,6	1,8
PCB31	0,94	0,69	0,88
PCB52	4,7	4,8	4,7
PCB101	7,3	7,2	6,1
PCB105	2,3	2	2
PCB118	9,1	6,8	7,1
PCB138	13,6	12	11,2
PCB153	23,6	18,6	19,9
PCB156	1,0	0,91	0,91
PCB170	2,3	1,4	1,5
PCB180	5,7	3,7	3,8
S7PCB**	66,0	54,7	54,5
HCB	15,7	15,4	17,2
a-HCH	1,3	1,7	1,9
b-HCH	0,36	0,47	0,56
g-HCH	0,47	0,56	0,68
p,p'-DDE	46,6	39	34
p,p'-DDD	13,3	12,5	12,7
p,p'-DDT****	(5,3)	(4,6)	(4,9)
o,p'-DDT****	4,9	5,0	4,0
SDDT	64,8	56,5	50,7
PCB153/DDE	0,51	0,48	0,58
transnonachlor	27,3	23,0	22,7
a-chlordan	17,8	16,9	17,8
g-chlordan	5,3	5,1	5,5
oxychlordan	4,2	3,8	3,7
SCHL	54,6	48,8	49,6
Tox-26	20,7	18,9	20,0
Tox-50	34,0	34,4	36,4
Tox-62	12,3	10,1	12,2
PBDE-47	2,8	2,6	2,5
PBDE-99	<0,2	<0,2	<0,2
PBDE-100	0,44	0,47	0,45
% extracted fat	42,7	53,6	57,1

**** PCB # 28, 52, 101, 118, 138, 153, 180**

***** Contamination prevents accurate quantification**

****** Not certified values (indicative) in QUASIMEME cod liver**

Table 10 b. Persistent organochlorines in cod liver 2010 (ng/g ww)

	COD NNW2	COD NNW2	COD NNW2
	H2	H4	H5
PCB28	1,4	1,5	1,6
PCB31	0,67	0,73	0,92
PCB52	3,9	4,0	4,5
PCB101	5,5	5,2	5,3
PCB105	1,6	1,5	1,4
PCB118	6,1	5,1	4,9
PCB138	11,7	7,3	9,5
PCB153	18,7	15,6	14,9
PCB156	0,62	0,66	0,78
PCB170	1,3	0,99	0,83
PCB180	3,9	3,1	3,0
S7PCB**	51,2	41,8	43,7
HCB	14,9	15,1	16,8
a-HCH	1,3	1,5	1,7
b-HCH	0,43	0,45	0,56
g-HCH	0,45	0,55	0,6
p,p'-DDE	34,8	32,7	31,9
p,p'-DDD	9,7	10,2	11,1
p,p'-DDT****	(3,5)	(3,5)	(3,5)
o,p'-DDT****	3,2	3,5	3,4
SDDT	47,7	46,4	46,4
PCB153/DDE	0,54	0,48	0,47
transnonachlor	18,9	19,0	19,0
a-chlordan	12,5	14,0	14,9
g-chlordan	3,9	4,4	4,6
oxychlordan	3,8	3,6	3,7
SCHL	39,1	41,0	42,2
Tox-26	14,9	16,0	17,6
Tox-50	24,1	27,4	30,9
Tox-62	6,8	7,8	8,4
PBDE-47	2,4	2	2,2
PBDE-99	<0,2	<0,2	<0,2
PBDE-100	0,44	0,33	0,53
% extracted fat	48,9	50,8	56,9

**** PCB # 28, 52, 101, 118, 138, 153, 180**

***** Contamination prevents accurate quantification**

****** Not certified values (indicative) in QUASIMEME cod liver**

Appendix VI.

Graphs of biological variation in Cod (Gadus morhua) 1990-2010

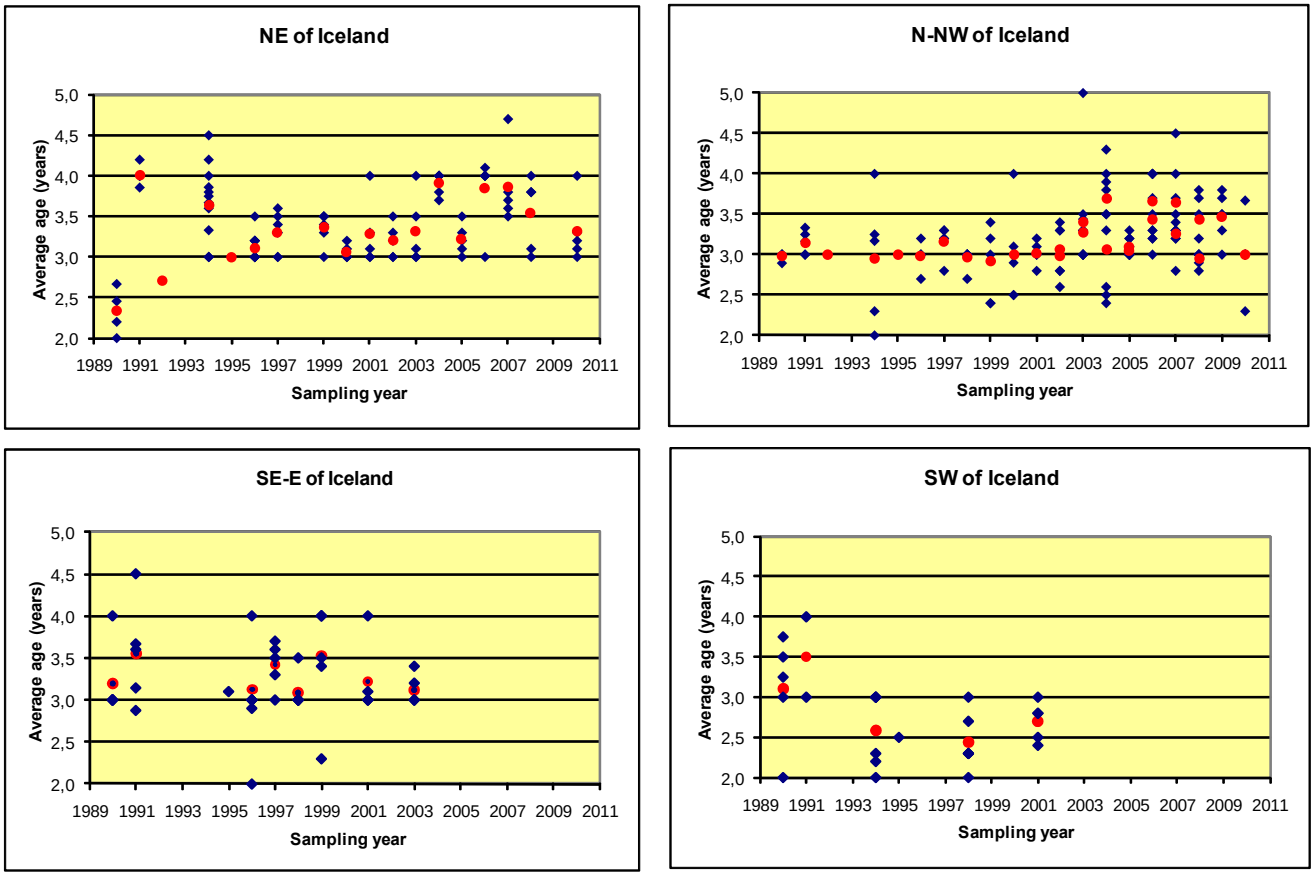


Figure 2a. Average age in 30-45 cm Cod (Gadus morhua) from Icelandic waters in March 1990-2010.The red dots represent the average values.

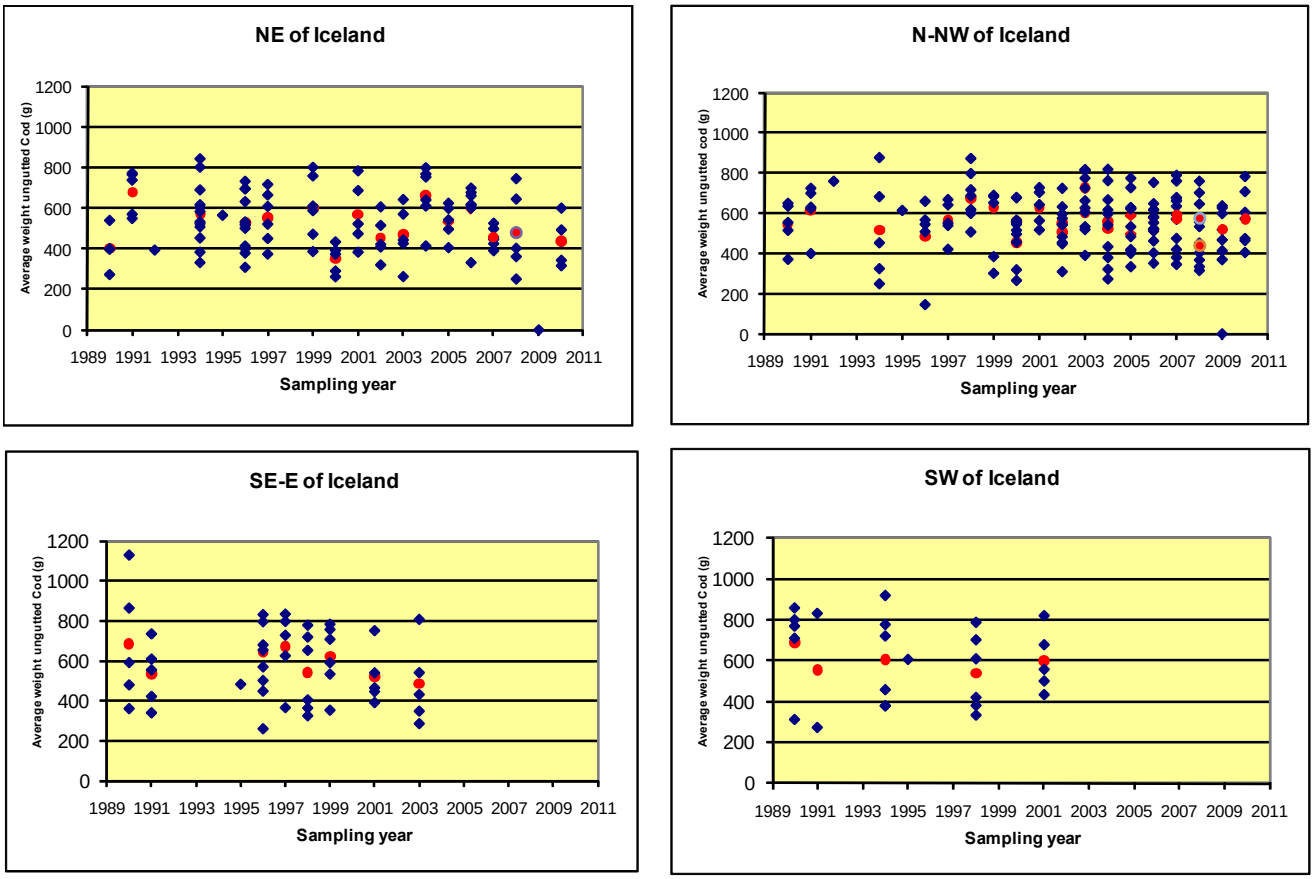


Figure 2b. Average weight ungutted Cod (Gadus morhua), 30-45 cm, from Icelandic waters in March 1990-2010.The red dots represent the average values.

Biological variation in 30-45 cm Cod (Gadus morhua) from Icelandic waters in March 1990-2010

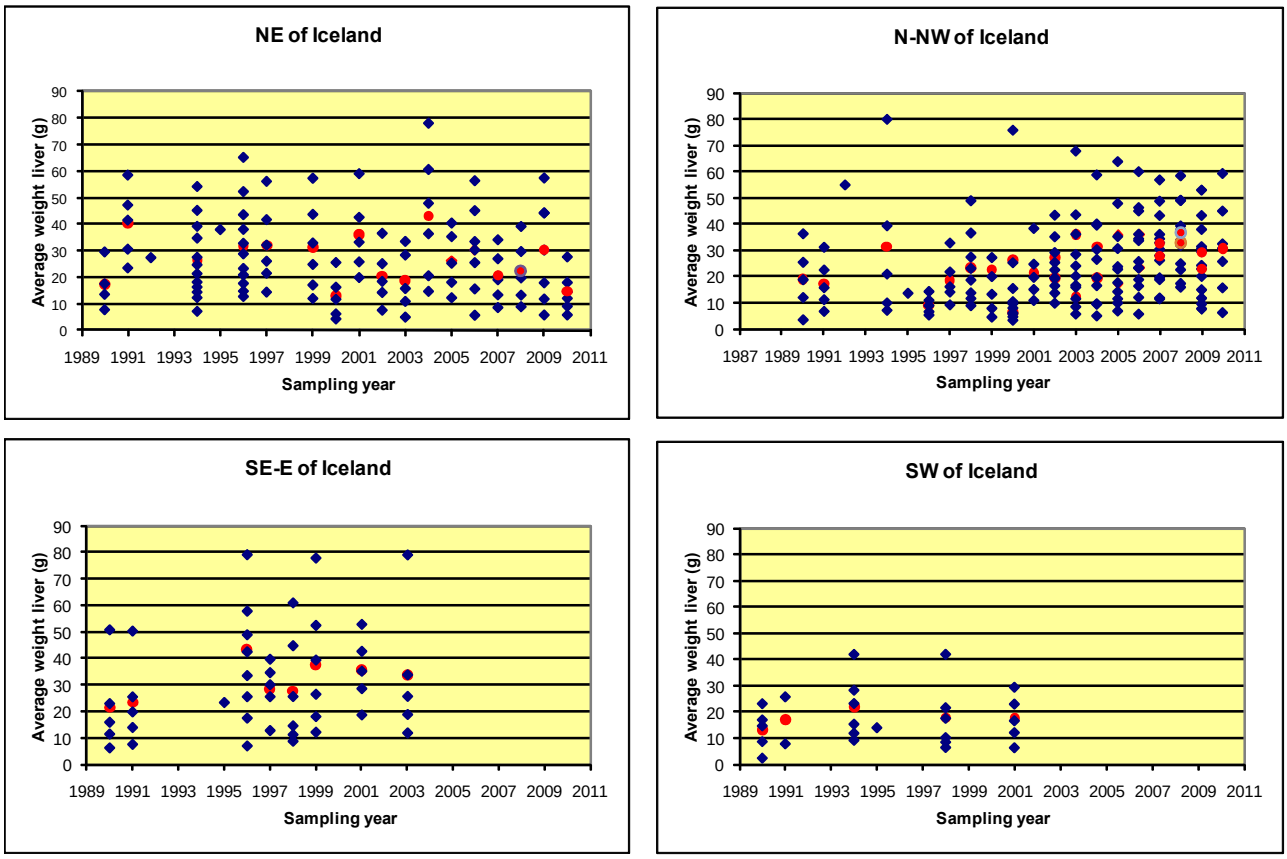


Figure 2c. Average weight liver of Cod (Gadus morhua), 30-45 cm, from Icelandic waters in March 1990-2010.The red dots represent the average values.

