REPORT

Results from the Swedish National Screening Programme 2010

Subreport 1. Polychlorinated naphthalenes (PCNs)

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Report Summary

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Results from the Swedish National Screening Programme 2010
Subreport 1. Polychlorinated Naphthalenes (PCNs)

Summary

A screening study has been performed concerning Polychlorinated Naphthalenes (PCNs). These chemicals are currently not used in Sweden, but may be unintentionally emitted from various sources. The current project indicates that PCNs are ubiquitous in the Swedish environment. PCNs were found in all samples analysed and based on the results it was possible to identify several sources of PCNs. Long-range air transport is most likely a significant source of PCNs. Further, municipal solid waste incinerators, municipal solid waste dump sites, metal processing facilities and chlor-alkali production plants all seem to emit PCNs. On the contrary, traffic is likely a minor source of PCNs.
Sludge from municipal sewage treatment plants has a homologue pattern similar to air, which may indicate that PCNs mainly reach the sewer systems through collection of storm water. A gradient in PCN concentrations were also observed in sediments collected at increasing distance from Stockholm. However, the concentrations were in the range of background (offshore) sediments, which suggest that the urban impact on the PCN levels are minor to moderate.
In biota the PCN levels seems to decrease over time. The time trend for PCNs in guillemot eggs could be followed for the last 35 years and over that period the concentrations have dropped by an order of magnitude, although, during the last decade the levels has levelled off. The long term time-trend and short-term temporal variations of PCNs resembles those of polychlorinated dibenzo-*p*-dioxins and dibenzofurans (PCDD/Fs) they may thus share the same bioaccumulation/biomagnification pathways. Furthermore, human milk was found to contain relatively high concentrations of PCNs. Expressed on relative biological potency (REP) basis the levels are similar to the total toxic equivalents (TEQs) of PCDD/F. The weekly PCN-REP intake for a 1-month baby was estimated at 22 pg/kg body weight (bw), which is above the tolerable weekly intake of 14 pg TEQ/kg bw recommended by EU Scientific Committee of Food. It may, thus, be time to consider the PCNs for inclusion in the TEQ concept of the World Health Organization and assign the most toxic congeners toxic equivalent factors (TEFs).

Keyword

Polychlorinated naphthalenes, PCNs, screening, sources and fate, environmental levels.

Bibliographic data

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Summary

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PCNs were found in all samples analysed and based on the results it was possible to identify several sources of PCNs. Long-range air transport is most likely a significant pathway of PCNs. Further, municipal solid waste incinerators, municipal solid waste dump sites, metal processing facilities and chlor-alkali production plants all seem to emit PCNs. On the contrary, traffic is likely a minor source of PCNs.

Sludge from municipal sewage treatment plants has a homologue pattern similar to that in air, which may indicate that PCNs mainly reach the sewer systems through collection of storm water. A gradient in PCN concentrations were also observed in sediments collected at increasing distance from Stockholm. However, the concentrations were in the range of background (offshore) sediments, which suggest that the urban impact on the PCN levels are minor to moderate.

Decreasing PCN concentrations over time was observed for both herring and guillemot. For the latter, the time trend could be followed over the last 35 years. Over this period the PCN concentrations have dropped by one order of magnitude. However, during the last decade the levels has levelled off. Since the long term time-trend and short term temporal variations of the PCNs resembles closely those of the polychlorinated dibenzo-*p*-dioxins and dibenzofurans (PCDD/Fs) they may share the same bioaccumulation/biomagnification pathways.

Human milk was found to contain relatively high concentrations of PCNs. Expressed on relative biological potency (REP) basis the levels are similar to the total toxic equivalents (TEQs) of PCDD/F. The weekly PCN-REP intake for a 1-month baby was estimated to be 22 pg/kg body weight, which is above the tolerable weekly intake of 14 pg TEQ/kg body weight recommended by EU Scientific Committee of Food. That indicates that it may be time to consider the PCNs for inclusion in the TEQ concept of the World Health Organization (WHO) and assign the most toxic congeners consensus toxic equivalent factors (TEFs).

Sammanfattning

En screeningundersökning har utförts angående polyklorerade naftalener (PCN).

PCN hittades i alla prover som analyserats och baserat på resultaten var det möjligt att identifiera flera källor. Långväga lufttransport är sannolikt en betydande spridningsväg för PCN. Kommunala avfallsförbränningsanläggningar och soptippar samt metallförädlings- och kloralkali-industri verkar även de släppa ut PCN men det är svårt att skatta dess kvantitativa betydelse för den totala PCN belastningen. Däremot verkar trafiken sannolikt vara en mindre källa till PCN.

Slam från kommunala reningsverk har en homologprofil som liknar den i luft, vilket kan tyda på att PCN främst når avloppssystemen via dagvatten. En gradient i PCN-koncentrationer observerades även i sediment som samlats in på ökande avstånd från Stockholm. Dock var halterna inom intervallet för bakgrundssediment (utsjöprover), vilket tyder på att den urbana påverkan är liten eller måttlig.

PCN-koncentrationerna minskar över tid i både strömming och sillgrissla. För den senare kunde tidstrenden följas under de senaste 35 åren. Under denna period sjönk PCN-koncentrationerna tiofalt. Under det senaste årtiondet har dock nivåerna planat ut. Den långsiktiga tidstrenden och de kortsiktiga haltvariationerna för PCN är mycket lika de för polyklorerade dibenso-*p*-dioxiner och dibensofuraner (PCDD/F) vilket tyder på att dessa ämnesklasser bioackumulerar/biomagnifierar på liknande sätt.

Bröstmjölk befanns innehålla relativt höga halter av PCN. Omräknat som relativ biologisk potens (REP) motsvarar halterna de för PCDD/F (uttryckt i totala toxiska ekvivalenter; TEQs). Veckointaget av PCN-REP beräknades till 22 pg/kg kroppsvikt för en 1-månaders bebis, vilket ligger över det tolerabla veckointag på 14 pg TEQ/kg kroppsvikt som rekommenderas av EU:s vetenskapliga kommitté för livsmedel. Det tyder på att det kan vara dags att överväga att inkludera PCN i TEQ-begreppet och att Världshälsoorganisationen (WHO) i så fall fastställer toxiska ekvivalentfaktorer (TEF) för de mest toxiska kongenerna.

Table of contents

1 Introduction

As an assignment from the Swedish Environmental Protection Agency, screening studies of Polychlorinated naphtalenes (PCN), Fluorescent whitening agents (FWA) and Pharmaceuticals have been performed during 2010/2011.

The overall objectives of the screening studies are to determine concentrations of the selected substances in a variety of media in the Swedish environment, to highlight important transport pathways, and to assess the possibility of current emissions in Sweden. The results are presented in three separate reports according to Table 1.

Table 1. Substance groups included in the screening.

Substance group	Sub-report #
Polychlorinated naphtalenes (PCN)	1
Fluorescent whitening agents	2
Pharmaceuticals	3

The screening study has been carried out by Swedish Environmental Research Institute (IVL) together with Umeå University (UmU). The chemical analyses of the fluorescent whitening agents were undertaken at IVL, PCN and pharmaceuticals were analysed at UmU.

This sub-report concerns the screening of polychlorinated naphthalenes. Polychlorinated naphthalenes (PCNs) are currently not used in Sweden but have been used in various technical applications and may also be emitted upon combustion of chlorine containing fuels.

2 Chemical properties, fate and toxicity

2.1 Structure and Properties

Polychlorinated naphthalenes (PCNs) is a group of substances structurally similar to dioxins and consists of 75 congeners (Weidmann, 1993). They are assessed as PBT and vPvB substances, depending on the number of chloro substituents (di- to pentachloro congeners meets vB).

The basic structure of PCNs is naphthalene, which has eight positions open for substitution with chlorine. Table 2 show the individual and groups of PCNs that has been quantified in the current study. These include the di- through octaCN homologues (for profile comparisons), the most persistent and bioaccumulative tetraCN, and all pentaCN, hexaCN and heptaCN congeners.

Table 2 Individual PCN and groups of PCNs that has been quantified in the current study.

CAS	Abbreviation	Name
91-20-3D	PCN	Chlorinated naphthalenes
28699-88-9	DiCN	Dichloronaphthalenes
1321-65-9	TrCN	Trichloronaphthaleners
1335-88-2	TeCN	Tetrachloronaphthalenes
1321-64-8	PeCN	Pentachloronaphthalenes
1335-87-1	HxCN	Hexachloronaphthalenes
32241-08-0	HpCN	Heptachloronaphthalenes
67922-22-9	PCN-36	1,2,5,6- Tetrachloronaphthalene
53555-64-9	PCN-42	1,3,5,7-Tetrachloronaphthalene
67922-25-2	PCN-49	1,2,3,4,5-Pentachloronaphthalene
67922-26-3	PCN-50	1,2,3,4,6-Pentachloronaphthalene
150224-18-3	PCN-51	1,2,3,5,6-Pentachloronaphthalene
53555-65-0	PCN-52	1,2,3,5,7-Pentachloronaphthalene
150224-24-1	PCN-53	1,2,3,5,8-Pentachloronaphthalene
150224-16-1	PCN-54	1,2,3,6,7-Pentachloronaphthalene
150224-23-0	PCN-55	1,2,3,6,8-Pentachloronaphthalene
150205-21-3	PCN-56	1,2,3,7,8-Pentachloronaphthalene
150224-20-7	PCN-57	1,2,4,5,6-Pentachloronaphthalene
150224-19-4	PCN-58	1,2,4,5,7-Pentachloronaphthalene
150224-25-2	PCN-59	1,2,4,5,8-Pentachloronaphthalene
150224-17-2	PCN-60	1,2,4,6,7-Pentachloronaphthalene
150224-22-9	PCN-61	1,2,4,6,8-Pentachloronaphthalene
150224-21-8	PCN-62	1,2,4,7,8-Pentachloronaphthalene
58877-88-6	PCN-63	1,2,3,4,5,6-Hexachloronaphthalene
67922-27-4	PCN-64	1,2,3,4,5,7-Hexachloronaphthalene
103426-93-3	PCN-65	1,2,3,4,5,8-Hexachloronaphthalene
103426-96-6	PCN-66	1,2,3,4,6,7-Hexachloronaphthalene
103426-97-7	PCN-67	1,2,3,5,6,7-Hexachloronaphthalene
103426-95-5	PCN-68	1,2,3,5,6,8-Hexachloronaphthalene
103426-94-4	PCN-69	1,2,3,5,7,8-Hexachloronaphthalene
17062-87-2	PCN-70	1,2,3,6,7,8-Hexachloronaphthalene
103426-95-5	PCN-71	1,2,4,5,6,8-Hexachloronaphthalene
103426-92-2	PCN-72	1,2,4,5,7,8-Hexachloronaphthalene
58863-14-2	PCN-73	1,2,3,4,5,6,7-Heptachloronaphthalene
58863-15-3	PCN-74	1,2,3,4,5,6,8-Heptachloronaphthalene
2234-13-1	PCN-75	Octachloronaphthalene

2.2 Toxicity

PCNs are planar chlorinated aromatic compounds with a structure and size similar to polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/Fs). Consequently, they share the same toxic mechanisms and effects. The toxic responses are initiated upon binding to the Ah receptor and include, among others, induction of the EROD and AHH enzyme systems. Different congeners have varying ability to bind to the Ah-receptor and cause enzyme induction. Currently there are not enough data available to allow consensus TEFs to be established. However, data are available for more than 20 congeners and these have been used to estimate (using quantitative structure-activity relationships, QSARs) relative potency values (REPs) *vs.* TCDD. REP values for the measured compounds are given in Table 3.

Table 3 Relative potency values (vs. TCDD) of individual PCN and groups of PCNs.

PCN-	Hanberg (1990)		Blackenship (2000)	Villeneuve (2000)	Behnisch (2003)		QSAR-REP Puzyn (2007)		Exp-REP
	EROD	AHH	Ah	EROD	Ah	EROD	EROD	Ah	(worst)
42				<3.5E-6	7.5E-6	<1.9E-6	1.2E-6	3.2E-6	7.5E-6
49							3.6E-7	7.9E-7	
50					6.8E-5	4.3E-5	4.2E-5	3.0E-5	6.8E-5
51							1.5E-5	1.5E-5	
52					<3.4E-6	<1.8E-6	8.5E-6	3.8E-5	3.4E-6
53					<1.8E-6	<1.2E-6	1.3E-8	5.2E-6	1.8E-6
54			1.7E-4	2.7E-4	5.8E-4		2.8E-5	5.5E-5	5.8E-4
55							7.1E-6	6.8E-5	
56				3.9E-5			2.3E-5	5.6E-5	3.9E-5
57				7.8E-6			1.5E-6	1.5E-6	7.8E-6
58							1.9E-7	2.6E-6	
59							6.2E-8	5.2E-7	
60				<3.9E-7			1.3E-6	2.8E-5	3.9E-7
61				<3.9E-7			2.9E-7	1.3E-5	3.9E-7
62							1.9E-6	1.5E-5	
63	2.0E-3	2.0E-3					2.2E-5	2.2E-5	2.0E-3
64	2.0E-5	2.0E-5					1.1E-4	1.0E-5	2.0E-5
65							1.3E-5	8.9E-8	
66			4.0E-3	1.5E-3	1.2E-3	5.4E-4	6.9E-4	2.9E-3	4.0E-3
67	2.0E-3	3.0E-3	1.0E-3	3.1E-4	4.8E-4		1.0E-3	1.7E-3	3.0E-3
68	2.0E-5	2.0E-5	1.5E-4	<4.4E-4	4.9E-4		2.7E-4	1.1E-4	4.9E-4
69	2.0E-3	1.0E-3			1.1E-4		8.3E-7	1.5E-4	1.1E-4
70			5.9E-4	1.7E-3	2.8E-3	6.4E-6	2.8E-3	7.1E-4	2.8E-3
71	7.0E-6	7.0E-6			<1.1E-6		4.3E-5	1.6E-7	7.0E-6
72	7.0E-6	7.0E-6			6.0E-5		1.0E-4	8.9E-8	6.0E-5
73	3.0E-3	3.0E-3	1.0E-3	3.8E-4	5.2E-4		3.8E-4	1.8E-3	3.0E-3
74					4.1E-6		(2.7E-3)	1.0E-7	4.1E-6
75					1.0E-5		(3.2E-2)	(8.7E-8)	1.0E-5

2.3 Production and use

PCN has been used for 80 years and the produced volume exceeds one hundred thousand tons (NV literature review). Polychlorinated naphthalene (PCN) has been previously used, like PCBs, such as pesticides, flame retardants, waterproofing and insulation of cables, and dielectric fluids in capacitors and other electronic components. Today the production and use has been discontinued.

However, several PCNs have been pre-registered at ECHA for the new EU REACH Regulation (ECHA).

PCNs are also formed unintentionally through combustion and high temperature and in other chemical processes. The dispersion in the environment is today considered diffuse and to stem from both leakages from old equipment, landfills and contaminated sites and from the unintentional formation during combustion and chemical processes (NV literature review).

3 Previous measurements in the environment

A selection of previously reported environmental concentrations is cited in Table 4.

Table 4 Previously reported concentrations of PCN in different matrices.

Water/sediment/air [a]				Point sources [b]				Biota [c]			
9.9 pg/m^3	AirB	Swe	Egebäck 04	2.6 ng/l	Leach	Swe	Järnberg 97	0.48-0.89 ng/g fw	HuM	Swe	Norén 00
3.4 pg/m^3	AirB	Swe	Egebäck 04	22-24 µg/l	Sew	USA	HSDB	1.0 ng/g fw	HuM	Can	Newsome 95
60 pg/m^3	AirC	Swe	NV rap. 07	3185 µg/kg	Dump	USA	HSDB	152-677 ng/g fw	HuB	Swe	Weistrand 97
0.03-0.44 ng/l	StW	Jap	HSDB					3.0 ng/g fw	Salmon	Swe	Lundberg 02
0.15 µg/l	SuW	Ger	HSDB					≤1.2 ng/g fw	Perch	Swe	Lundberg 02
0.6-8 ng/g TS	Sed	Swe	Järnberg 97					380 ng/g fw	Pike	Swe	Järnberg 93
Detected	Sed	Swe	Sweco 09:3					≤380 ng/g fw	Goby	Swe	Falandysz 96
Tetra-CN 0.4-3.2 µg/g	Sed	Fin	HSDB					68-200 ng/g fw	GuE	Swe	Järnberg 93
								44 µg/g ww	Lipids	Spa	Domingo 04
Penta-CN 0.1-0.5 µg/g	Sed	Fin	HSDB					71 pg/g ww	Grain	Spa	Domingo 04
								39 pg/g ww	Fish	Spa	Domingo 04
Hexa-CN <0.25 µg/g TS	Sed	Fin	HSDB					36 pg/g ww	Milk	Spa	Domingo 04
								22 pg/g ww	Lipids	Spa	Marti-cid 08
								8.0 pg/g ww	Grain	Spa	Marti-cid 08
								47 pg/g ww	Fish	Spa	Marti-cid 08
								237 pg/g ww	Salmon	Spa	Marti-cid 08
								12 pg/g ww	Milk	Spa	Marti-cid 08

[a] AirB: Background air; AirC: City air; StW: Stormwater; SuW: Surface water; Sed: Sediment.
[b] Leach: Leachate; Sew: Sewage water; Dump: Solids from dump site.
[c] HuM: Human milk; Human blood; GuE: Guillemot eggs. Fw: fat weight; ww: wet weight.

4 Sampling strategy and study sites

4.1 Screening program

A sampling strategy was developed in order to determine concentrations of PCNs in the Swedish environment and to identify the important pathways. The sampling programme was focused on background levels, emissions from point sources, diffuse emissions from urban areas and human exposure. The individual samples are listed in Appendix 1 and the sampling program is summarized in Table 5. A number of additional samples were available and were also analysed (total number of samples are given in parentheses).

Table 5 National sampling program.

Type	Air	Sed.	Water	Biota	Sludge	Soil	Total
Background areas							
Råö	2						2
Pallas	2						2
Offshore		3		4 (6)			7 (9)
Coastal				20 (26)			20 (26)
Point sources							
Chlor-alkali industry						1	1
Incineration	3						3
Metal production	3 (4)	3					6 (7)
Scrap reclamation		3					3
Backyard burning	1						1
Diffuse sources							
Urban area	2	3			7 (9)		12 (14)
Leachate water			3				3
Human exposure				4			4
Total	13(14)	12	3	28 (36)	7 (9)	1	64 (76)

In addition to the national screening program Swedish county administrative boards had the opportunity to collect and send samples for analysis. The administrative county board in Norrbotten, Värmland and Västerbotten participated with samples, Table 6.

Table 6 Regional samples.

Type	Air	Sed.	Water	Biota	Sludge	Soil	Total
Norrbotten				2			2
Värmland		2		1			3
Västerbotten		1					1
Total		3		3			6

5 Methods

Due to economic constraints a majority of samples have been collected for dioxin or dioxin-like compound analysis within the framework of other screening studies. New samples were only collected for background air.

5.1 Sampling

The air samples were collected by IVL staff as filter (particulate phase) and PUF adsorbent (gaseous phase) samples according to established procedures. The samples were stored frozen (-18°C) until extraction.

5.2 Analysis

5.2.1 Sample preparation

Air filters and adsorbents were extracted with acetone. The filters were then re-extracted with toluene to ensure exhaustive extraction. All extractions were performed at IVL.

The extracts were then shipped to UmU for cleane up and analysis. Multi-layer silica columns were used to remove bulk co-extracted materials and the samples were then fractionated using activated carbon columns. The PCNs are planar halogenated aromatic compounds, as are the dioxins. PCNs are therefore retained strongly by the carbon sorbent and recovered together with dioxins through back-flush elution with toluene.

5.2.2 Instrumental analysis

Gas chromatography – high resolution mass spectrometry (GC-HRMS) was performed using electron impact ionization. Selective ion recording (SIR) was used to enhance the sensitivity, and to further boost the sensitivity, the analysis was segmented into three time-windows – one for diCN through tetraCN, one for pentaCN and Hexa CN, and one for heptaCN and OctaCN. In order to separate the isomers of PCN it was necessary to use a special GC column that is normally used for chiral analysis, Restec BDEXcst (Helm, 1999).

PCNs were quantified with the isotope dilution technique using TCDD as the internal standard. At least one congener at each homologue level was used to establish response factors. If a matching standard was lacking, the quantification was used using a standard with the same number of chlorine substituents, assuming the same molar response.

5.2.3 Quality control

For a positive identification of a PCN it had to elute with the same retention time as that of a standard. A technical PCN, Nibren-wachs D130, was used for comparison, and the components were identified using the isomer-profiles given in Helm, 1999. Further, the isotope ratio of the quantification ion and a qualification ion was checked and accepted if it was within 10% of the theoretical value. Finally, blanks that were run in parallel to the samples had to be free of signals, or contain minor peaks (as compared to the samples), in the retention window of the PCNs.

6 Results and discussion

The results of the measurements of the PCNs are presented in detail in Appendix 2 where the concentrations of the individual substances are given. An overview of the data is given in the following sections.