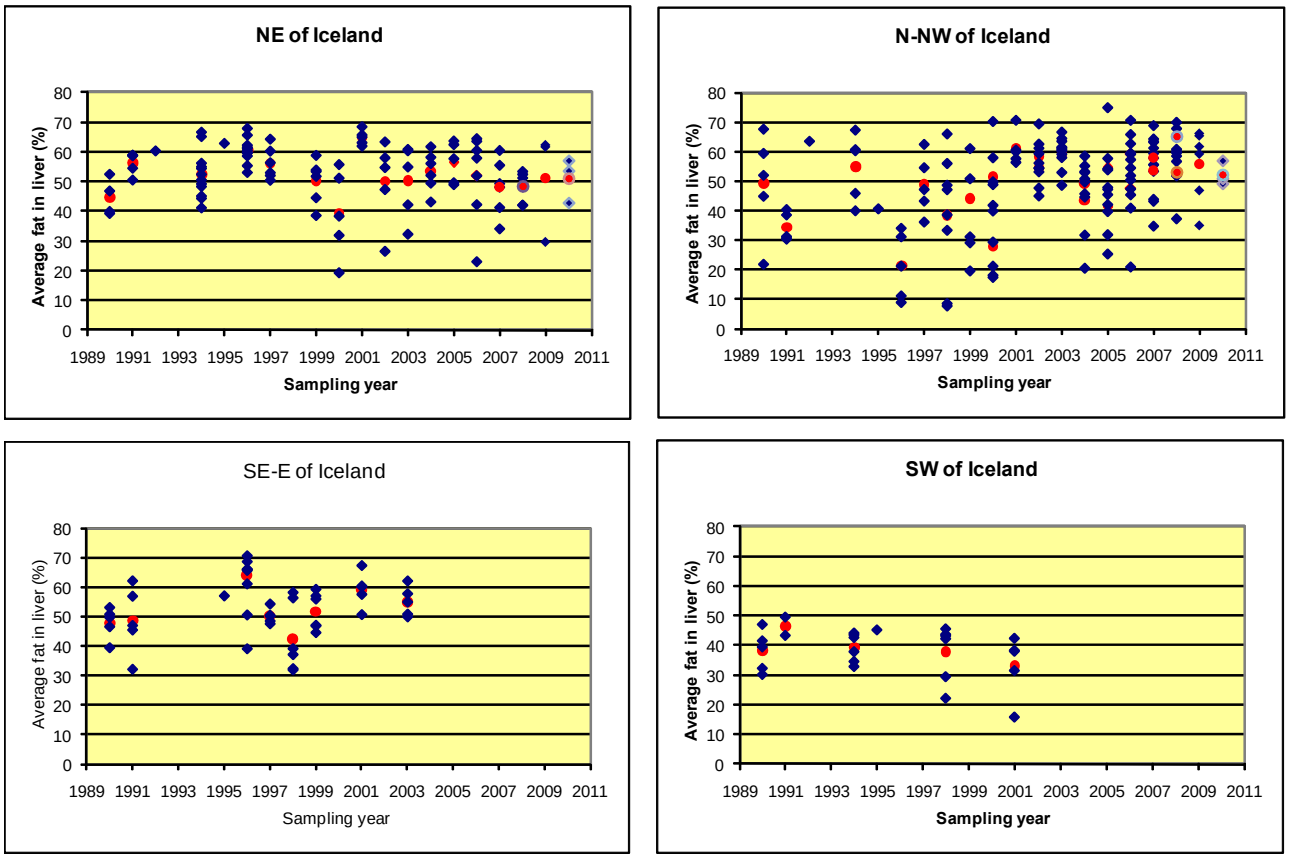


Figure 2d. Average fat (%) in liver of Cod (Gadus morhua), 30-45 cm, from Icelandic waters in March 1990-2010.The red dots represent the average values.

Appendix VII.

Graphs of metals and organic compounds in Blue mussel (*Mytilus edulis*) 1990-2009

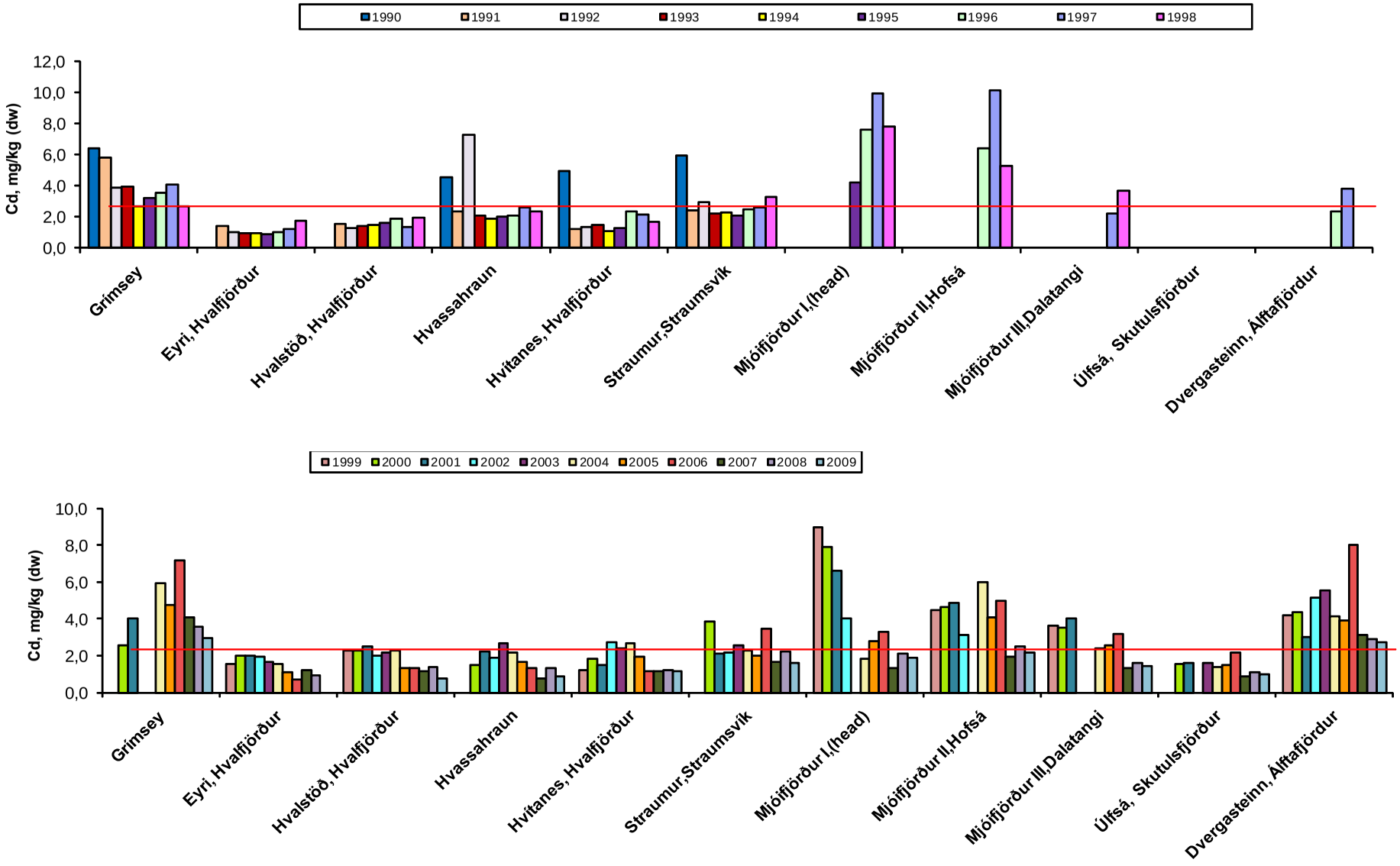


Figure 3a. Cadmium concentration (dw) in Blue mussel (Mytilus edulis) around Iceland 1991-2009. Red line indicates ICES 90 75% baseline (11).

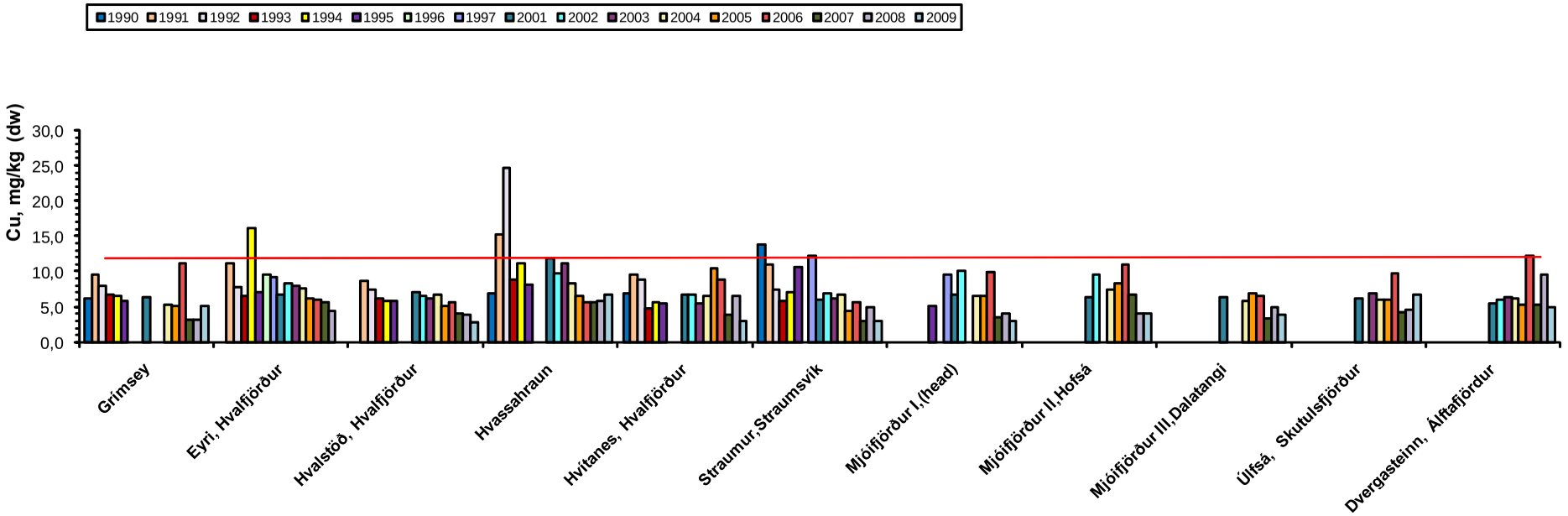


Figure 3b. Copper concentration (dw) in Blue mussel (Mytilus edulis) around Iceland 1990-2009. Red line indicates ICES 90 75% baseline (11).

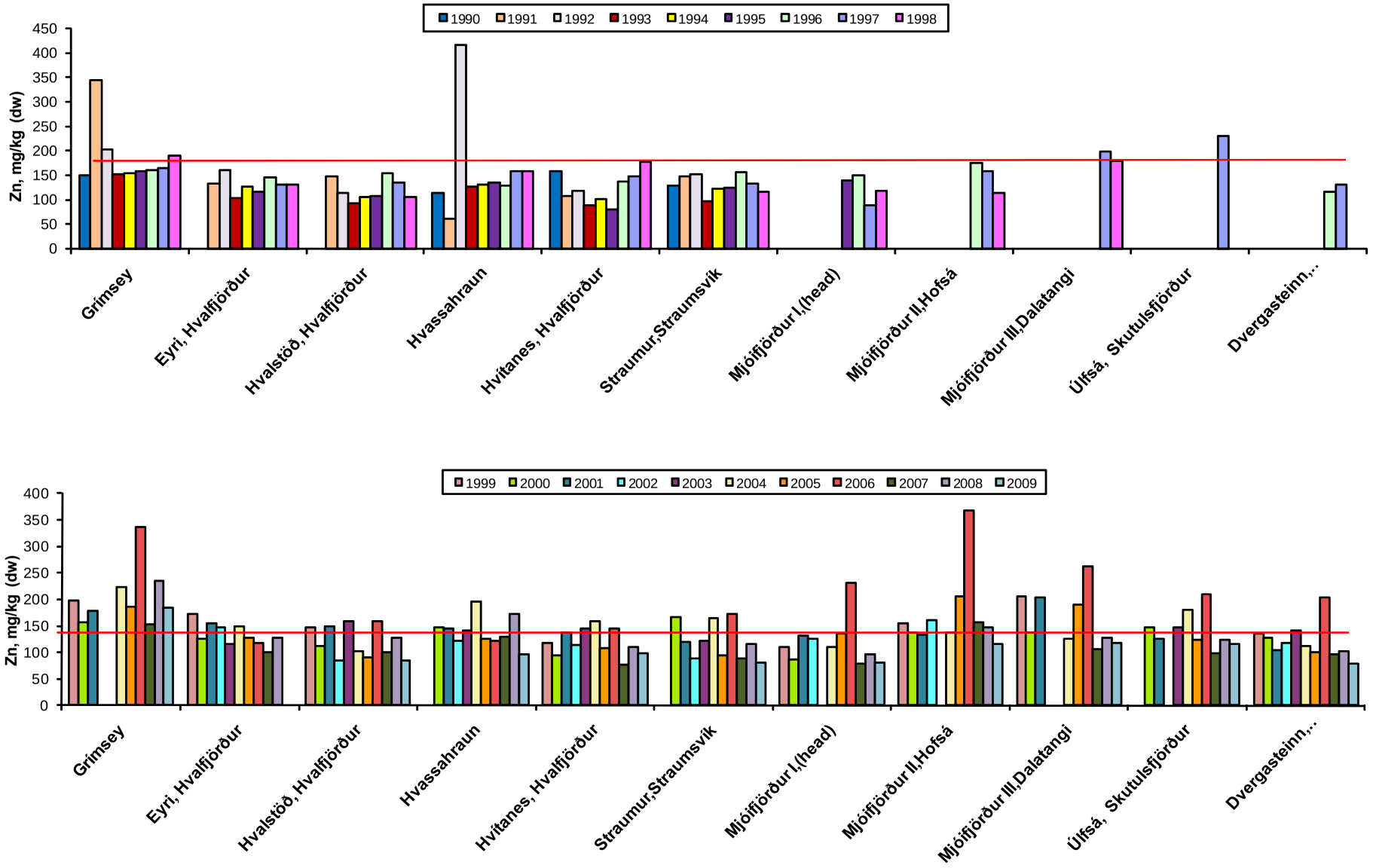


Figure 3c. Zinc concentration (dw) in Blue mussel (Mytilus edulis) around Iceland 1990-2009. Red line indicates ICES 90 75% baseline (11).