6.1 Air samples

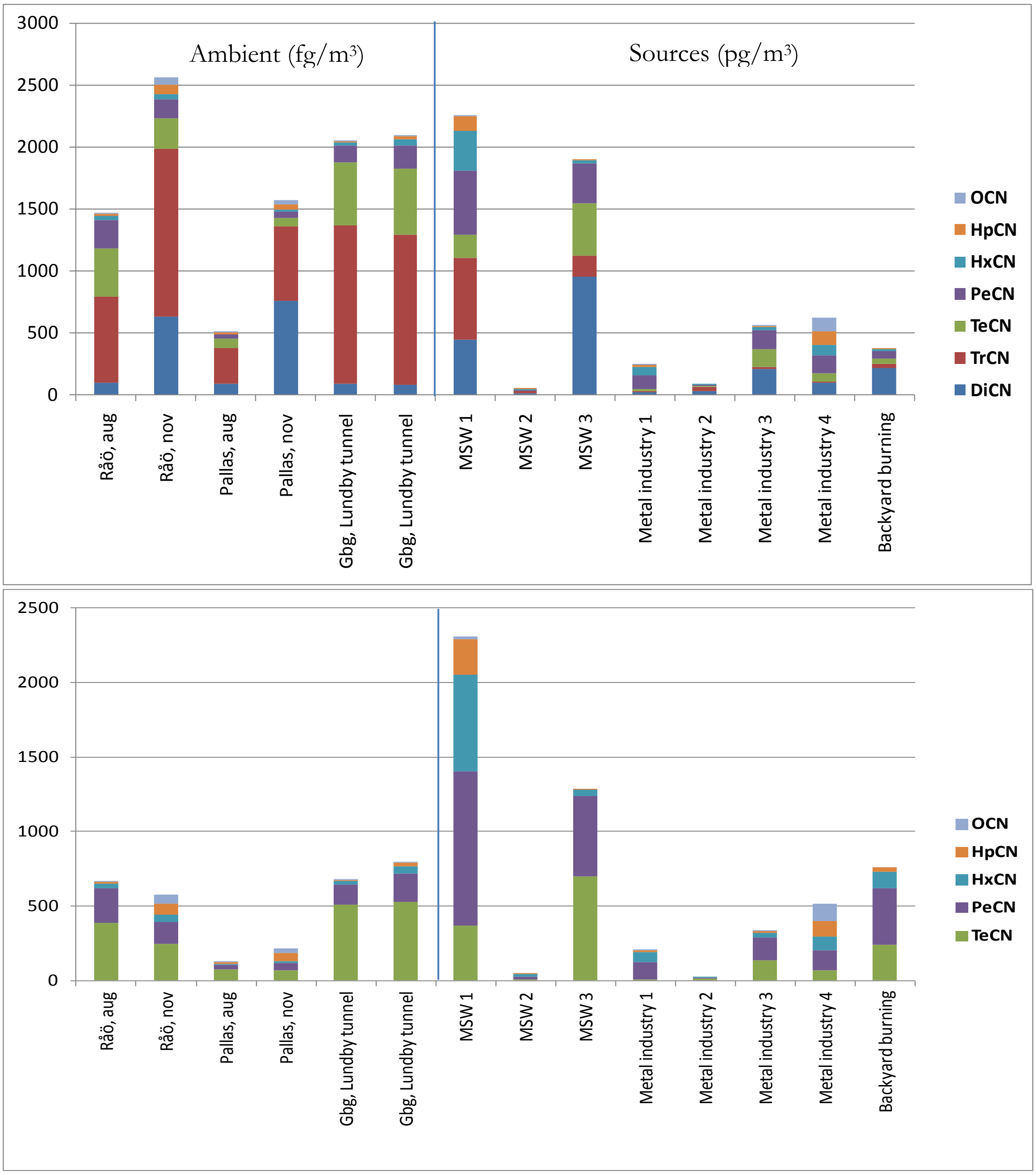


Figure 1 Di-OctaCN (top) and Tetra-OctaCN (lower) homologue profiles of PCNs in air. Note the difference in concentration units between source and ambient air samples.

The background and ambient air generally contained three orders of magnitude lower total PCN concentrations than air from various potential sources (Figure 1).

Less halogenated PCNs, especially TrCNs, accounted for a larger share of the PCNs in the ambient air samples. However, there may be a difference in the sampling efficiency between the ambient air and combustion gas samplings. The latter are performed at a higher temperature and there may be a risk of breakthrough (since the methodology has been validated for tetra-octachloro dibenzo-*p*-dioxins and dibenzofurans that are less volatile). When comparing the profiles of the Te-OctaCN there seem to be less variation in PCN patterns between source and receptor (ambient air) samples.

Thus, the investigated source may contribute to the PCNs found in ambient air. However, long-range air transport is also likely to be significant (based on data from Råö outside Gothenburg and Pallas in Northern Finland).

Among the sources there is a large spread in concentrations between various municipal solid waste incinerators (MSWs) and metal industries and it is, thus, unclear how representative the facilities are on a national level. Additional samples would be required to assess the quantitative significance of these PCN sources. It is clear, however, that traffic is not a major contributor.

6.2 Sludge, leachate and soil samples

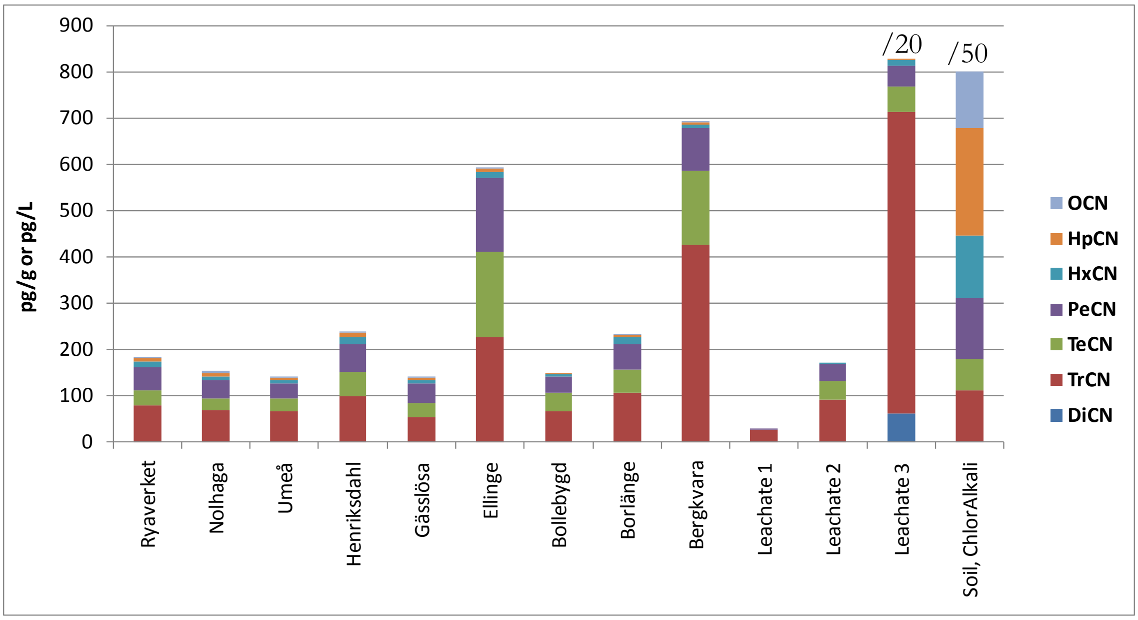


Figure 2 Di-OctaCN homologue profiles of PCNs in sludge, leachate and soil. The levels of the soil and one leachate were high and were scaled down to enhance the presentation.

The levels and profiles of PCNs in sludge (Figure 2) were very similar for most sewage treatment plants (STPs). Elevated levels were found in the two smallest plants (Ellinge and Bergkvara). Similar profiles were also found in the leachate samples. These did however differ dramatically in total concentrations with one with low, one with moderate and one with very high total concentration.

The profiles of the sludge and leachate samples resembled closely those of air (Figure 1) with the exception for DiCNs that were detected at levels close to the limit-of-quantification in most sludge and leachate samples and was therefore not quantified. This indicates a common source.
The PCN profile of the soil from the chlor-alkali was distinctly different and resembled closely those of highly chlorinated technical PCN formulations, and the levels were very high (40 ng/g dry weight). One plausible PCN formation route is through chlorination of naphthalene impurities in graphite electrodes that were used during chlorine production. Another is that PCNs were intentionally produced e.g. during World War II. This type of industries produced several technically important products for the government during that period.

6.3 Sediment samples

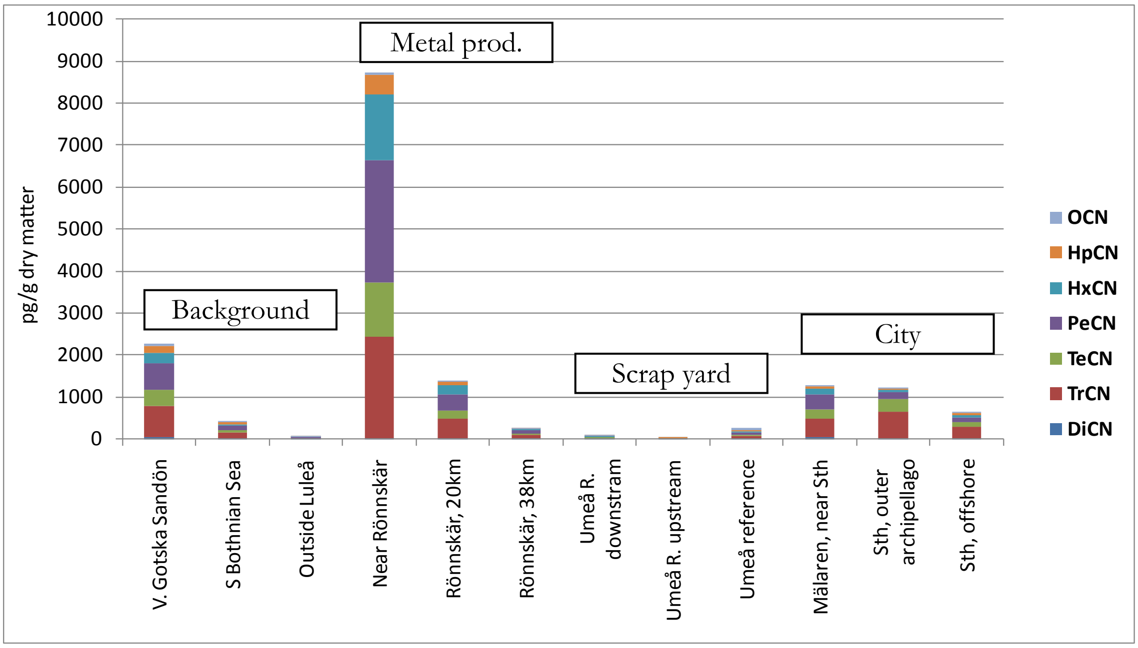


Figure 3 Di-OctaCN homologue profiles of PCNs in sediment samples.

Sediment samples were selected along four profiles to capture the influence of potential sources:

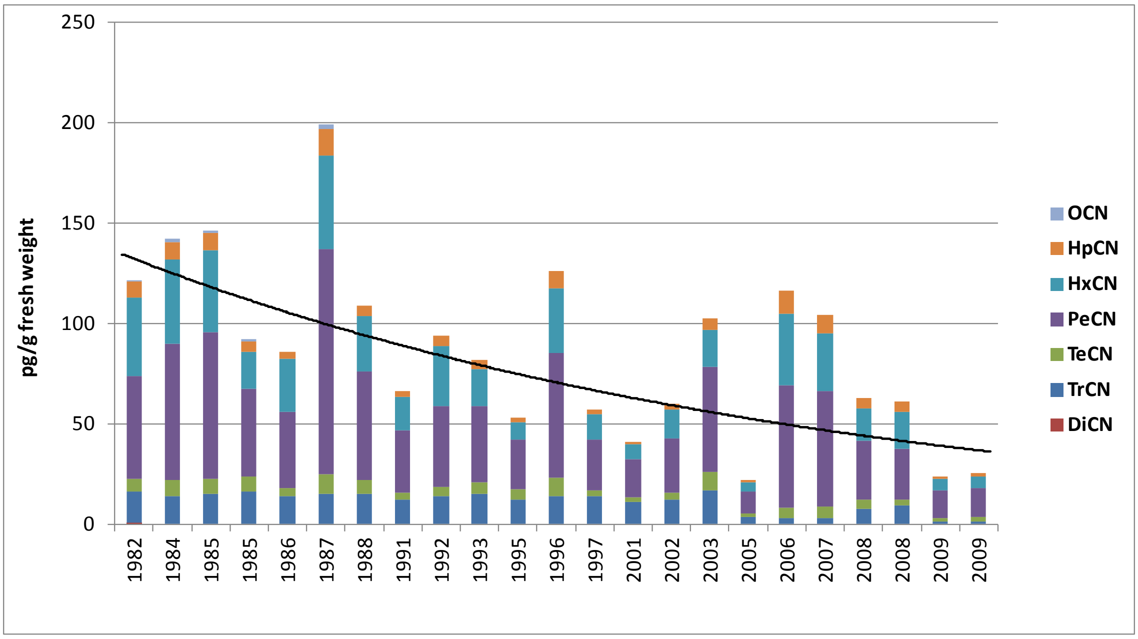
1. Long-range air transport: North-South gradient of offshore sediment.
2. Metal production and e-waste reclamation: Gradient from a production plant.
3. Scrap handling: Upstream, downstream of a scrap yard in Umeå and a coastal reference.
4. Urban diffusive emissions: Gradient from Stockholm.

The results (Figure 3) indicate that there may be a significant contribution from long-range air transport via prevailing south or south-west winds. There are also indications that the metal production and e-waste reclamation facility emit PCNs.