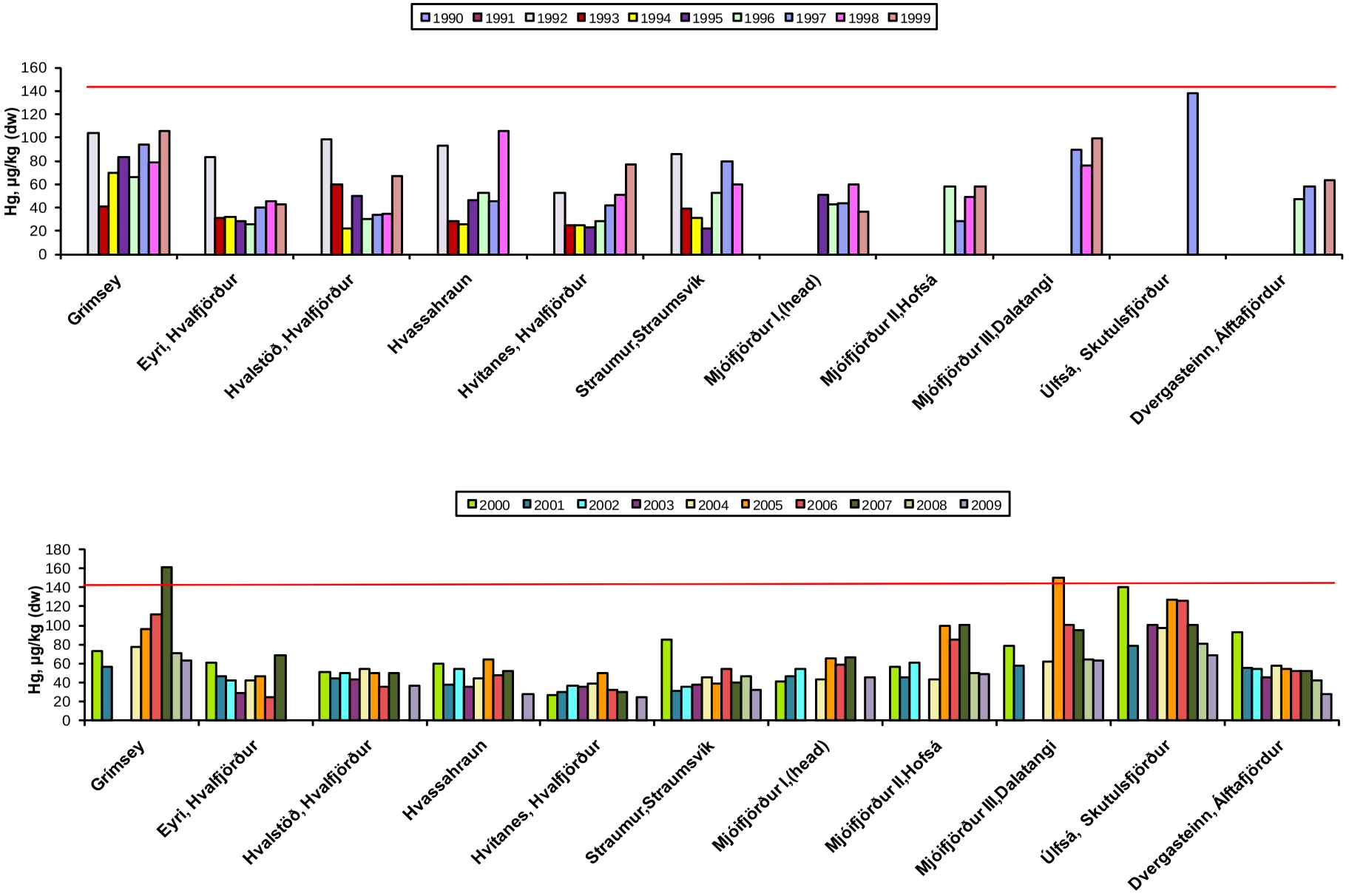


Figure 3d. Mercury concentration (dw) in Blue mussel (Mytilus edulis) around Iceland 1990-2009. Red line indicates ICES 90 75% baseline (11).

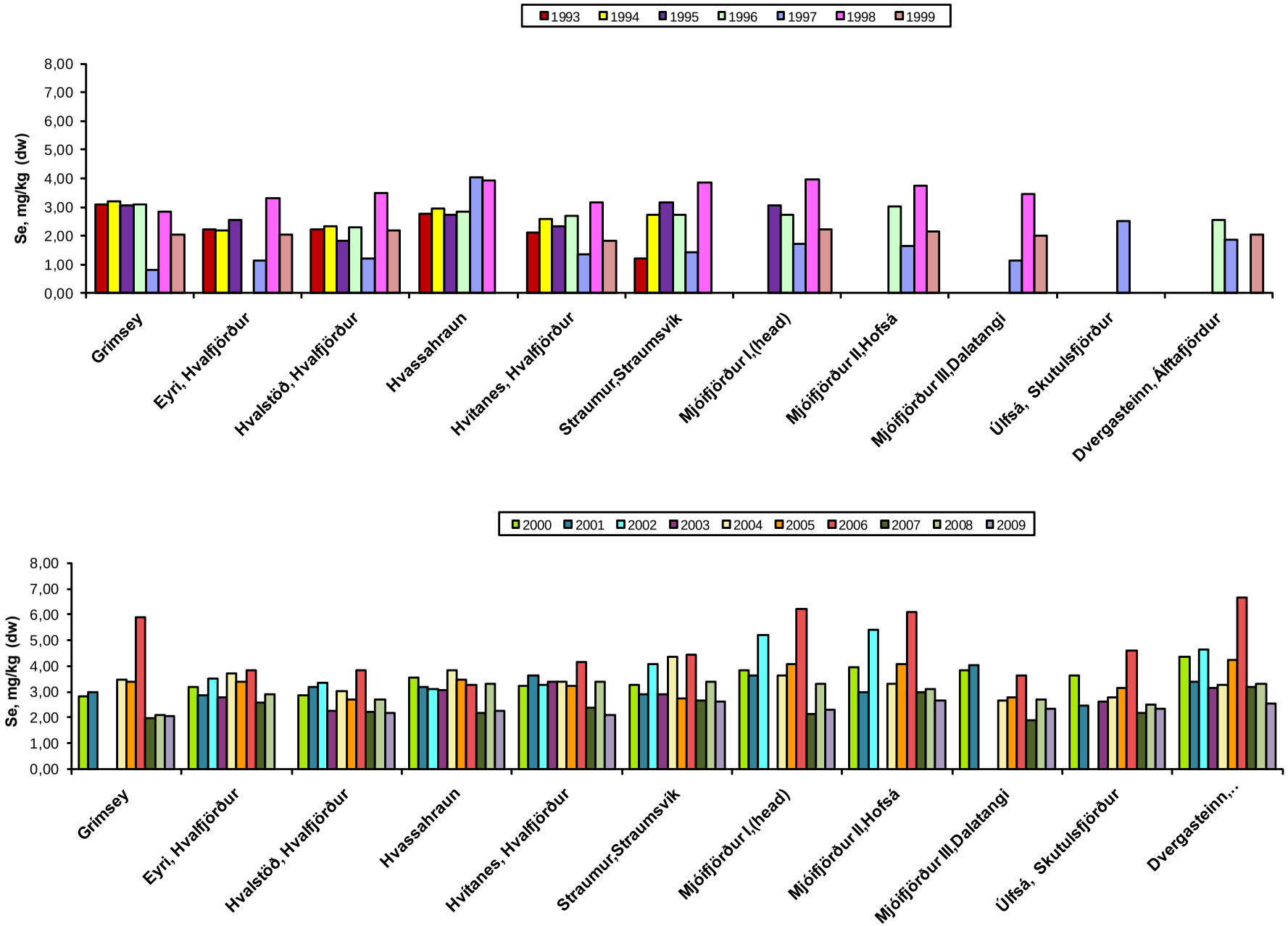


Figure 3e. Selenium concentration (dw) in Blue mussel (Mytilus edulis) around Iceland 1993-2009.

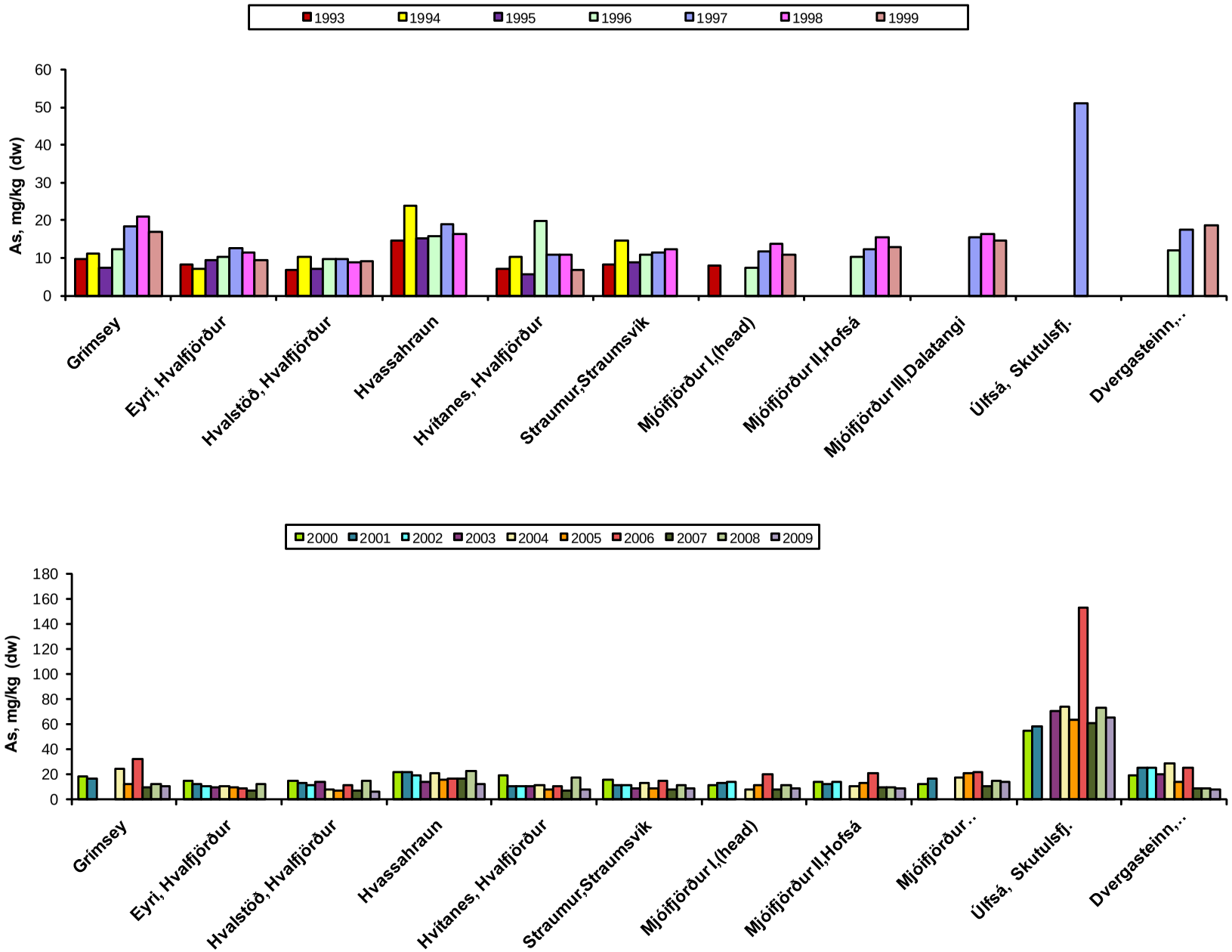


Figure 3f. Arsenic concentration (dw) in Blue mussel (Mytilus edulis) around Iceland 1993-2009.