Somewhat higher levels on PCNs were measured in the Stockholm area than in the corresponding reference. It is questionable however if the limited data set allows any firm conclusions to be drawn. Similarly, although the sample taken downstream the scrap yard in Umeå River contain higher concentrations of PCNs than the upstream sample, the coastal reference contain still higher concentrations. Thus, even if there is a contribution from the scrap yard, its quantitative importance seems to be limited.

6.4 Biota samples

6.4.1 Herring samples



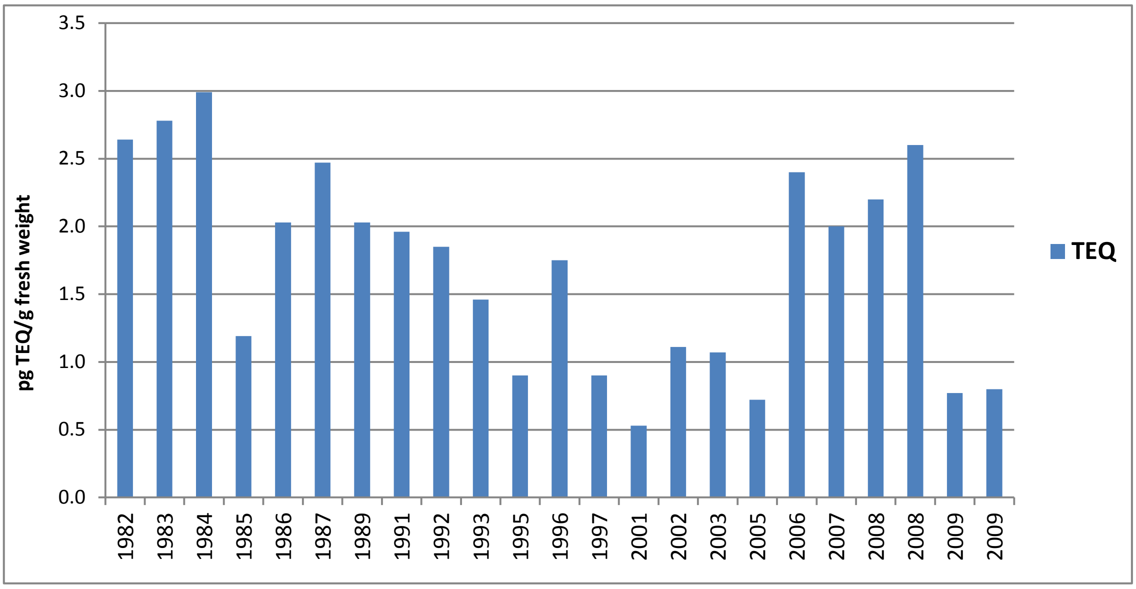


Figure 4 Upper: Di-OctaCN concentrations and homologue profiles of PCNs in herring samples (DiCN not detected). An exponential trend line was fitted to the data to illustrate the general trend. Lower: PCDD/F (TEQ) concentrations in the herring samples

Declining concentrations and constant homologue profiles were observed for herring collected during fall (Figure 4, upper). There was roughly a 3-fold decrease in concentration over the time period, but there were significant inter-annual differences in concentrations.

The temporal variation of the PCN concentrations show a considerable covariation with the TEQ values of the PCDD/Fs (Figure 4, lower). The general trend is almost the same with high concentrations in 1982-1984, low concentrations in 1985/86, high concentrations again in 1987, then decreasing concentrations until 2005, followed by relatively high concentrations in 2006-2008 and finally, low concentrations in 2009. This indicates that the same bioaccumulation/ biomagnification pathway(s) are involved for both compound classes.

In 2008 and 2009 duplicate samplings were performed and both PCN and PCDD/F levels compared well within years (despite the large difference between years). This indicates that there is truly a between-year difference (not only between catches of fish) and provide added confidence in the time trends.

A limited number of PCNs, specifically PeCNs 52, 60, 61, HxCNs 66, 67, 69, and HpCN 73, accounts for a large share of the total PCNs (>70%) in all samples. Many of these has previously been identified as bioaccumulating and persistent (Järnberg *et al.*, 1993).

During three years 2001-2003 samples were also collected during spring (Appendix 2). These contained higher total levels of PCNs (on average 2.5-fold). The same phenomena has been observed for PCDD/Fs in herring (Bignert *et al.*, 2007).

6.4.2 Guillemot samples

The homologue profiles of PCNs in guillemot egg samples are constant over time; although there are significant inter-annual differences in concentrations (Figure 5, top panel). If only the rather persistent HxCN congeners are considered it is possible to use data from Järnberg *et al.* to compare the time trend over the last 35 years (Figure 1, lower panel). From that graph it is clear that the levels of PCNs, at least of HxCNs, has decreased dramatically over the last decades and also that the decrease has levelled off in recent years (as has previously been reported for PCDD/Fs) (Olsson *et al.*, 2003).

For guillemot the difference in persistency amongst the PCNs are even more evident than for herring. HxCN 66 and 67 alone accounts for about 70% of the total and PeCNs 52, 60, 61, HxCNs 66, 67, 69, and HpCN 73 accounts for 90% of the total.

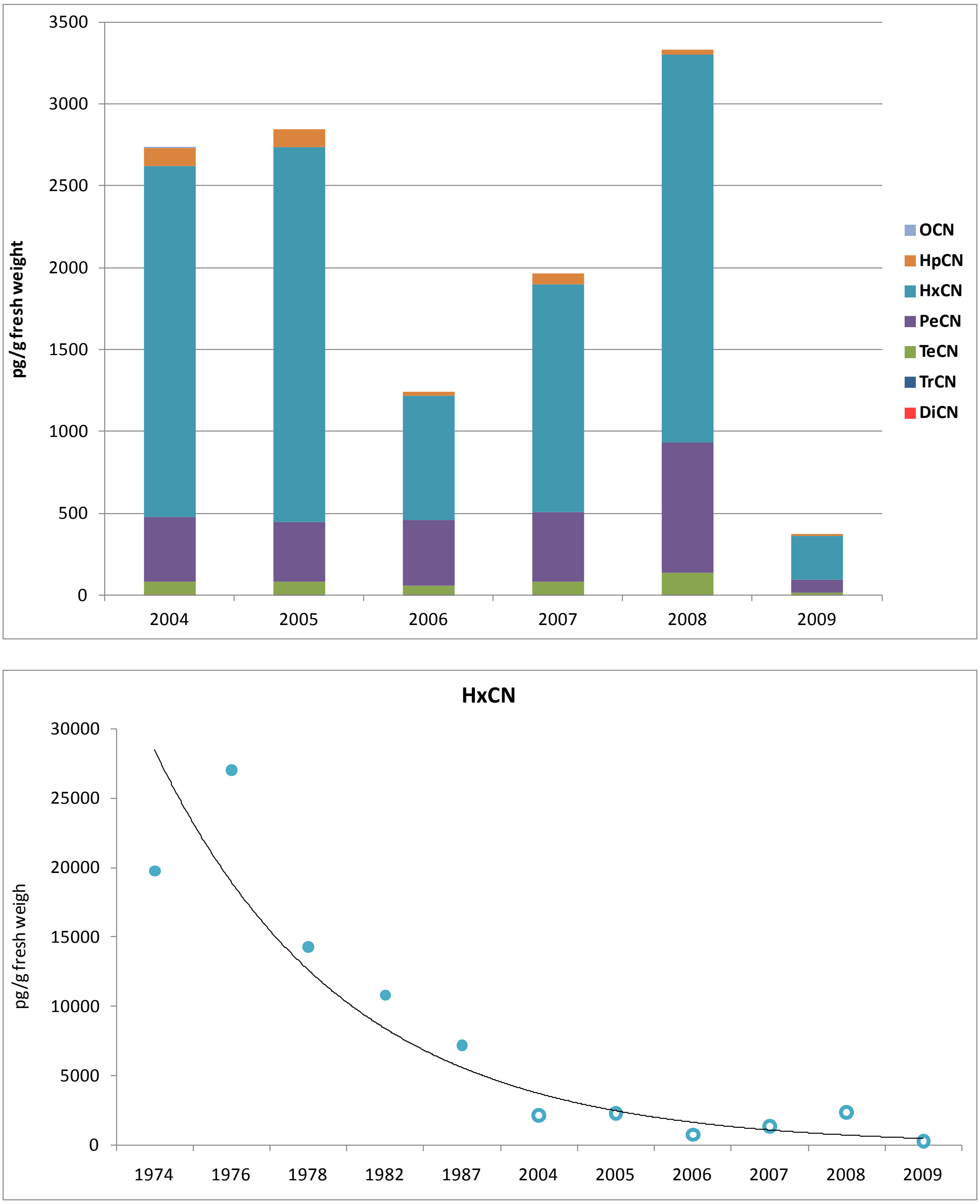


Figure 5 Di-OctaCN homologue profiles of PCNs in guillemot samples (top) and time trend for HxCN (lower panel) using data from the current study (open circles) and from Järnberg *et al.* 1993 (closed circles). An exponential trend line was fitted to the data to illustrate the general time trend

6.4.3 Human milk samples

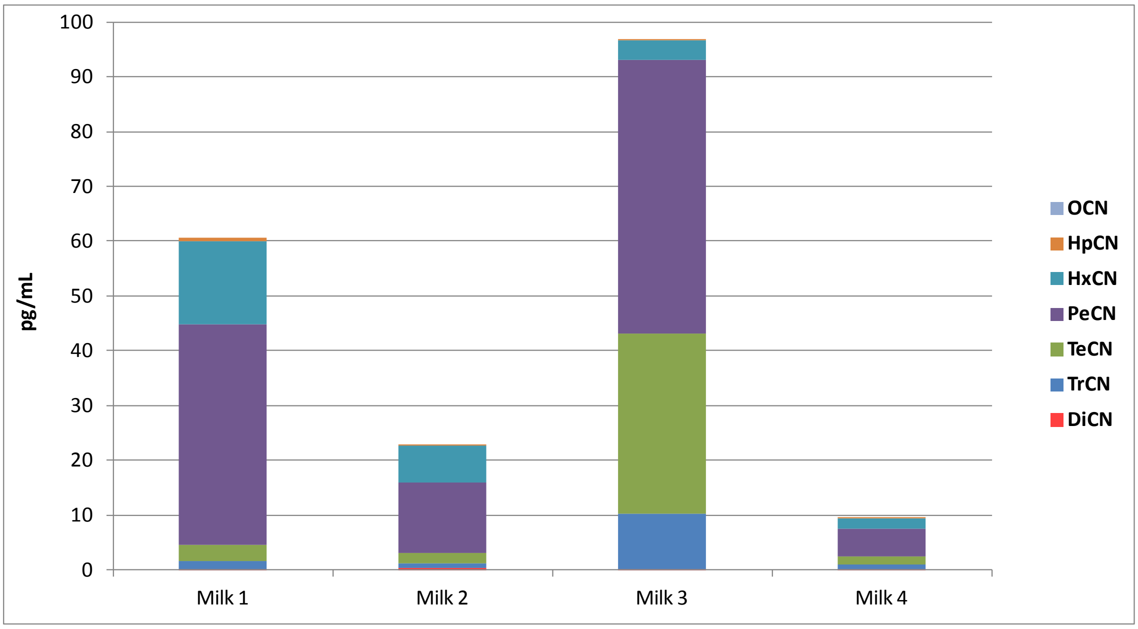


Figure 6 Di-OctaCN homologue profiles of PCNs in human milk from Uppsala.

Four samples of human milk were analyzed and three of these had very similar PCN profile (Figure 6). The fourth contained the highest total concentrations and a larger percentage of less halogenated, and less persistent, PCNs, which might indicate that this person was recently exposed to "fresh" PCN.