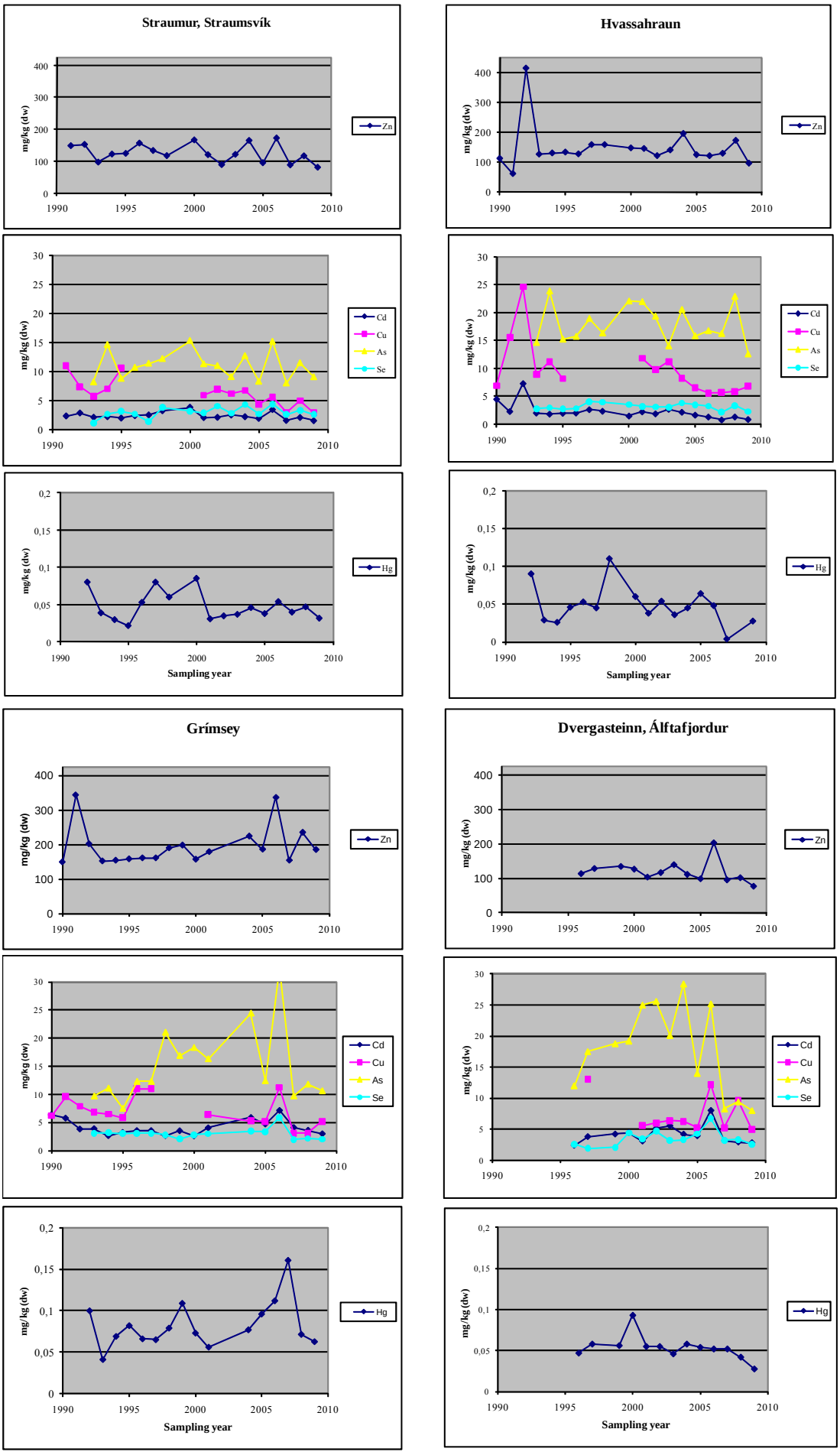


Figure 4a. Concentration of heavy metals (dry weight) in Blue mussel from different sampling sites around Iceland, 1990-2009.

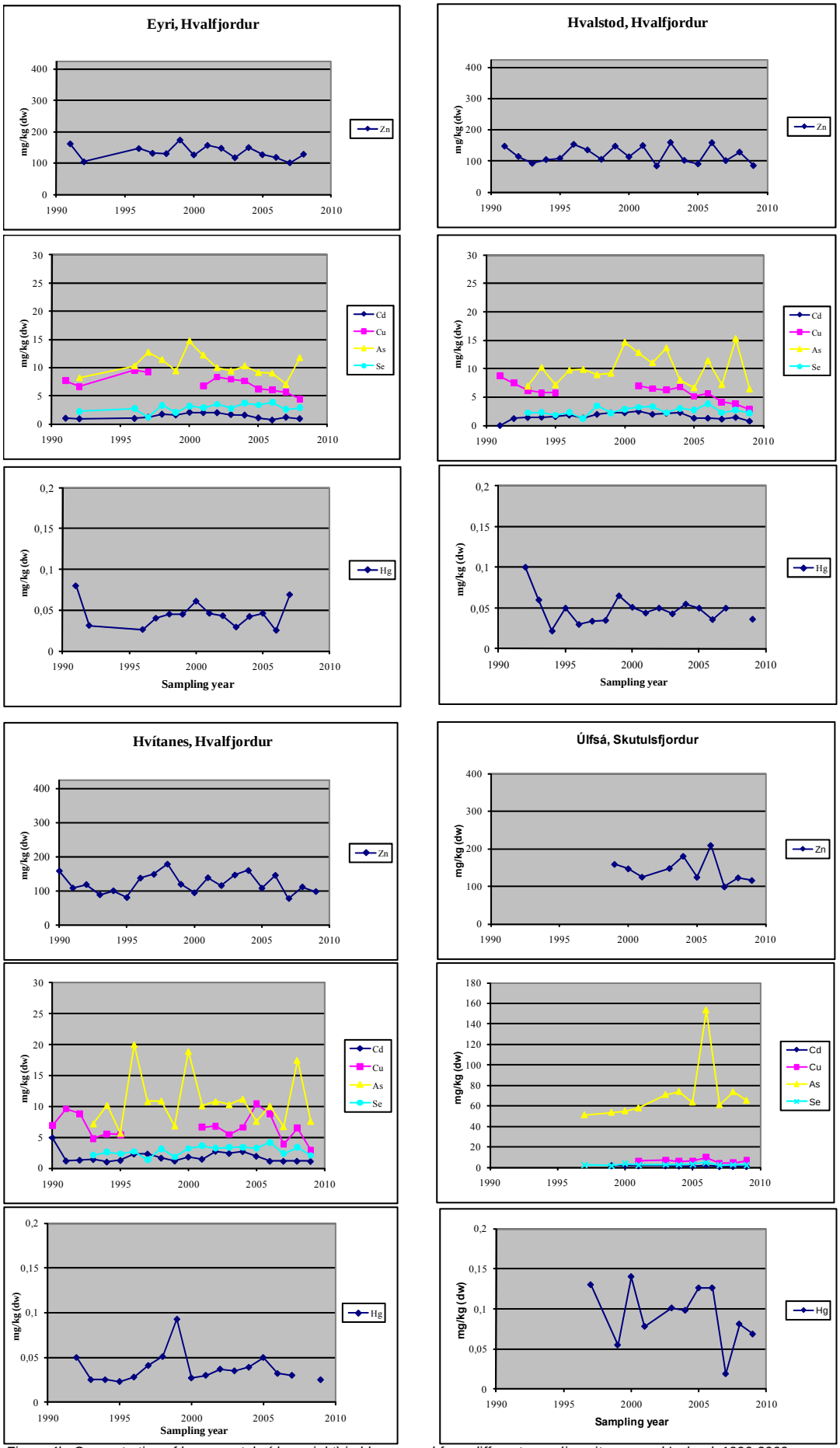


Figure 4b. Concentration of heavy metals (dry weight) in blue mussel from different sampling sites around Iceland, 1990-2009.

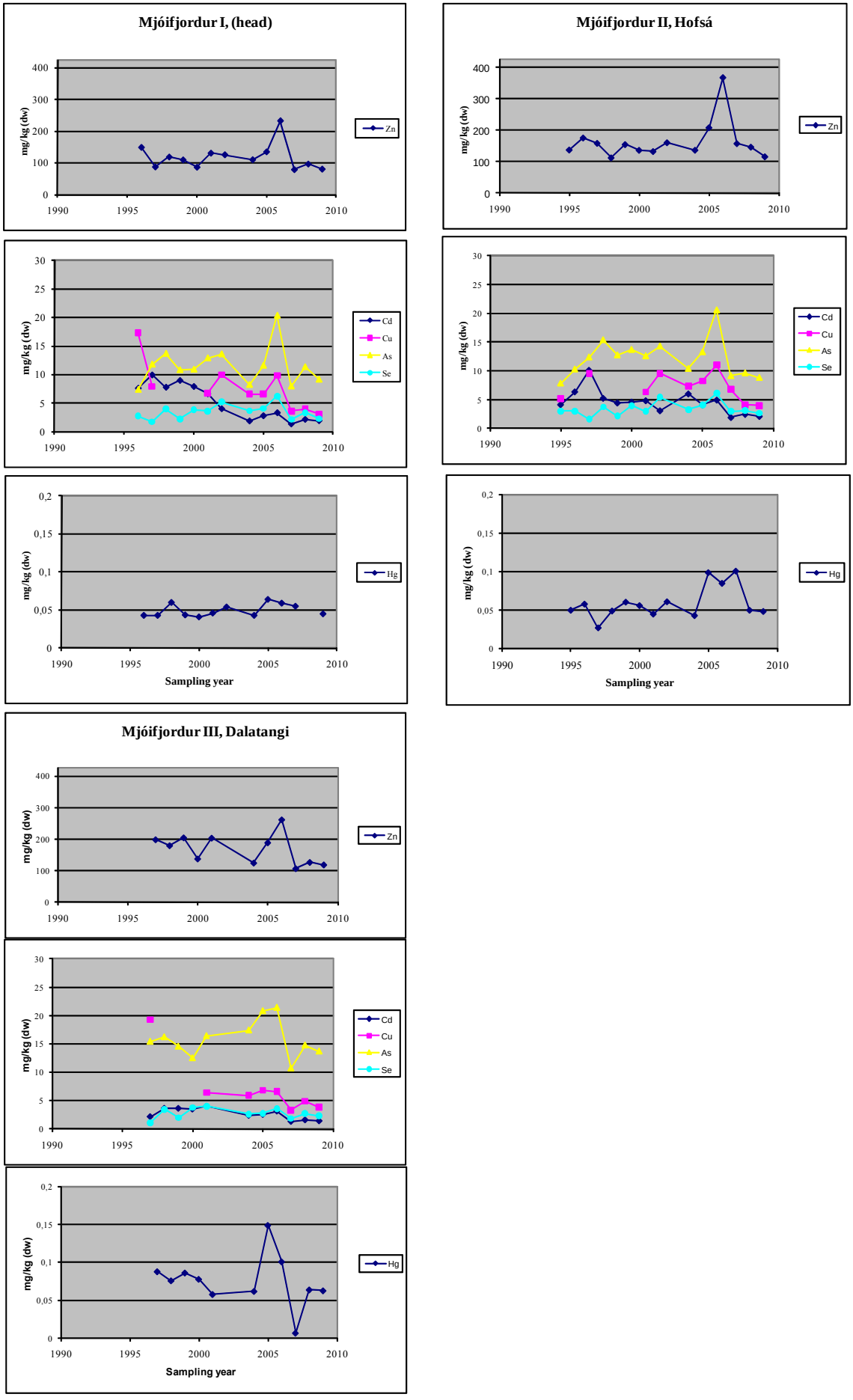


Figure 4c. Concentration of heavy metals (dry weight) in blue mussel from different sampling sites around Iceland, 1990-2009.

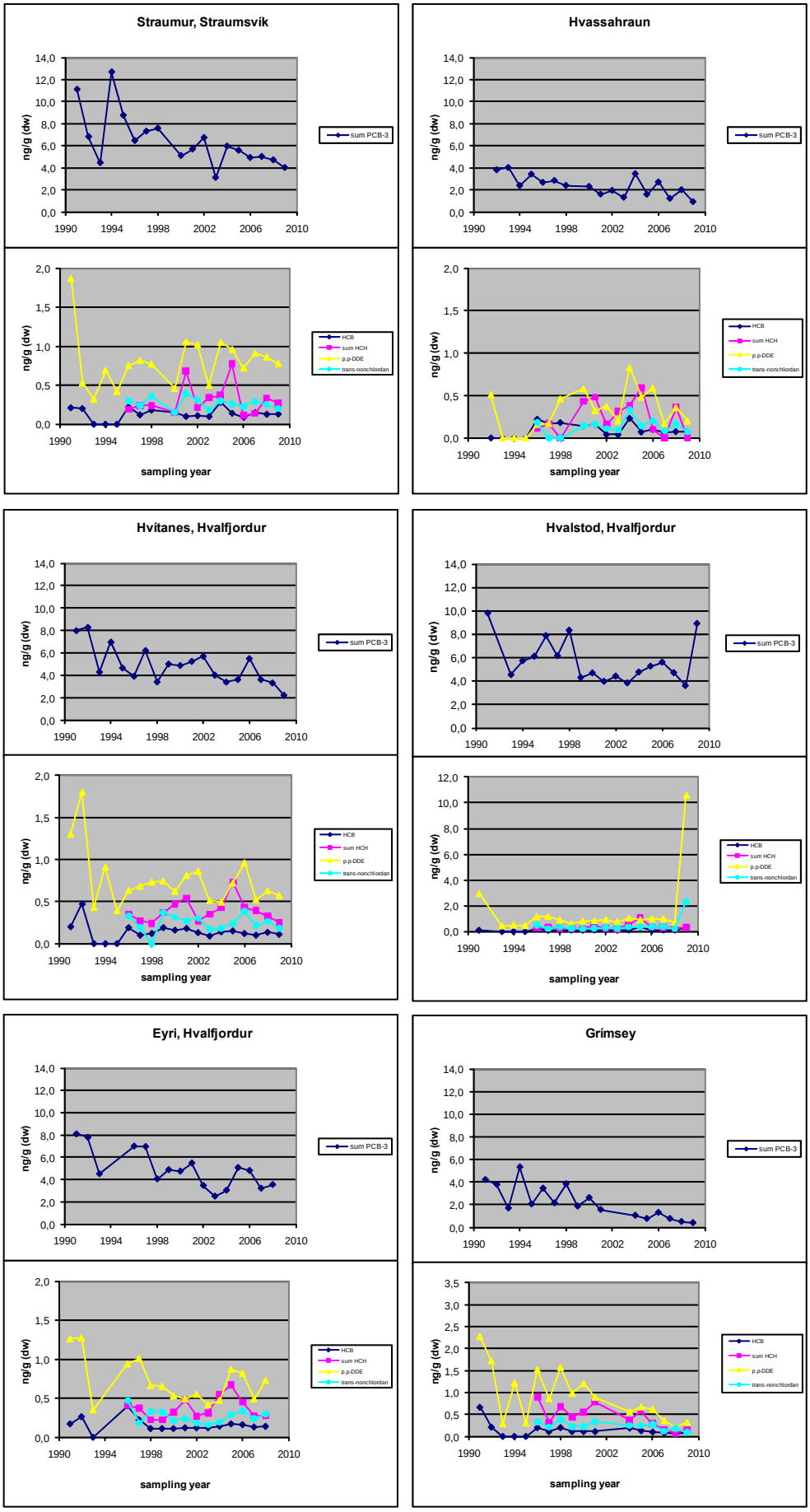


Figure 5a. Concentration of organochlorine compounds (dw) in Blue mussel (Mytilus edulis) at different locations 1991-2009.