6.5 Total potential toxicity of PCNs and PCDD/Fs

In order to get a first estimate of the relative biological potency of PCNs for aquatic organisms and humans a total relative potency (REP) was calculated for the PCN using the individual REPs of Table 3 (right hand column) and was compared to the total toxic equivalency (TEQ) of PCDD/Fs. For abiotic matrices a similar calculation was performed to achieve a total toxic potential ($REP_{potential}$) residing in the various sample matrices. The true biological potency will however depend on the availability of the pollutants, the pharmacokinetics in biota, and other factors.

Table 7 Overview of REP and TEQ values for PCNs and PCDD/Fs, respectively, in screening samples.

Matrix	REP (or $REP_{potential}$)			TEQ			REP/TEQ		
	median	min	max	median	min	max	median	min	max
Air	0.00013	0.00005	0.00029	0.0015	0.00034	0.0076	8.7%	3.8%	27%
Sediment	0.18	0.016	1.2	8.8	0.34	48	1.9%	0.68%	11%
Sludge	0.022	0.011	0.037	30	14	52	0.072%	0.059%	0.095%
Leachate	0.0052	<0.00001	0.19	1.8	0.59	4.9	0.29%	0.001%	3.8%
Combustion gas	0.19	0.0022	2.6	46	2.7	1970	0.63%	0.022%	1.2%
Industrial soil	12			260			4.6%		
Guillemot	6.2	0.94	8.1	120	24	159	4.8%	2.5%	6.2%
Herring (fall)	0.055	0.013	0.13	1.8	0.53	3.0	3.6%	1.8%	5.7%
Herring (spring)	0.12	0.088	0.26	1.1	0.62	2.6	11%	3.3%	42%
Human milk	0.017	0.0063	0.026	0.018			95%		

These calculations indicates that the PCNs may be of limited concern, at least regarding dioxin-related effects (Table 7). The median REP/TEQ ratios are below 10% for most matrices, i.e. the total PCDD/Fs are 10-fold more potent than the total PCNs.

In spring herring the median PCN contribution is 11% and the absolute median REP was 0.12 pg/g fresh weigh. However, since the fish were analyzed without skin and subcutaneous fat the corresponding concentration in whole fish would be higher, about 2-fold according to Bignert *et al.* 2007, i.e. approximately 0.25 pg/g whole fish. That is 6% of the EU maximum residue level (MRL) for dioxins (expressed as TEQ) for fish (4 pg/g fresh weight). For the most contaminated herring sampled in spring the PCN concentration was 0.26 pg/g, corresponding to about 0.5 pg/g whole fish, which would be 12% of the MRL. Alone this is not alarming, but since the PCN contributions add to the pollutant burden of PCDD/Fs that are already close to the MRL it may still have to be considered.

Furthermore, in human milk the REP of the PCNs and the TEQ of the PCDD/Fs did match each other (the median REP was 95% of the median TEQ reported by Livsmedelsverket, 2006). The total weekly intake of PCN (expressed as total REPs) for a 1 month baby was calculated. Assuming a body weight of 4 kg and a daily intake of 750 ml milk with a PCN concentration 0.017 pg PCN-REP/ml (median for the investigated milk) a weekly intake of 22 pg PCN-REP/kg body weight was obtained. This exceeds the tolerably weekly intake (TWI) of 14 pg TEQ/kg body weight recommended by the EU Scientific Committee on Food (SCF, 2001).

7 Conclusions

- Long-range air transport is most likely a significant pathway for PCNs.
- Municipal solid waste incinerators and metal processing facilities emit PCNs.
- Traffic is likely a minor source of PCNs.
- Sludge has a homologure pattern similar to air, which may indicate that PCNs mainly reach the sewer systems through collection of storm water.
- A gradient in PCN concentrations were observed in sediments collected at increasing distance from Stockholm, but they were in the range of background (offshore) sediments.
- Soil from a chlor-alkali plant and leachate from a municipal solid waste dump contained high levels of PCNs. Emissions from such point sources may result in elevated levels in nearby recepients.
- Decreasing PCN concentrations over time was observed for both herring and guillemot. For the latter, the time trend could be followed over the last 35 years. Over this period the PCN concentrations have dropped by an order of magnitude. However, during the last decade the levels has now levelled off.
- The long term time-trend and short term temporal variations of the PCNs resembles closely those of the PCDD/Fs, which may indicate that they share the same bio-accumulation/magnification pathways.
- Human milk contain relatively high concentrations of PCNs. Expressed on REP-basis the levels are similar to those of PCDD/F-TEQs. The weekly PCN-REP intake for a 1-month child was estimated to be 22 pg/kg body weight, which is above the tolerable weekly intake of 14 pg TEQ/kg body weight recommended by EU Scientific Committee of Food.

8 Acknowledgement

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Appendix 1. Sample table

MPR#	Type	Matrix	Site	Description	Amount	Unit	Lipids, %
3474:52	Diffuse	Air	Råö	Air, aug	5000	m^3	
3474:53	Diffuse	Air	Råö	Air, nov	5000	m^3	
3474:54	Diffuse	Air	Pallas	Air, aug	4000	m^3	
3474:55	Diffuse	Air	Pallas	Air, nov	4000	m^3	
3368:11	Diffuse	Air	Göteborg	Urban Air, Lundbytunneln	4100	m^3	
3368:12	Diffuse	Air	Göteborg	Urban Air, Lundbytunneln	3000	m^3	
3437:1	Point source	Air	MSW	Incineration	5.0	m^3	
3210:1	Point source	Air	MSW	Incineration	5.0	m^3	
3330:41	Point source	Air	MSW	Incineration	6.0	m^3	
2968:12	Point source	Air	Metal industry	High temperature processes	20	m^3	
2974:1	Point source	Air	Metal industry	High temperature processes	22	m^3	
2974:2	Point source	Air	Metal industry	High temperature processes	24	m^3	
2983:1	Point source	Air	Metal industry	High temperature processes	20	m^3	
3267:7	Diffuse	Air	Backyard burning	Uncontrolled combustion	1.6	m^3	
MCN:EKA	Point source	Soil	EKA	Soil	1	g	
3434:1	Diffuse	Sewage sludge	Ryaverket	NV yearly screening	25	g dry weight	
3434:2	Diffuse	Sewage sludge	Nolhaga	NV yearly screening	25	g dry weight	
3434:3	Diffuse	Sewage sludge	Umeå	NV yearly screening	25	g dry weight	
3434:4	Diffuse	Sewage sludge	Henriksdahl	NV yearly screening	25	g dry weight	
3434:5	Diffuse	Sewage sludge	Gässlösa	NV yearly screening	25	g dry weight	
3434:6	Diffuse	Sewage sludge	Ellinge	NV yearly screening	25	g dry weight	
3434:7	Diffuse	Sewage sludge	Bollebygd	NV yearly screening	25	g dry weight	
3434:8	Diffuse	Sewage sludge	Borlänge	NV yearly screening	25	g dry weight	
3434:9	Diffuse	Sewage sludge	Bergkvara	NV yearly screening	25	g dry weight	
3474:56	Point source	Leachate	Site 1	SWECO screening	1	L	
3474:57	Point source	Leachate	Site 3	SWECO screening	1	L	
3474:59	Point source	Leachate	Site 5	SWECO screening	1	L	
3020:4	Background	Sediment	S Bothnian Sea	Offshore	6.8	g dry weight	
3187:7	Background	Sediment	Outside Luleå	Offshore	15	g dry weight	
2959:11	Background	Sediment	V. Gotska Sandön	Offshore	13	g dry weight	
3020:2	Point source	Sediment	Near Rönnskär	Metal processing	13	g dry weight	
3020:17	Reference	Sediment	Bjuröfjärden	Reference, 20 km	6.7	g dry weight	
3187:13	Reference	Sediment	Lövsele	Reference, 38 km	13	g dry weight	
3075:23	Point source	Sediment	Umeå River	Downstream scrap yard	15	g dry weight	
3187:2	Reference	Sediment	Umeå River	Upstream scrap yard	22	g dry weight	
3474:51	Reference	Sediment	Ostnäsfjärden	Coastal reference	11	g dry weight	
2905:10	Point source	Sediment	Östra Mälaren	Close to Stockholm	11	g dry weight	
3020:18	Reference	Sediment	Stockholm archipelago	Outer archipelago	2.3	g dry weight	
3020:1	Reference	Sediment	Offshore	Reference	6.3	g dry weight	
2890:11	Background	Guillemot eggs	Stora Karlsö	2004	18	g wet weight	14
2995:1	Background	Guillemot eggs	Stora Karlsö	2005	19	g wet weight	14
3156:30	Background	Guillemot eggs	Stora Karlsö	2006	35	g wet weight	14
3242:4	Background	Guillemot eggs	Stora Karlsö	2007	30	g wet weight	12
3303:19	Background	Guillemot eggs	Stora Karlsö	2008	30	g wet weight	12
3419:85	Background	Guillemot eggs	Stora Karlsö	2009	30	g wet weight	12
2857:1	Background	Herring, muscle	Ängskärsklubb	1982	30	g wet weight	3.4
2857:2	Background	Herring, muscle	Ängskärsklubb	1983	30	g wet weight	4.1
2857:3	Background	Herring, muscle	Ängskärsklubb	1984	30	g wet weight	3.1
2857:4	Background	Herring, muscle	Ängskärsklubb	1985	30	g wet weight	3.3
2857:6	Background	Herring, muscle	Ängskärsklubb	1986	30	g wet weight	3.3
2857:5	Background	Herring, muscle	Ängskärsklubb	1987	30	g wet weight	2.7

MPR#	Type	Matrix	Site	Description	Amount	Unit	Lipids, %
2857:7	Background	Herring, muscle	Ängskärsklubb	1989	30	g wet weight	4.3
2857:8	Background	Herring, muscle	Ängskärsklubb	1991	30	g wet weight	5.3
2857:9	Background	Herring, muscle	Ängskärsklubb	1992	30	g wet weight	2.8
2857:10	Background	Herring, muscle	Ängskärsklubb	1993	30	g wet weight	3.4
2857:11	Background	Herring, muscle	Ängskärsklubb	1995	30	g wet weight	4.5
2857:12	Background	Herring, muscle	Ängskärsklubb	1996	30	g wet weight	5.3
2857:13	Background	Herring, muscle	Ängskärsklubb	1997	30	g wet weight	2.9
2857:14	Background	Herring, muscle	Ängskärsklubb	2001	30	g wet weight	2.6
2857:15	Background	Herring, muscle	Ängskärsklubb	2002	30	g wet weight	3.5
2857:16	Background	Herring, muscle	Ängskärsklubb	2003	30	g wet weight	3.5
3025:26	Background	Herring, muscle	Ängskärsklubb	2005	36	g wet weight	4.1
3040:8	Background	Herring, muscle	Ängskärsklubb	2006	60	g wet weight	4.3
3242:3	Background	Herring, muscle	Ängskärsklubb	2007	30	g wet weight	4.1
3347:5	Background	Herring, muscle	Ängskärsklubb	2008	36	g wet weight	3.0
3347:6	Background	Herring, muscle	Ängskärsklubb	2008	36	g wet weight	2.4
3430:28	Background	Herring, muscle	Ängskärsklubb	2009	36	g wet weight	2.9
3430:29	Background	Herring, muscle	Ängskärsklubb	2009	24	g wet weight	3.3
2857:17	Background	Herring, muscle	Ängskärsklubb (spring)	2001	30	g wet weight	4.2
2857:18	Background	Herring, muscle	Ängskärsklubb (spring)	2002	30	g wet weight	5.0
2857:19	Background	Herring, muscle	Ängskärsklubb (spring)	2003	30	g wet weight	4.6
3373:1	Diffuse	Human milk	Uppsala	LV screening	51	g wet weight	3.0
3373:2	Diffuse	Human milk	Uppsala	LV screening	59	g wet weight	4.6
3373:3	Diffuse	Human milk	Uppsala	LV screening	51	g wet weight	3.2
3373:4	Diffuse	Human milk	Uppsala	LV screening	58	g wet weight	1.9
		Regional screening					
3474:33	Background	Herring, muscle	Storfjärden	Norrbotten	30	g wet weight	1.4
3474:34	Background	Herring, muscle	Seskaröfjärden	Norrbotten	30	g wet weight	2.1
3474:48	Diffuse	Perch, muscle	Varnumsviken	Värmland	14	g wet weight	0.63
3474:49	Point source	Sediment	Strandmossen	Värmland (city dump)	9.3	g dry weight	
3474:50	Diffuse	Sediment	Varnum vid Haga	Värmland	15	g dry weight	
3474:51	Point source	Sediment	Tväran	Västerbotten	22	g dry weight	

Appendix 2. Results table 1 DiCN (tot) – PeCN-56

No.	Type	Matrix	Site	Unit	DiCN (tot)	TrCN (tot)	TeCN (tot)	TeCN 36	TeCN 42	PeCN 52	PeCN 60	PeCN 61	PeCN 58	PeCN 50	PeCN 51	PeCN 57	PeCN 53	PeCN 62	PeCN 49/54	PeCN 59	PeCN 55	PeCN 56
3474:52	Backgr.	Air, aug	Råö	fg/m^3	101	694	390	61	16	14	44	33	12	20	14	21	17	20	4.5	28	ND	1.0
3474:53	Backgr.	Air, nov	Råö	fg/m^3	629	1356	244	24	16	14	31	18	6.5	17	16	10	10	10	8.2	11	ND	1.3
3474:54	Diffuse	Air, aug	Pallas	fg/m^3	93	283	74	1.9	3.5	2.7	7.7	4.1	1.5	3.4	2.8	3.1	2.6	2.6	0.92	3.5	ND	ND
3474:55	Diffuse	Air, nov	Pallas	fg/m^3	756	601	71	7.1	6.1	5.1	11	5.2	1.9	5.4	5.1	3.0	4.9	2.7	1.7	3.3	ND	ND
3368:11	Diffuse	Urban Air	Gbg, Lundby tunnel	fg/m^3	88	1276	511	90	30	8.6	23	26	2.0	10	10	13	12	9.5	ND	20	ND	1.4
3368:12	Diffuse	Urban Air	Gbg, Lundby tunnel	fg/m^3	82	1210	528	77	20	11	23	23	3.6	27	14	15	15	17	13	24	0.75	1.9
3437:1	Source	High temp.	MSW	pg/m3	888	1339	371	51	6.6	97	185	18	31	130	240	39	21	35	231	4.3	ND	ND
3210:1	Source	High temp.	MSW	pg/m3	18	38	11	0.45	0.77	1.3	2.2	0.56	0.98	1.8	2.7	0.87	0.81	1.1	1.8	0.57	ND	ND
3330:41	Source	High temp.	MSW	pg/m3	1579	278	700	171	54	82	156	27	46	33	70	13	6.4	8.3	90	0.98	ND	7.8
2968:12	Source	High temp.	Metal industry	pg/m3	20	13	11	ND	ND	6.7	9.5	ND	ND	ND	0.009	7.6	26	21	26	12	ND	6.1
2974:1	Source	High temp.	Metal industry	pg/m3	32	30	13	2.2	0.59	0.64	1.4	1.5	0.27	0.32	0.78	0.82	0.84	0.69	0.53	1.1	ND	0.044
2974:2	Source	High temp.	Metal industry	pg/m3	209	18	139	39	0.71	17	34	11	1.9	0.43	33	6.9	5.0	4.0	31	3.8	ND	2.9
2983:1	Source	High temp.	Metal industry	pg/m3	101	9.2	68	18	0.97	13	24	8.7	1.5	1.3	30	6.0	4.4	7.4	26	3.3	ND	12
3267:7	Diffuse	High temp.	Backyard burning	pg/m3	1355	250	241	86	5.0	17	47	11	2.0	47	70	7.7	8.1	76	73	7.6	ND	11
MCN:EKA	Source	Soil	EKA	pg/g dw	46	5528	3303	ND	208	270	826	902	185	409	252	663	1091	830	ND	1225	ND	30
3434:1	Diffuse	Sludge	Ryaverket	pg/g dw	ND	79	32	ND	2.2	1.5	5.9	8.4	0.74	1.8	1.1	4.8	7.0	7.5	ND	12	ND	0.32
3434:2	Diffuse	Sludge	Nolhaga	pg/g dw	ND	70	24	4.8	1.7	1.0	5.8	6.3	0.55	1.8	0.96	4.0	5.2	5.9	ND	7.8	ND	0.28
3434:3	Diffuse	Sludge	Umeå	pg/g dw	ND	66	27	5.5	1.6	0.87	4.4	5.2	0.46	1.4	0.83	3.9	4.2	5.1	ND	7.3	ND	0.18
3434:4	Diffuse	Sludge	Henriksdahl	pg/g dw	ND	100	52	12	3.2	1.8	6.7	11	0.92	2.3	1.4	5.6	7.1	9.5	ND	13	ND	0.34
3434:5	Diffuse	Sludge	Gässlösa	pg/g dw	ND	54	29	6.1	1.7	1.1	5.1	6.6	0.58	1.8	1.0	4.6	5.2	6.4	ND	9.6	ND	0.27
3434:6	Diffuse	Sludge	Ellinge	pg/g dw	ND	225	185	33	11	9.7	23	32	2.8	7.7	3.7	13	15	26	ND	26	ND	0.65
3434:7	Diffuse	Sludge	Bollebygd	pg/g dw	ND	67	38	8.1	2.3	1.5	4.9	6.6	0.58	1.7	0.83	3.2	4.1	5.2	ND	6.4	ND	0.19
3434:8	Diffuse	Sludge	Borlänge	pg/g dw	ND	107	48	10	2.6	1.2	7.6	8.6	0.76	2.0	1.1	5.9	7.5	8.8	ND	13	ND	0.32
3434:9	Diffuse	Sludge	Bergkvara	pg/g dw	ND	425	161	39	9.1	2.9	7.8	19	1.6	4.2	1.9	8.7	11	13	ND	22	ND	0.63
3474:56	Source	Leachate	Site 1	pg/L	ND	26	ND	0.42	ND	ND	ND	0.088	0.008	0.35	0.17	0.1	0.13	0.13	ND	0.093	ND	0.078
3474:57	Source	Leachate	Site 3	pg/L	ND	92	39	6.7	2.7	2.6	5.0	6.3	0.55	1.4	0.42	3.8	5.5	6.5	ND	5.3	ND	ND
3474:59	Source	Leachate	Site 5	pg/L	1242	13016	1083	223	101	19	94	122	11	29	22	106	137	160	ND	224	ND	5.6
3020:4	Backgr.	Sed. offshore	S Bothnian Sea	pg/g dw	17	141	59	8.2	3.8	7.4	21	12	4.5	7.1	8.0	8.9	8.1	9.1	3.4	7.5	ND	ND
3187:7	Backgr.	Sed. offshore	Outside Luleå	pg/g dw	5.0	12	5.6	0.077	0.43	0.66	2.2	1.6	0.61	0.80	0.61	1.1	2.3	1.5	0.30	2.1	ND	0.13
2959:11	Backgr.	Sed. offshore	V. Gotska Sandön	pg/g dw	53	734	390	20	41	44	158	76	28	33	40	58	67	70	16	42	ND	5.9
3020:2	Source	Sed. Metal	Near Rönnskär	pg/g dw	18	2412	1307	335	72	73	337	399	100	99	66	315	403	472	ND	609	ND	26
3020:17	Ref.	Sed. Metal	Rönnskär, 20km	pg/g dw	11	484	170	42	7.9	11	46	54	14	15	11	45	51	64	ND	80	ND	3.8
3187:13	Ref.	Sed. Metal	Rönnskär, 38km	pg/g dw	17	71	34	6.4	2.3	3.1	11	10	2.5	3.0	2.6	6.9	9.9	11	ND	13	ND	0.55
3075:23	Source	Sed. Scrap	Umeå R. downstram	pg/g dw	8.5	17	6.9	0.18	0.55	0.94	3.0	2.6	0.64	0.85	1.0	2.0	2.6	2.7	ND	3.2	ND	0.24
3474:51	Ref.	Sed. Scrap	Umeå R. upstream	pg/g dw	3.0	1.3	0.64	ND	ND	0.084	0.35	0.32	0.081	0.25	0.21	0.65	0.86	0.42	ND	0.45	ND	0.065
3187:2	Ref.	Sed. Scrap	Umeå reference	pg/g dw	12	64	23	5.7	3.4	2.7	15	6.0	1.5	3.3	3.3	3.5	4.1	2.4	ND	3.7	ND	0.29
2905:10	Source	Sed. Urban	Mälaren, near Sth	pg/g dw	34	457	218	54	14	17	53	46	11	19	24	36	38	29	33	53	ND	4.2
3020:18	Ref.	Sed. Urban	Sth, archipellago	pg/g dw	24	610	310	75	15	12	32	22	5.6	12	11	15	17	10	13	24	ND	1.6
3020:1	Ref.	Sed. Urban	Sth, offshore	pg/g dw	16	275	100	21	6.1	6.8	26	16	4.1	8.7	9.2	12	13	9.3	10	11	ND	1.4
2890:11	Backgr.	Guillemot egg	Stora Karlsö, 2004	pg/g ww	1.3	0.43	80	0.61	73	91	67	158	31	8.4	2.7	3.4	0.70	6.1	24	1.0	ND	ND
2995:1	Backgr.	Guillemot egg	Stora Karlsö, 2005	pg/g ww	0.75	0.38	82	0.61	74	91	57	144	28	7.2	2.5	2.7	0.56	6.0	26	0.98	ND	ND
3156:30	Backgr.	Guillemot egg	Stora Karlsö, 2006	pg/g ww	0.63	0.24	60	0.60	54	73	176	100	20	5.6	1.6	2.5	0.49	4.5	15	0.64	ND	ND
3242:4	Backgr.	Guillemot egg	Stora Karlsö, 2007	pg/g ww	0.77	0.41	84	0.66	76	101	115	140	27	8.7	1.7	3.3	0.71	6.3	20	1.1	ND	ND
3303:19	Backgr.	Guillemot egg	Stora Karlsö, 2008	pg/g ww	0.66	0.39	139	1.2	124	165	241	257	50	13	2.5	6.2	1.3	15	38	2.1	ND	ND
3419:85	Backgr.	Guillemot egg	Stora Karlsö, 2009	pg/g ww	0.20	0.095	16	0.12	14	17	20	28	5.4	0.34	0.25	0.64	0.14	1.7	4.5	0.23	ND	ND