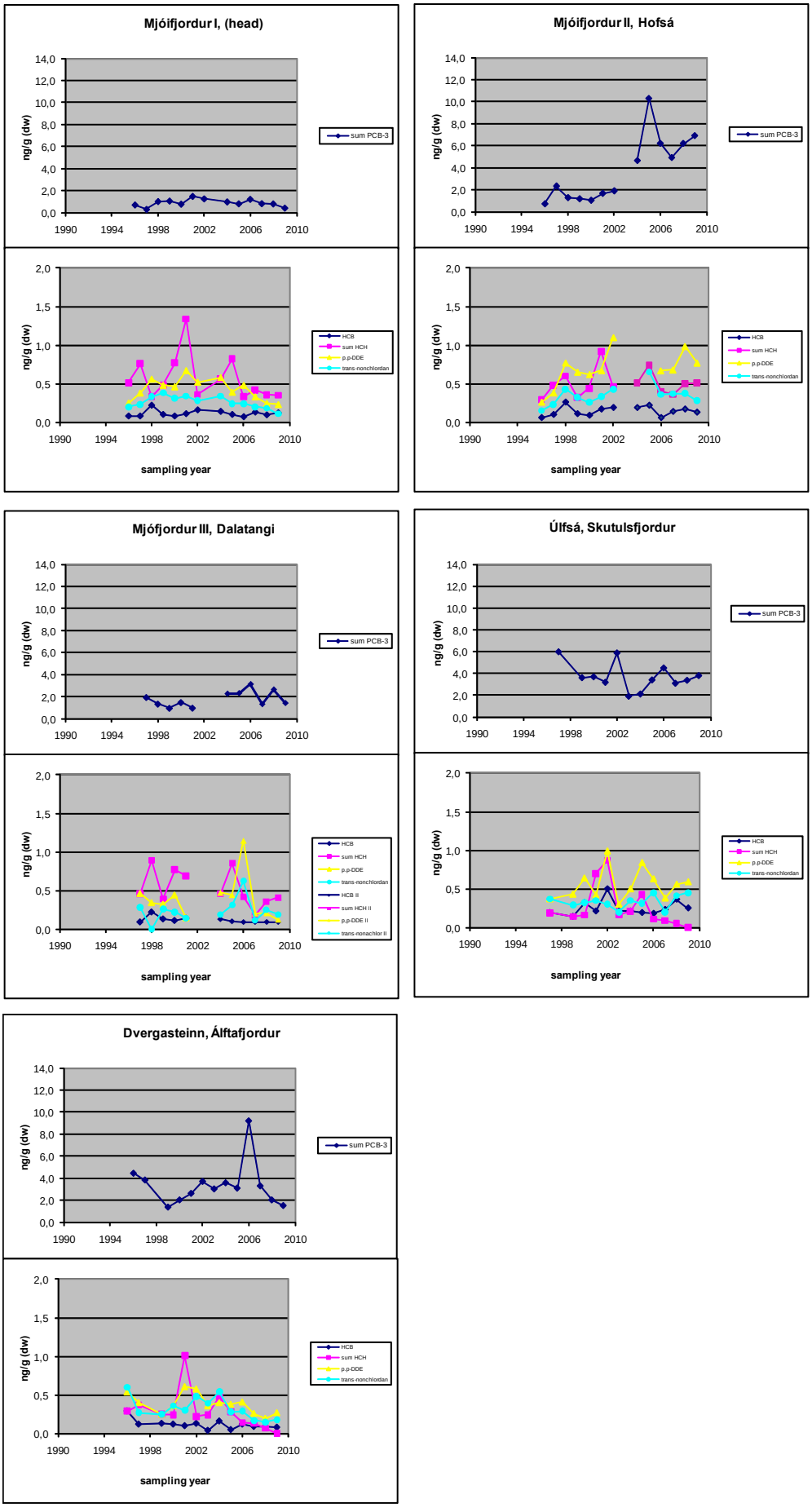


Figure 5b. Concentration of organochlorine compounds (dw) in Blue mussel (Mytilus edulis) at different locations 1991-2009.

Appendix VIII.

Graphs of metals and organic compounds in Cod (*Gadus morhua*) 1990-2009

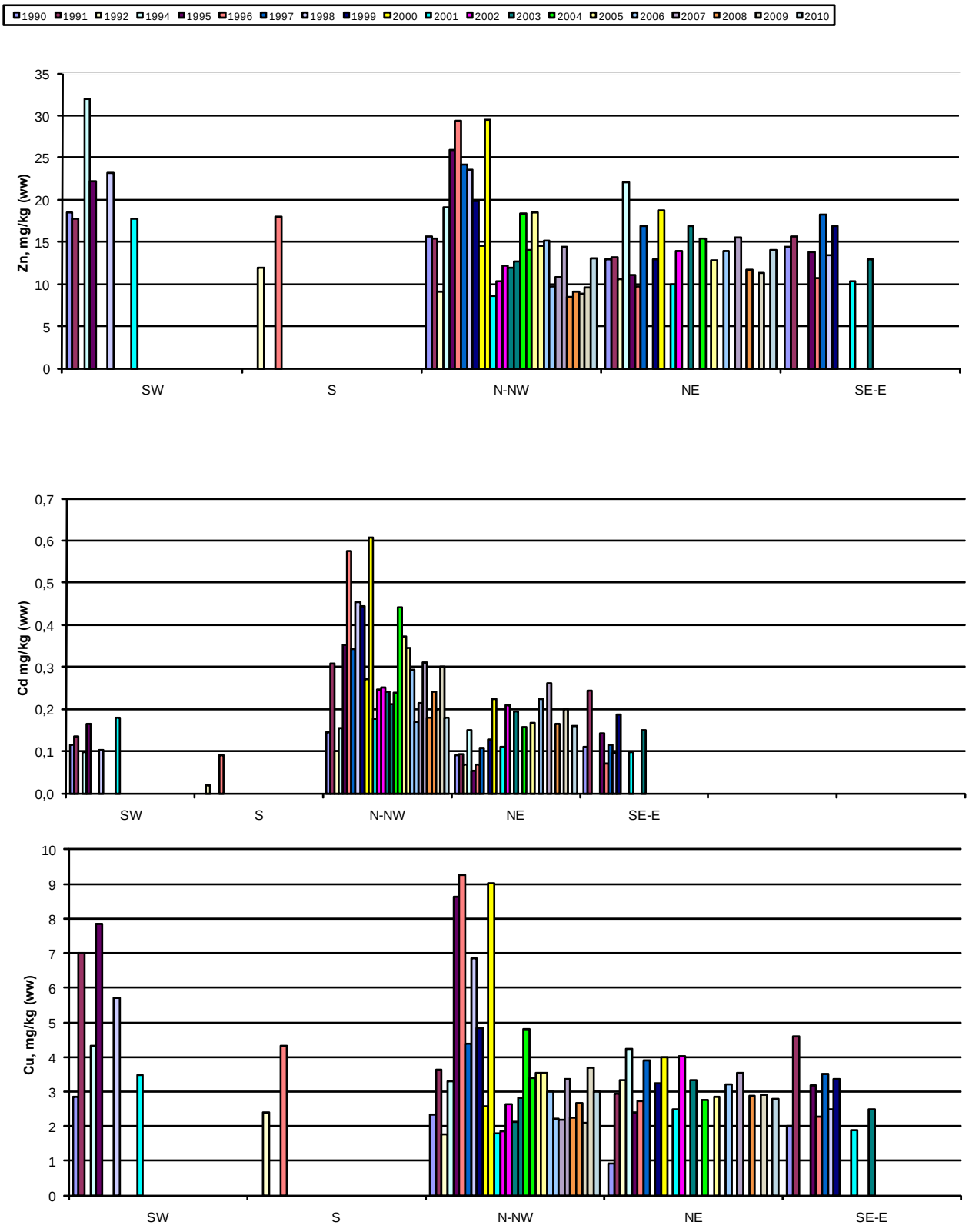


Figure 6a. Heavy metal concentration (ww) in livers of 30-45cm cod (Gadus morhua) from Icelandic waters in March 1990-2010.

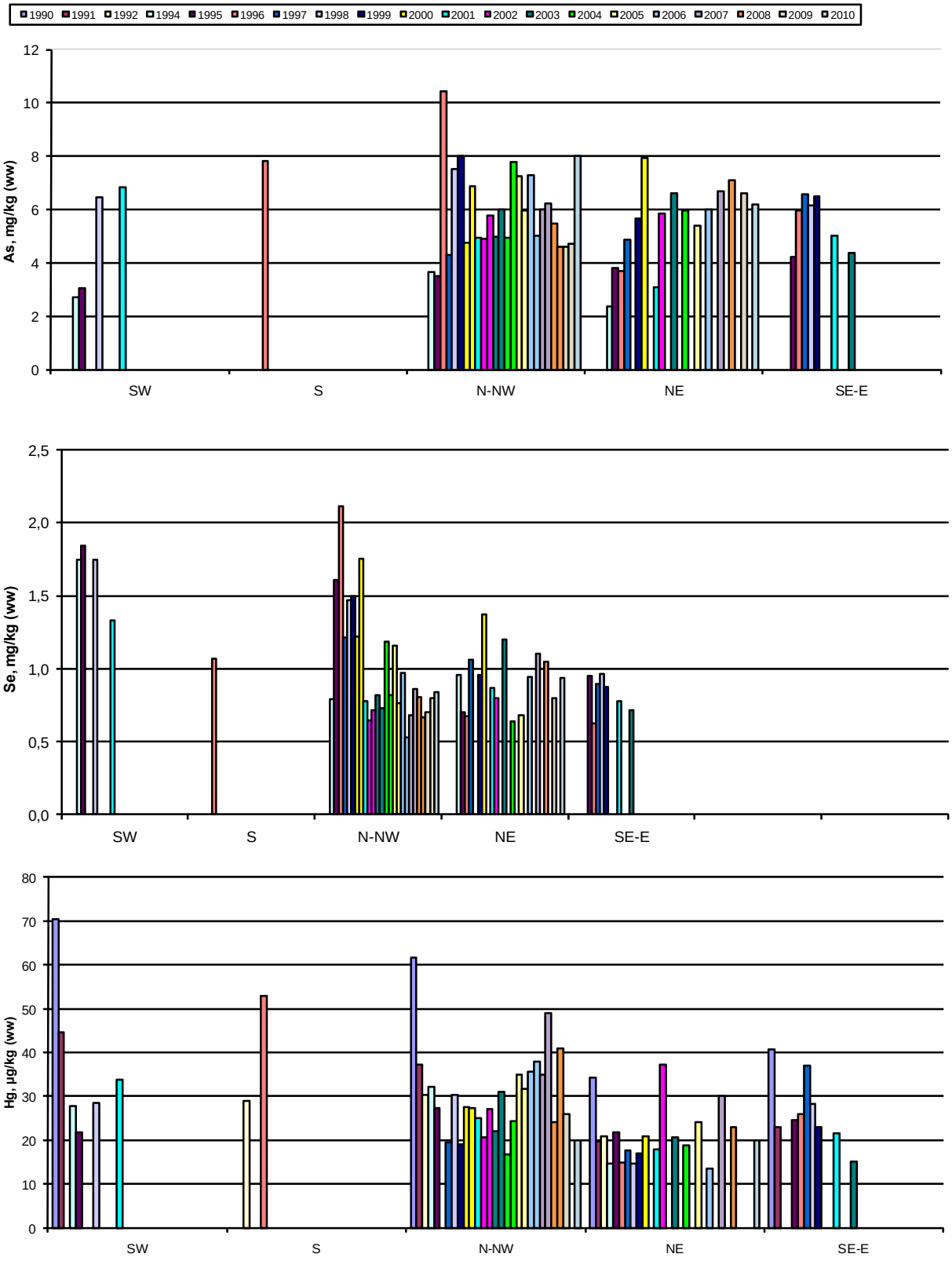


Figure 6b. Heavy metal concentration (ww) in livers of 30-45cm cod (Gadus morhua) from Icelandic waters in March 1990-2010 Mercury (Hg) was analysed in the flesh