No.	Type	Matrix	Site	Unit	DiCN (tot)	TrCN (tot)	TeCN (tot)	TeCN 36	TeCN 42	PeCN 52	PeCN 60	PeCN 61	PeCN 58	PeCN 50	PeCN 51	PeCN 57	PeCN 53	PeCN 62	PeCN 49/54	PeCN 59	PeCN 55	PeCN 56
2857:1	Backgr.	Herring	Ängskärsklubb 1982	pg/g ww	1.5	15	6.7	0.046	3.8	9.0	22	13	2.6	0.21	0.25	0.61	0.69	0.74	1.1	0.83	ND	ND
2857:2	Backgr.	Herring	Ängskärsklubb 1983	pg/g ww	ND	14	8.2	0.16	5.1	12	28	17	3.6	0.32	0.42	1.2	1.2	1.3	1.4	1.4	ND	ND
2857:3	Backgr.	Herring	Ängskärsklubb 1984	pg/g ww	ND	15	7.5	0.053	5.1	13	29	20	4.1	0.15	0.26	0.87	1.2	0.97	2.0	1.3	ND	ND
2857:4	Backgr.	Herring	Ängskärsklubb 1985	pg/g ww	ND	16	7.7	0.070	3.0	7.4	15	11	2.3	0.72	0.66	1.3	1.2	1.4	1.2	1.5	ND	ND
2857:6	Backgr.	Herring	Ängskärsklubb 1986	pg/g ww	ND	14	3.9	0.10	2.3	6.6	15	10	2.2	0.13	0.26	0.64	0.74	0.77	0.84	0.85	ND	ND
2857:5	Backgr.	Herring	Ängskärsklubb 1987	pg/g ww	ND	15	10	0.18	8.1	21	40	35	7.2	0.14	0.22	1.1	1.2	1.3	3.2	1.7	ND	ND
2857:7	Backgr.	Herring	Ängskärsklubb 1988	pg/g ww	ND	15	7.2	0.079	4.8	9.8	20	15	3.2	0.24	0.31	0.98	0.90	0.91	1.5	0.96	ND	ND
2857:8	Backgr.	Herring	Ängskärsklubb 1991	pg/g ww	ND	12	3.8	ND	1.9	6.2	12	7.8	1.6	0.23	0.25	0.52	0.49	0.63	0.70	0.54	ND	ND
2857:9	Backgr.	Herring	Ängskärsklubb 1992	pg/g ww	ND	14	4.4	0.031	2.7	8.5	15	11	2.4	0.14	0.27	0.48	0.47	0.57	0.97	0.61	ND	ND
2857:10	Backgr.	Herring	Ängskärsklubb 1993	pg/g ww	ND	15	6.1	0.048	3.1	7.0	13	10	2.2	0.39	0.33	0.8	0.93	0.94	1.1	1.0	ND	ND
2857:11	Backgr.	Herring	Ängskärsklubb 1995	pg/g ww	ND	12	5.5	0.092	2.1	4.0	8.5	6.4	1.3	0.33	0.21	0.73	0.63	0.75	0.92	0.85	ND	ND
2857:12	Backgr.	Herring	Ängskärsklubb 1996	pg/g ww	ND	14	8.9	0.12	5.2	11	23	16	3.4	0.57	0.39	1.2	1.4	1.6	2.1	1.6	ND	ND
2857:13	Backgr.	Herring	Ängskärsklubb 1997	pg/g ww	ND	14	3.0	0.054	1.8	4.8	9.3	6.6	1.4	0.15	0.20	0.39	0.42	0.46	0.66	0.47	ND	ND
2857:14	Backgr.	Herring	Ängskärsklubb 2001	pg/g ww	ND	11	2.4	0.028	1.2	3.4	6.2	5.2	1.1	0.18	0.19	0.36	0.49	0.46	0.76	0.54	ND	ND
2857:15	Backgr.	Herring	Ängskärsklubb 2002	pg/g ww	ND	12	3.6	0.085	2.0	5.0	8.9	7.5	1.6	0.27	0.18	0.58	0.70	0.78	0.97	0.71	ND	ND
2857:16	Backgr.	Herring	Ängskärsklubb 2003	pg/g ww	ND	17	9.2	0.094	3.5	9.2	15	13	2.7	1.2	0.53	1.7	2.0	2.1	2.6	2.0	ND	ND
3025:26	Backgr.	Herring	Ängskärsklubb 2005	pg/g ww	ND	3.7	1.8	0.008	0.74	2.1	3.7	2.7	0.57	0.11	0.13	0.20	0.20	0.22	0.39	0.19	ND	ND
3040:8	Backgr.	Herring	Ängskärsklubb 2006	pg/g ww	ND	3.1	5.2	0.014	3.6	14	22	16	3.4	0.22	0.19	0.58	0.77	0.75	2.0	0.92	ND	ND
3242:3	Backgr.	Herring	Ängskärsklubb 2007	pg/g ww	ND	2.8	5.8	0.15	3.6	12	19	16	3.4	0.42	0.25	0.8	1.1	1.1	2.4	1.3	ND	ND
3347:5	Backgr.	Herring	Ängskärsklubb 2008	pg/g ww	ND	7.9	4.4	0.074	2.1	5.9	9.6	7.6	1.6	0.28	0.17	0.62	0.66	0.73	1.4	0.88	ND	ND
3347:6	Backgr.	Herring	Ängskärsklubb 2008	pg/g ww	ND	9.3	3.2	0.26	1.7	5.4	8.1	6.6	1.4	0.16	0.16	0.41	0.42	0.51	1.0	0.64	ND	ND
3430:28	Backgr.	Herring	Ängskärsklubb 2009	pg/g ww	ND	1.4	1.8	0.039	0.95	2.5	4.3	3.7	0.77	0.12	0.089	0.31	0.39	0.38	0.63	0.43	ND	ND
3430:29	Backgr.	Herring	Ängskärsklubb 2009	pg/g ww	ND	1.6	2.1	ND	1.1	2.6	4.5	4.0	0.83	0.16	0.10	0.33	0.31	0.40	0.47	0.39	ND	ND
2857:17	Backgr.	Herring, spring	Ängskärsklubb 2001	pg/g ww	ND	14	5.8	0.072	3.3	12	18	15	3.1	0.36	0.36	0.79	0.87	0.86	1.6	0.96	ND	ND
2857:18	Backgr.	Herring, spring	Ängskärsklubb 2002	pg/g ww	ND	14	12	0.24	8.3	25	39	32	6.7	0.55	0.26	1.3	1.9	2.2	4.3	2.1	ND	ND
2857:19	Backgr.	Herring, spring	Ängskärsklubb 2003	pg/g ww	ND	12	7.6	0.20	4.5	12	20	16	3.3	0.41	0.26	0.76	0.9	0.87	2.4	1.0	ND	ND
3373:1	Diffuse	Human milk	Uppsala	pg/g ww	0.21	1.3	3.1	0.19	0.9	0.57	24	2.4	0.42	0.19	0.87	3.2	0.75	6.3	ND	1.6	ND	ND
3373:2	Diffuse	Human milk	Uppsala	pg/g ww	0.42	0.82	1.9	0.16	0.67	0.30	8.8	0.80	0.14	0.099	0.11	0.37	0.19	1.6	ND	0.33	ND	ND
3373:3	Diffuse	Human milk	Uppsala	pg/g ww	0.17	10	33	3.9	11	2.0	19	11	1.9	0.40	0.51	3.5	1.0	6.8	ND	3.8	ND	ND
3373:4	Diffuse	Human milk	Uppsala	pg/g ww	0.10	0.85	1.6	0.049	0.58	0.19	2.8	0.63	0.11	0.039	0.086	0.24	0.13	0.57	ND	0.23	ND	ND
		Regional screening																				
3474:33	Backgr.	Herring	Norrb. Storfjärden	pg/g ww	251	87	3.3	0.068	1.3	3.0	5.8	5.0	1.0	0.20	0.20	0.30	0.37	1.1	ND	0.34	ND	ND
3474:34	Backgr.	Herring	Norrb. Seskaröfj.	pg/g ww	314	91	3.5	0.069	1.3	3.3	6.9	5.8	1.2	0.21	0.25	0.50	0.67	1.5	ND	0.76	ND	ND
3474:48	Diffuse	Perch	Värm.Varnumsviken	pg/g ww	13	6.4	4.3	ND	1.7	1.5	4.3	4.7	0.98	0.25	0.38	1.3	1.4	1.2	ND	1.5	ND	ND
3474:49	Source	Sediment	Värm. Strandmossen	pg/g dw	486	427	209	49	19	15	112	66	5.8	21	28	46	54	71	ND	71	ND	2.2
3474:50	Diffuse	Sediment	Värm. Varnum	pg/g dw	22	38	15	2.6	1.3	1.4	6.2	4.7	0.41	2.0	1.7	3.5	4.2	5.2	ND	5.4	ND	0.25
3474:51	Source	Sed., scrap	Västerb. Tvärån	pg/g dw	3.0	1.3	0.64	ND	ND	0.084	0.35	0.32	0.081	0.25	0.21	0.65	0.86	0.42	ND	0.45	ND	0.065