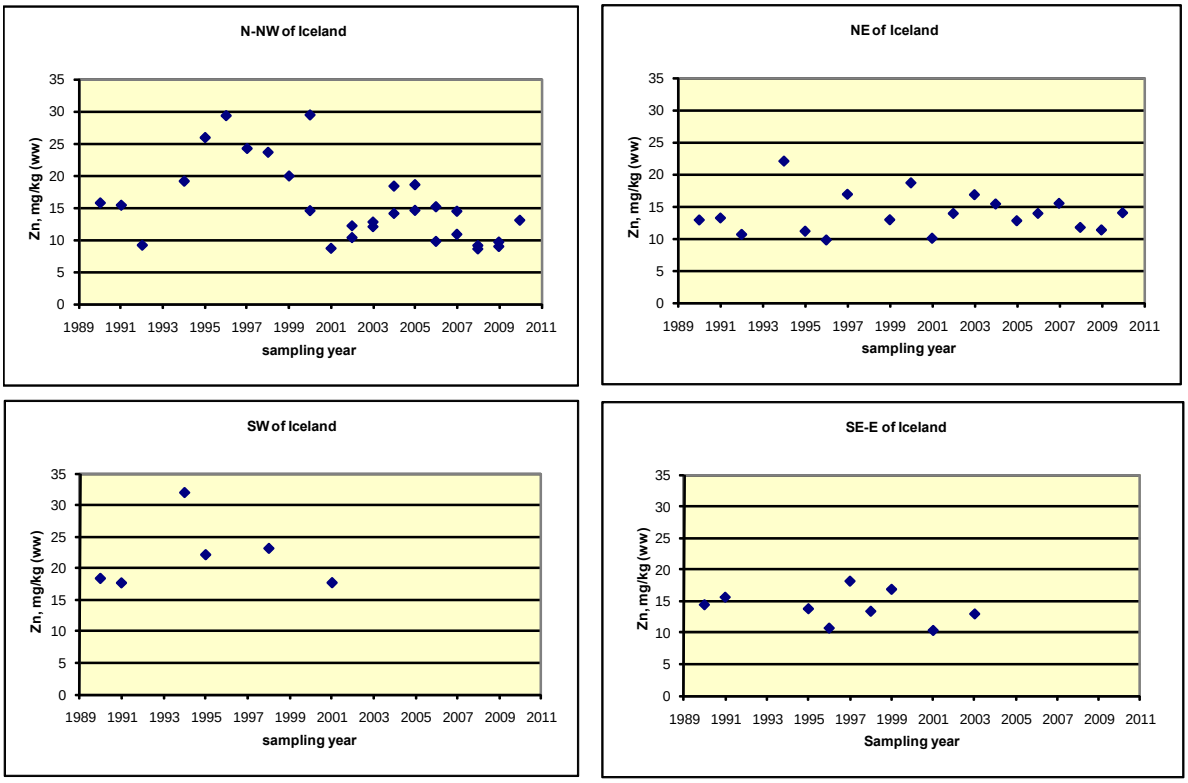


Figure 7a. Average concentration of Zinc (ww) in livers of 30-45 cm Cod (Gadus morhua) from different locations in Icelandic waters in March 1990-2010.

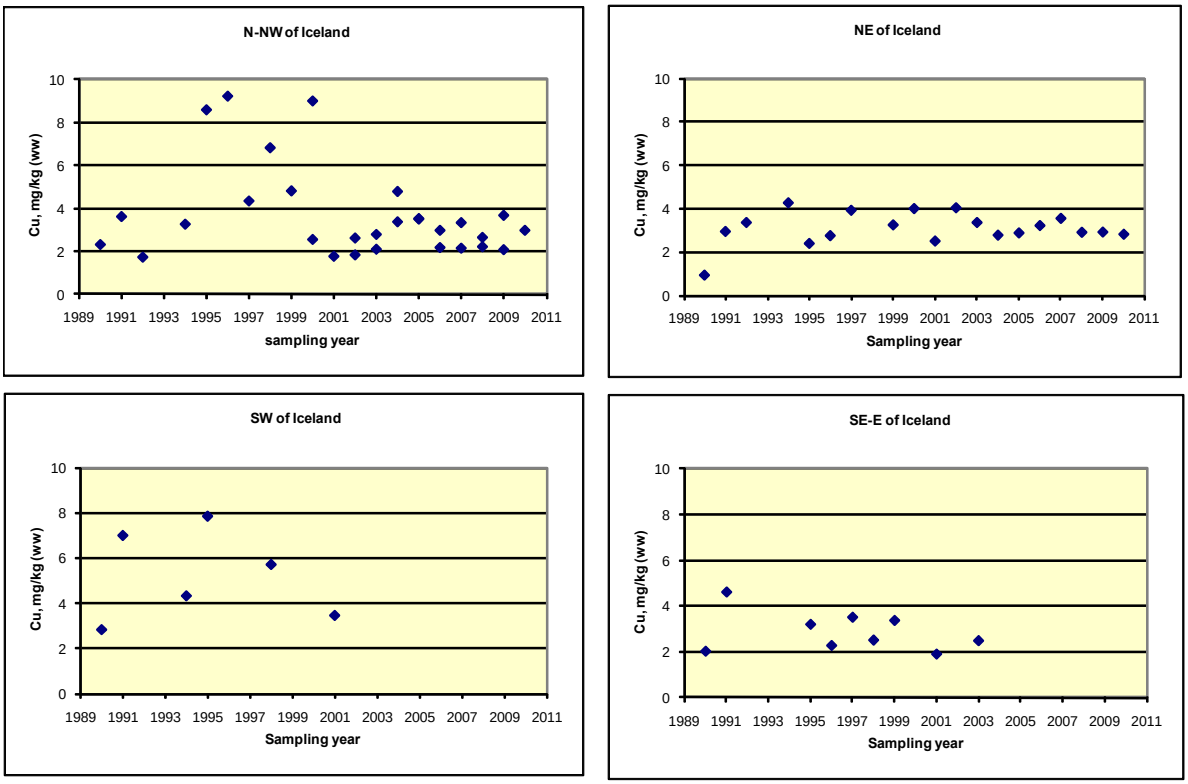


Figure 7b. Average concentration of Copper (ww) in livers of 30-45 cm Cod (Gadus morhua) from different locations in Icelandic waters in March 1990-2010.

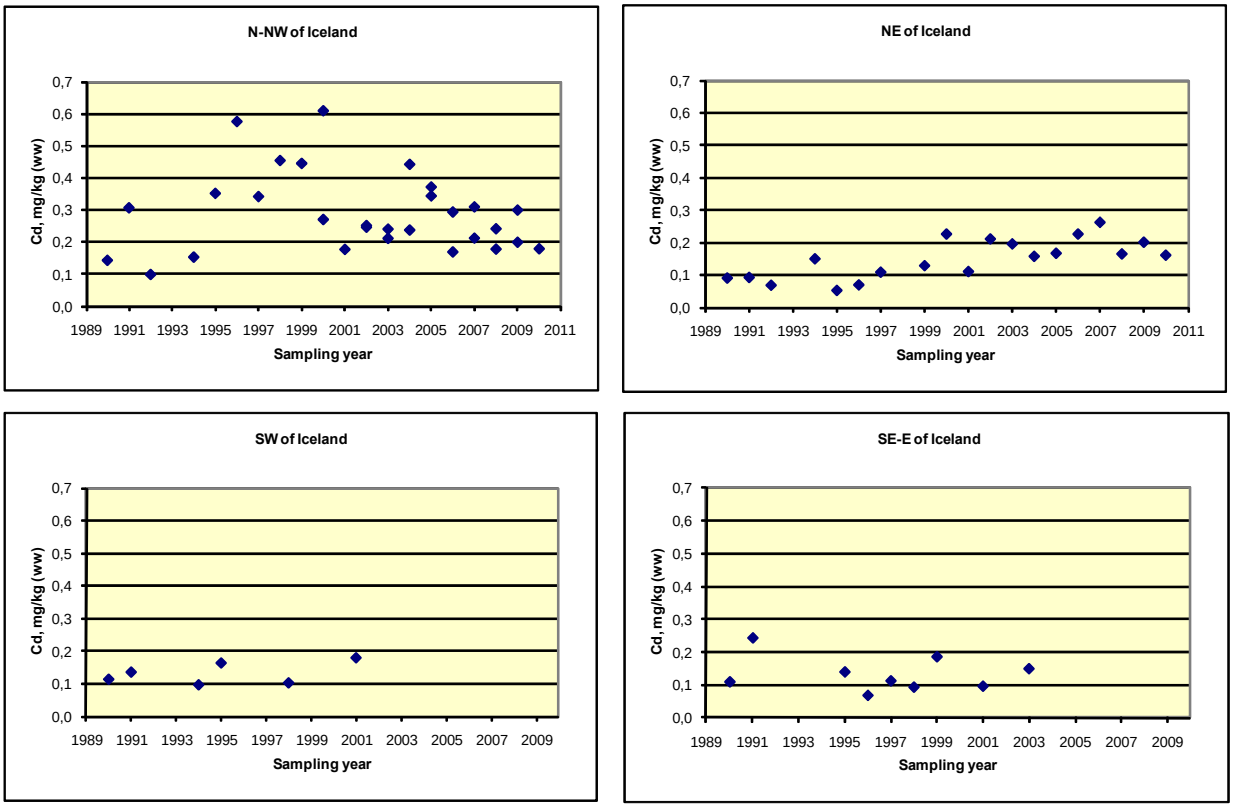


Figure 7c. Average concentration of Cadmium (ww) in livers of 30-45 cm Cod (Gadus morhua) from different locations in Icelandic waters in March 1990-2010.

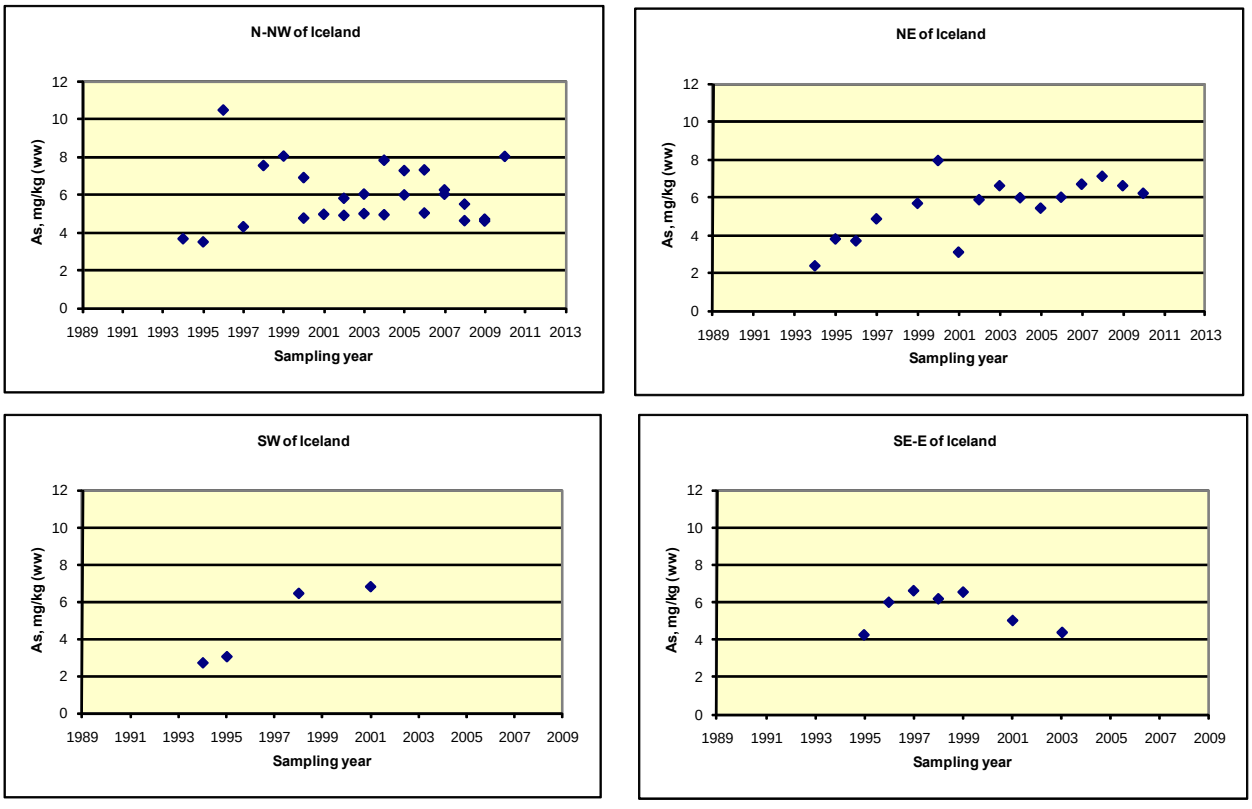


Figure 7d. Average concentration of Arsenic (ww) in livers of 30-45 cm Cod (Gadus morhua) from different locations in Icelandic waters in March 1990-2010.

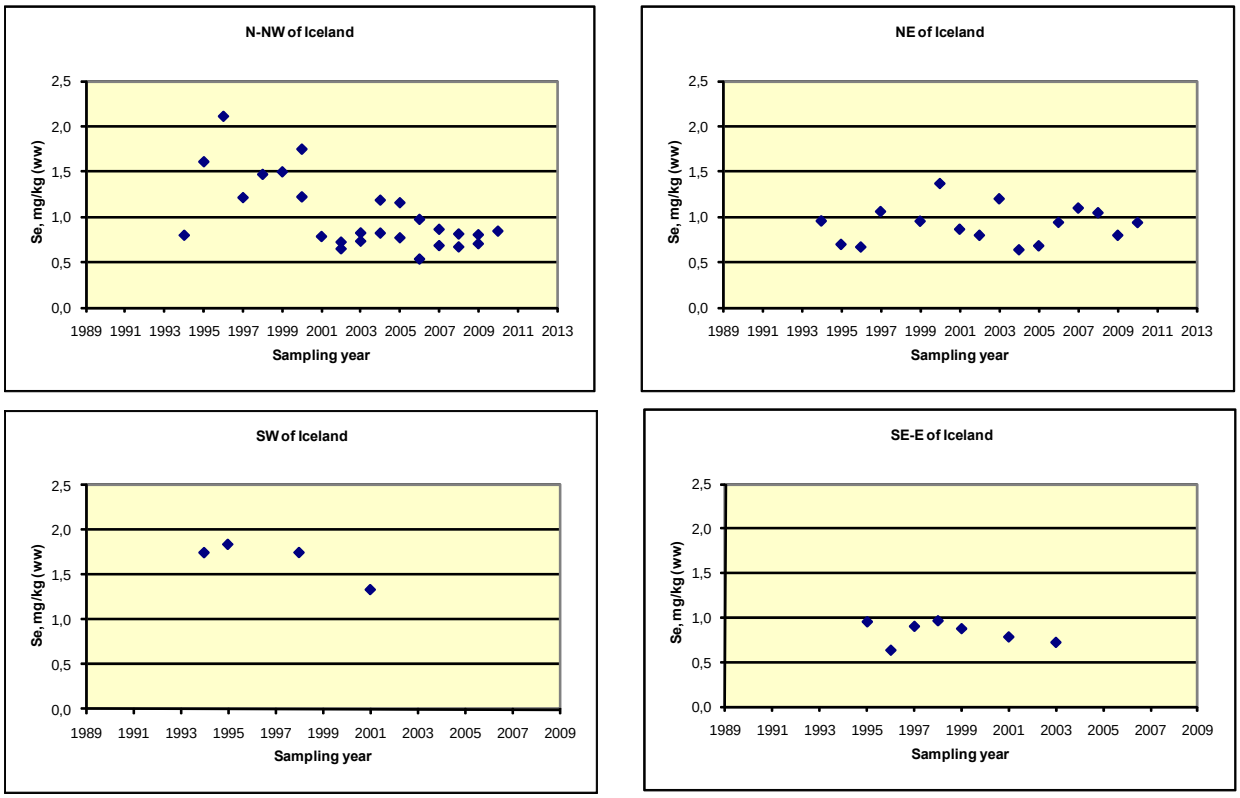


Figure 7e. Average concentration of Selenium (ww) in livers of 30-45 cm Cod (Gadus morhua) from different locations in Icelandic waters in March 1990-2010.

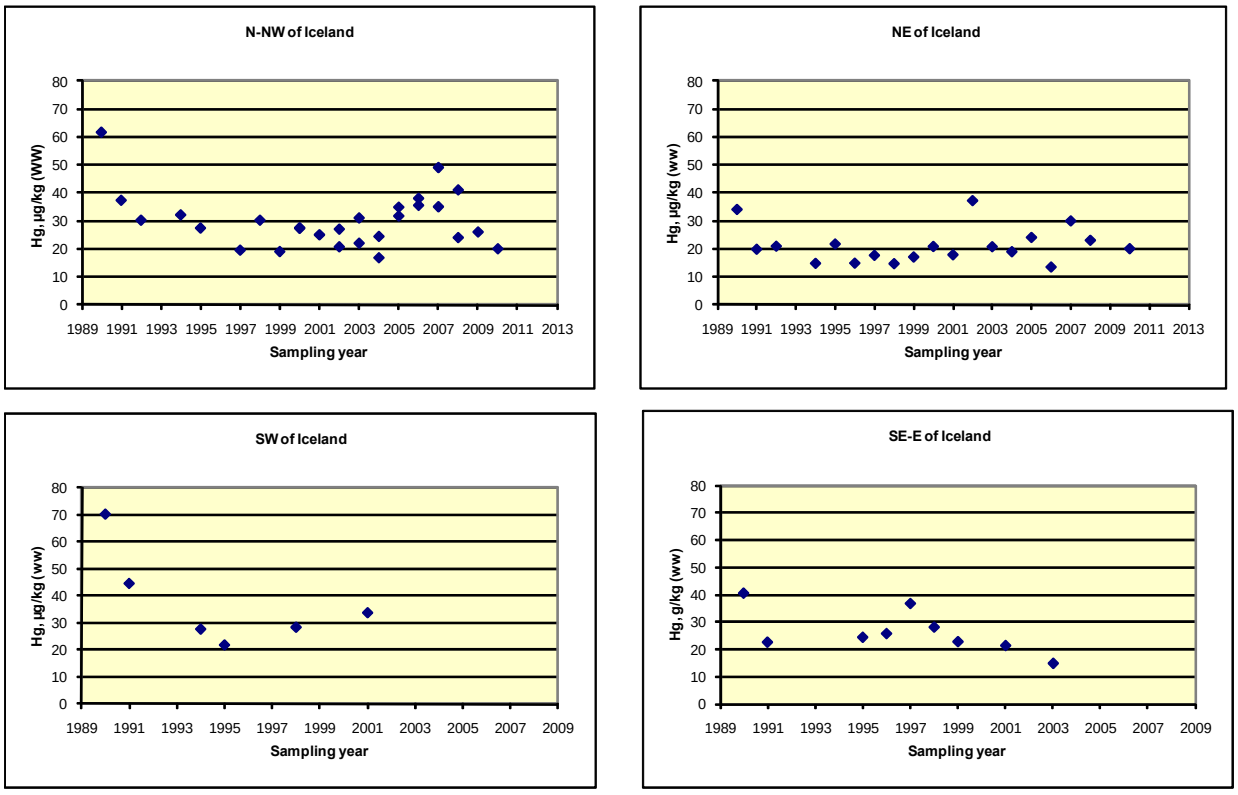
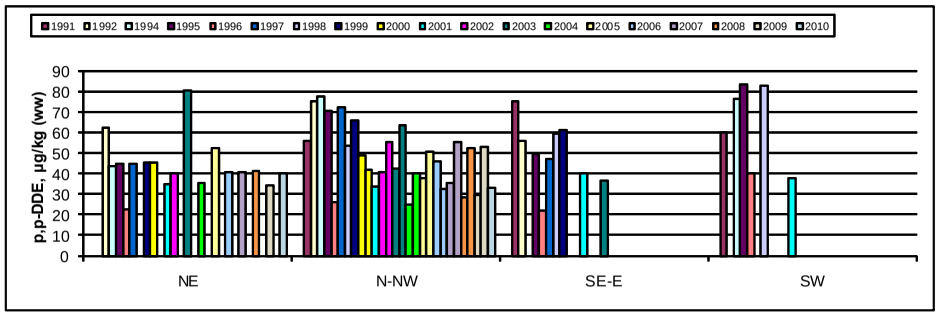
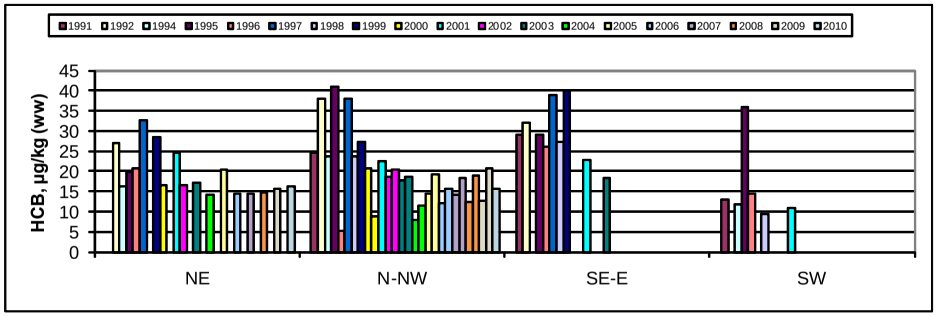
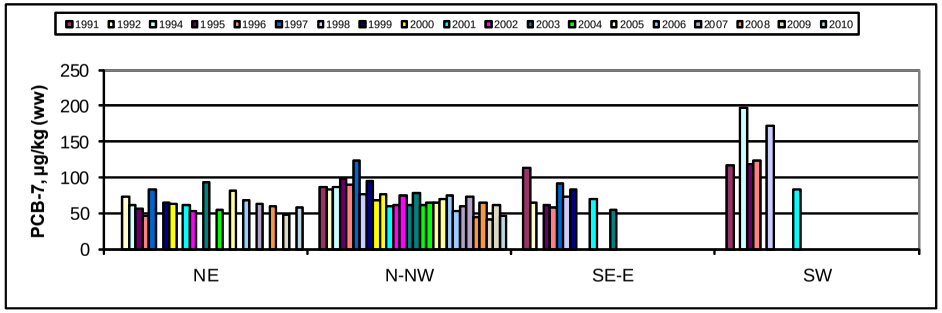
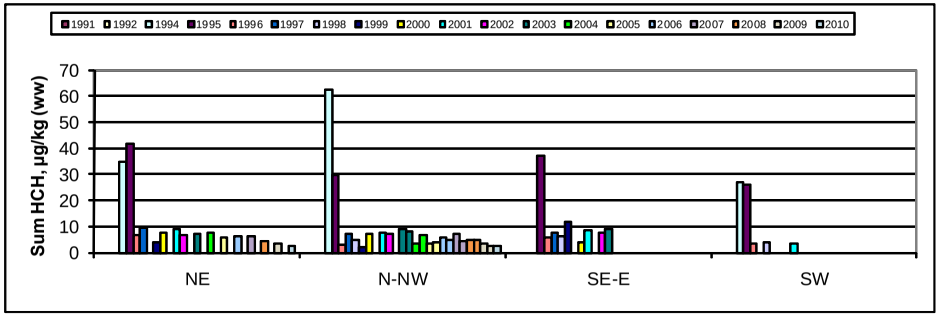


Figure 7f. Average concentration of Mercury (ww) in flesh of 30-45 cm Cod (Gadus morhua) from different locations in Icelandic waters in March 1990-2010.









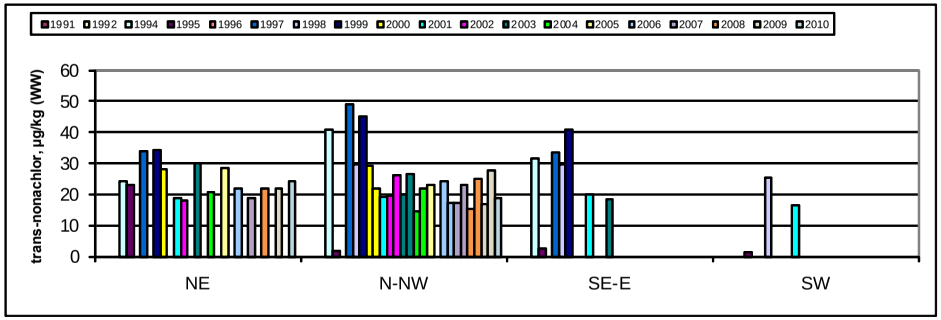


Figure 8. Average concentration of organochlorine compounds (ww) in livers of 30-45 cm Cod (Gadus morhua) from different locations in Icelandic waters in March 1991-2010.

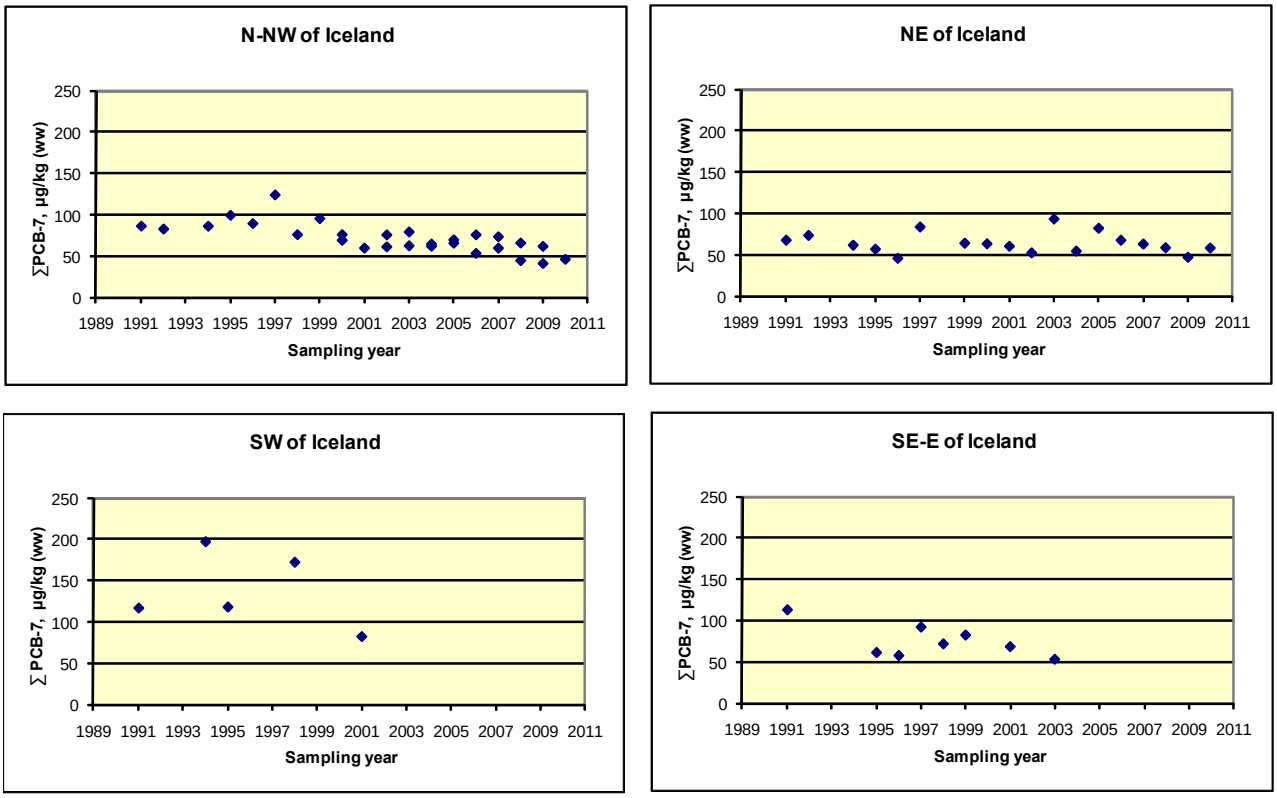


Figure 9a. Average concentration of ∑PCB-7 (ww) in livers of 30-45 cm Cod (Gadus morhua) from different locations in Icelandic waters in March 1991-2010.

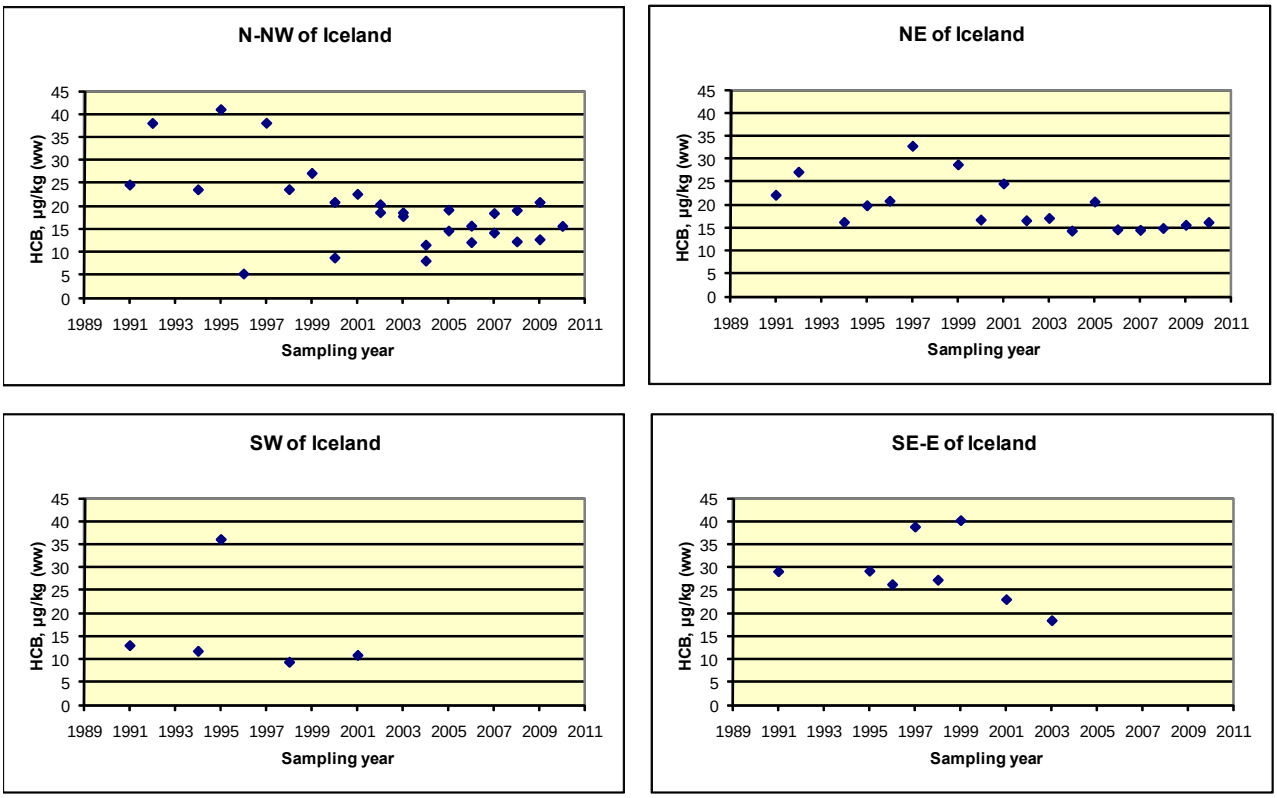


Figure 9b. Average concentration of HCB (ww) in livers of 30-45 cm Cod (Gadus morhua) from different locations in Icelandic waters in March 1991-2010.

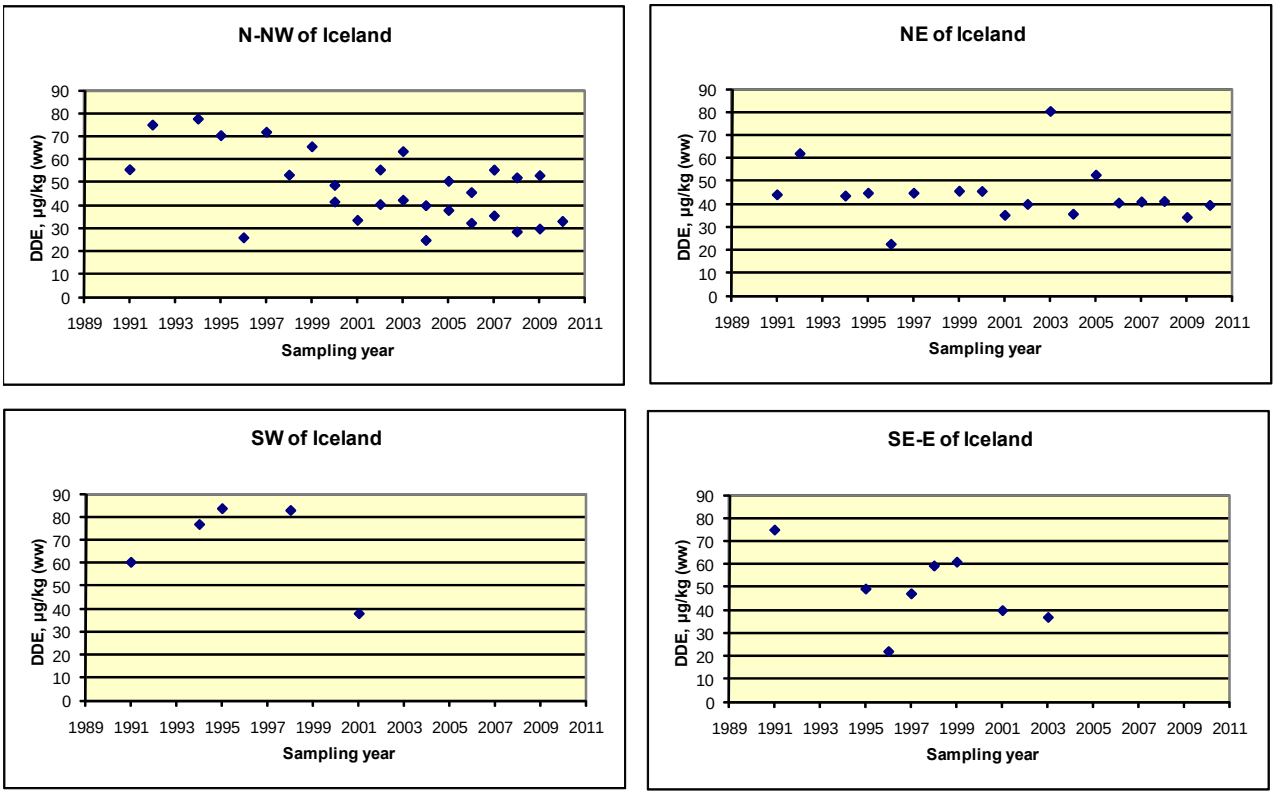


Figure 9c. Average concentration of DDE (ww) in livers of 30-45 cm Cod (Gadus morhua) from different locations in Icelandic waters in March 1991-2010.

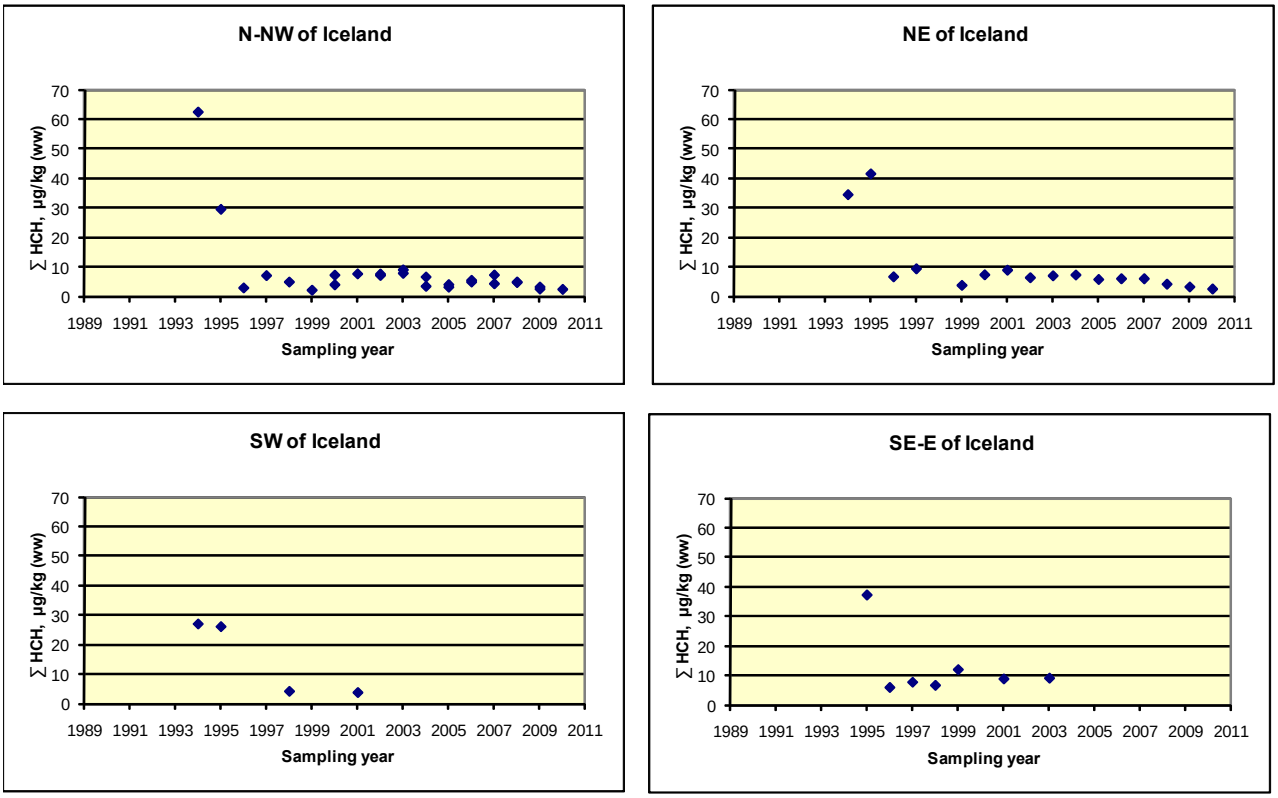


Figure 9d. Average concentration of ∑HCH (ww) in livers of 30-45 cm Cod (Gadus morhua) from different locations in Icelandic waters in March 1991-2010.

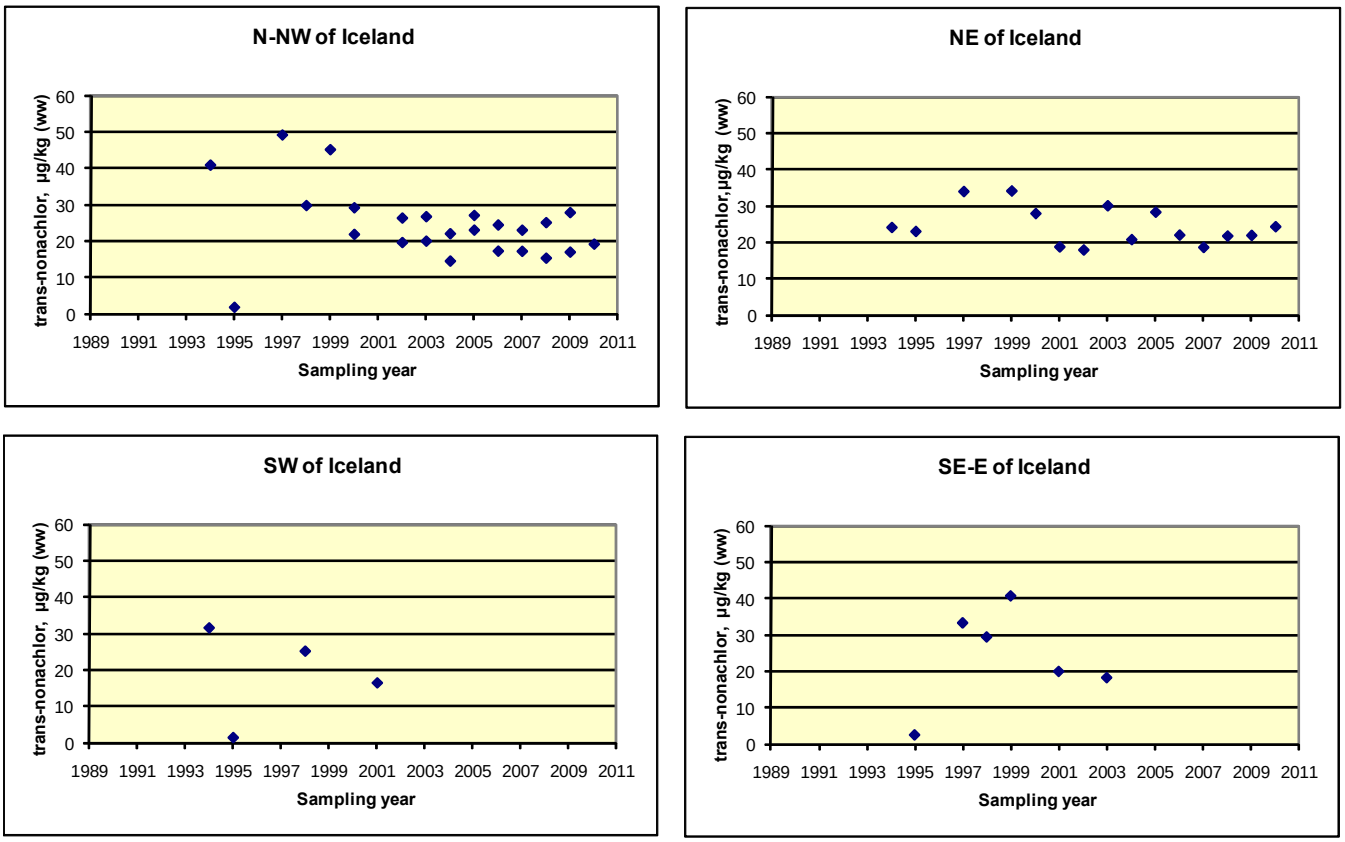


Figure 9e. Average concentration of transnonachlor (ww) in livers of 30-45 cm Cod (Gadus morhua) from different locations in Icelandic waters in March 1991-2010.