Appendix 2. Results table 2. HxCN-67 – OCN-75, REP, TEQ, REP/TEQ

No.	Type	Matrix	Site	Unit	HxCN 67	HxCN 66	HxCN 64	HxCN 68	HxCN 69	HxCN 71	HxCN 72	HxCN 63	HxCN 65	HxCN 70	HpCN 73	HpCN 74	OCN 75	REP	TEQ	REP / TEQ
3474:52	Backgr.	Air, aug	Råö	fg/m^3	7.4	8.2	1.6	2.7	3.9	2.6	0.56	2.0	1.8	ND	11	1.7	3.6	0.10	2.4	4.1%
3474:53	Backgr.	Air, nov	Råö	fg/m^3	10	12	4.4	4.6	4.8	1.7	0.90	3.7	1.1	0.95	65	9.1	60	0.29	7.6	3.8%
3474:54	Diffuse	Air, aug	Pallas	fg/m^3	1.5	1.8	ND	0.46	0.77	ND	ND	0.35	ND	ND	11	0.78	6.7	0.05	0.34	13%
3474:55	Diffuse	Air, nov	Pallas	fg/m^3	3.1	4.1	1.3	2.1	1.8	ND	ND	0.83	ND	ND	46	3.9	33	0.17	0.63	27%
3368:11	Diffuse	Urban Air	Gbg, Lundby tunnel	fg/m^3	4.4	4.4	1.1	2.0	3.0	4.1	0.81	1.8	1.7	ND	6.4	2.5	3.3	0.06	NA	NA
3368:12	Diffuse	Urban Air	Gbg, Lundby tunnel	fg/m^3	11	10	2.3	4.3	6.1	5.5	1.4	4.3	2.5	1.1	19	6.4	10	0.15	NA	NA
3437:1	Source	High temp.	MSW	pg/m^3	227	225	25	54	34	3.9	4.2	46	2	27	218	21	17	2.6	330	0.80%
3210:1	Source	High temp.	MSW	pg/m^3	2.8	2.5	2.0	ND	8.0	ND	ND	1.5	0.53	ND	4.5	1.3	ND	0.04	3.0	1.2%
3330:41	Source	High temp.	MSW	pg/m^3	14	16	2.6	5.4	2.4	0.45	0.32	ND	ND	1.1	2.7	0.31	ND	0.17	60	0.29%
2968:12	Source	High temp.	Metal industry	pg/m^3	17	22	4.7	6.3	8.2	2.4	0.31	5.1	1.8	0.84	8.6	3.9	3.0	0.20	32	0.62%
2974:1	Source	High temp.	Metal industry	pg/m^3	0.19	0.19	0.073	0.084	0.14	0.17	ND	0.080	0.055	ND	0.11	ND	ND	0.002	2.7	0.08%
2974:2	Source	High temp.	Metal industry	pg/m^3	10	11	1.5	2.6	2.6	1.2	0.35	2.2	0.58	0.43	6.3	1.3	1.9	0.12	14	0.86%
2983:1	Source	High temp.	Metal industry	pg/m^3	21	23	4.1	5.7	12	2.7	1.3	15	1.5	4.4	90	16	114	0.49	75	0.65%
3267:7	Diffuse	High temp.	Backyard burning	pg/m^3	39	40	5.4	8.3	5.4	1.1	ND	12	ND	ND	30	ND	ND	0.44	1970	0.02%
MCN:EKA	Source	Soil	EKA	pg/g dw	149	224	389	811	1599	1550	341	653	1022	ND	2908	8639	6131	12	260	4.6%
3434:1	Diffuse	Sludge	Ryaverket	pg/g dw	0.94	1.4	0.42	1.1	2.0	3.1	0.53	1.1	1.8	ND	4.1	2.8	2.4	0.024	30	0.08%
3434:2	Diffuse	Sludge	Nolhaga	pg/g dw	0.85	1.2	0.4	0.89	1.5	1.9	0.38	0.61	1.1	ND	5.7	1.5	3.1	0.026	33	0.08%
3434:3	Diffuse	Sludge	Umeå	pg/g dw	0.67	0.98	ND	0.64	1.2	1.7	0.29	0.62	0.96	ND	2.5	1.3	1.8	0.015	22	0.07%
3434:4	Diffuse	Sludge	Henriksdahl	pg/g dw	1.5	2.2	0.71	1.5	2.4	2.9	0.63	1.3	1.5	ND	6.8	2.6	3.1	0.037	52	0.07%
3434:5	Diffuse	Sludge	Gässlösa	pg/g dw	0.84	1.2	0.36	0.80	1.6	2.3	0.46	0.89	1.2	ND	2.9	1.4	1.8	0.019	30	0.06%
3434:6	Diffuse	Sludge	Ellinge	pg/g dw	0.88	1.3	0.75	1.4	2.7	3.3	0.93	1.3	1.8	ND	3.8	1.7	2.3	0.023	29	0.08%
3434:7	Diffuse	Sludge	Bollebygd	pg/g dw	0.47	0.69	0.27	0.51	0.98	1.2	0.27	0.46	0.83	ND	1.8	1.0	ND	0.011	15	0.07%
3434:8	Diffuse	Sludge	Borlänge	pg/g dw	0.99	1.5	0.40	1.2	2.5	3.4	0.67	1.2	1.9	ND	3.2	2.0	2.2	0.022	37	0.06%
3434:9	Diffuse	Sludge	Bergkvara	pg/g dw	0.52	0.77	0.39	0.83	1.4	1.9	0.41	0.64	0.98	ND	2.2	1.1	1.3	0.013	14	0.10%
3474:56	Source	Leachate	Site 1	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	4.0×10^{-6}	0.59	<0.01%
3474:57	Source	Leachate	Site 3	pg/L	ND	1.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.005	1.8	0.29%
3474:59	Source	Leachate	Site 5	pg/L	4.9	8.1	ND	22	65	66	20	28	40	ND	21	ND	ND	0.19	4.9	3.8%
3020:4	Backgr.	Sed. offshore	S Bothnian Sea	pg/g dw	9.3	9.3	2.5	4.5	7.3	2.9	ND	4.6	1.5	ND	36	4.0	14	0.19	14	1.4%
3187:7	Backgr.	Sed. offshore	Outside Luleå	pg/g dw	0.99	1.1	0.36	0.51	1.2	0.79	ND	0.50	0.47	ND	5.8	0.67	3.4	0.026	1.6	1.7%
2959:11	Backgr.	Sed. offshore	V. Gotska Sandön	pg/g dw	46	60	13	24	42	17	4.2	20	6.1	2.3	164	12	36	0.95	48	2.0%
3020:2	Source	Sed. Metal	Near Rönnskär	pg/g dw	41	43	51	119	338	425	92	197	263	ND	143	334	42	1.2	11	11%
3020:17	Ref.	Sed. Metal	Rönnskär, 20km	pg/g dw	8.3	11	7.1	19	47	73	10	24	28	ND	39	40	16	0.25	8.5	2.9%
3187:13	Ref.	Sed. Metal	Rönnskär, 38km	pg/g dw	2.2	2.6	1.2	ND	6.0	6.3	1.3	3.4	3.7	ND	11	4.8	15	0.059	3.2	1.8%
3075:23	Source	Sed. Scrap	Umeå R. downstram	pg/g dw	0.88	1.0	0.64	1.1	2.0	2.4	0.48	1.2	1.2	ND	6.3	2.8	8.4	0.029	2.0	1.4%
3474:51	Ref.	Sed. Scrap	Umeå R. upstream	pg/g dw	0.37	0.43	0.14	0.40	0.74	0.33	ND	0.58	0.27	ND	3.9	0.23	ND	0.016	0.34	4.7%
3187:2	Ref.	Sed. Scrap	Umeå reference	pg/g dw	5.7	6.7	2.0	3.5	4.3	2.3	0.37	2.8	0.79	ND	42	3.7	33	0.18	9.2	1.9%
2905:10	Source	Sed. Urban	Mälaren, near Sth	pg/g dw	19	20	4.2	14	21	20	4.1	13	9.0	1.3	38	12	21	0.31	46	0.68%
3020:18	Ref.	Sed. Urban	Sth, archipellago	pg/g dw	7.9	8.0	2.2	5.3	9.7	7.2	1.6	5.7	4.2	ND	30	7.8	17	0.17	16	1.1%
3020:1	Ref.	Sed. Urban	Sth, offshore	pg/g dw	8.8	11	3.4	6.7	9.8	5.9	1.2	6.8	3.0	0.34	48	7	28	0.24	18	1.3%
2890:11	Backgr.	Guillemot egg	Stora Karlsö, 2004	pg/g ww	940	1114	12	27	25	20	1.7	4.2	ND	3.4	107	2.3	0.43	7.6	149	5.1%
2995:1	Backgr.	Guillemot egg	Stora Karlsö, 2005	pg/g ww	1048	1145	12	29	23	20	1.6	2.9	ND	3.8	111	2.0	ND	8.1	159	5.1%
3156:30	Backgr.	Guillemot egg	Stora Karlsö, 2006	pg/g ww	345	348	6.9	15	23	12	0.90	2.2	ND	1.8	29	0.90	ND	2.5	102	2.5%
3242:4	Backgr.	Guillemot egg	Stora Karlsö, 2007	pg/g ww	548	746	10	26	25	21	2.0	3.8	ND	3.0	64	3.3	ND	4.9	110	4.4%
3303:19	Backgr.	Guillemot egg	Stora Karlsö, 2008	pg/g ww	1005	1204	19	45	46	38	2.4	4.8	ND	1.8	32	1.9	ND	8.0	130	6.2%
3419:85	Backgr.	Guillemot egg	Stora Karlsö, 2009	pg/g ww	121	135	1.4	2.5	2.6	3.2	0.33	0.84	ND	0.6	11	0.54	ND	0.94	24	3.9%

No.	Type	Matrix	Site	Unit	HxCN 67	HxCN 66	HxCN 64	HxCN 68	HxCN 69	HxCN 71	HxCN 72	HxCN 63	HxCN 65	HxCN 70	HpCN 73	HpCN 74	OCN 75	REP	TEQ	REP / TEQ
2857:1	Backgr.	Herring	Ängskärsklubb 1982	pg/g ww	10	13	1.1	1.4	8.5	4.3	0.33	0.25	0.37	ND	7.4	0.68	0.52	0.11	2.6	4.1%
2857:2	Backgr.	Herring	Ängskärsklubb 1983	pg/g ww	11	13	1.4	1.9	8.2	4.7	0.45	0.50	0.71	ND	7.1	1.3	1.8	0.11	2.8	4.0%
2857:3	Backgr.	Herring	Ängskärsklubb 1984	pg/g ww	10	12	1.7	2.0	8.7	4.7	0.53	0.45	0.71	ND	7.8	1.1	1.0	0.11	3.0	3.6%
2857:4	Backgr.	Herring	Ängskärsklubb 1985	pg/g ww	5.0	5.6	0.98	1.2	3.0	1.8	0.21	0.40	0.32	ND	4.2	0.67	1.5	0.053	1.2	4.4%
2857:6	Backgr.	Herring	Ängskärsklubb 1986	pg/g ww	6.5	8.5	0.91	1.1	5.2	3.0	0.37	0.24	0.42	ND	3.0	0.41	ND	0.065	2.0	3.2%
2857:5	Backgr.	Herring	Ängskärsklubb 1987	pg/g ww	12	14	2.4	3.0	8.0	5.0	0.49	0.69	0.59	0.19	12	1.4	2.1	0.13	2.5	5.3%
2857:7	Backgr.	Herring	Ängskärsklubb 1988	pg/g ww	7.1	8.4	1.28	1.4	5.6	2.9	0.27	0.23	0.25	ND	5.0	0.43	ND	0.073	2.0	3.6%
2857:8	Backgr.	Herring	Ängskärsklubb 1991	pg/g ww	5.1	5.5	0.58	0.61	3.2	1.5	0.13	0.17	0.13	ND	2.4	0.23	ND	0.046	2.0	2.3%
2857:9	Backgr.	Herring	Ängskärsklubb 1992	pg/g ww	8.4	8.9	0.86	1.3	6.8	3.2	0.27	0.20	0.17	ND	4.8	0.44	ND	0.077	1.8	4.2%
2857:10	Backgr.	Herring	Ängskärsklubb 1993	pg/g ww	5.0	5.7	0.76	1.0	3.7	1.8	0.12	0.28	0.21	ND	3.9	0.29	ND	0.051	1.5	3.5%
2857:11	Backgr.	Herring	Ängskärsklubb 1995	pg/g ww	2.5	2.7	0.43	0.71	1.3	0.69	0.075	0.18	0.14	ND	1.8	0.19	ND	0.025	0.90	2.8%
2857:12	Backgr.	Herring	Ängskärsklubb 1996	pg/g ww	10	10	1.3	1.8	5.6	2.6	0.29	0.54	0.34	ND	8.0	0.57	ND	0.10	1.8	5.7%
2857:13	Backgr.	Herring	Ängskärsklubb 1997	pg/g ww	3.6	4.1	0.60	0.77	2.2	1.1	0.074	0.16	0.097	ND	2.4	0.22	ND	0.036	0.90	4.0%
2857:14	Backgr.	Herring	Ängskärsklubb 2001	pg/g ww	2.0	2.1	0.40	0.53	1.3	0.71	0.080	0.15	0.095	ND	1.3	0.19	ND	0.019	0.53	3.7%
2857:15	Backgr.	Herring	Ängskärsklubb 2002	pg/g ww	4.3	4.3	0.65	0.87	2.3	1.4	0.075	0.28	0.12	ND	2.7	0.28	ND	0.040	1.1	3.6%
2857:16	Backgr.	Herring	Ängskärsklubb 2003	pg/g ww	5.7	4.8	1.1	1.2	3.4	1.6	0.15	0.48	0.20	ND	5.1	0.37	ND	0.055	1.1	5.1%
3025:26	Backgr.	Herring	Ängskärsklubb 2005	pg/g ww	1.5	1.4	0.28	0.45	0.91	0.40	0.039	0.083	0.064	ND	0.59	0.091	ND	0.013	0.72	1.8%
3040:8	Backgr.	Herring	Ängskärsklubb 2006	pg/g ww	10	11	1.8	2.0	6.7	3.2	0.18	0.41	0.23	0.19	11	0.51	ND	0.11	2.4	4.7%
3242:3	Backgr.	Herring	Ängskärsklubb 2007	pg/g ww	7.7	9.1	1.5	1.7	5.2	2.6	0.20	0.49	0.27	0.14	8.3	0.41	ND	0.089	2.0	4.4%
3347:5	Backgr.	Herring	Ängskärsklubb 2008	pg/g ww	4.8	5.4	ND	0.86	3.1	1.3	0.11	0.34	0.15	ND	4.4	0.37	ND	0.052	2.2	2.3%
3347:6	Backgr.	Herring	Ängskärsklubb 2008	pg/g ww	6.1	6.4	0.63	ND	3.6	1.4	0.073	0.28	0.13	ND	4.7	0.21	ND	0.060	2.6	2.3%
3430:28	Backgr.	Herring	Ängskärsklubb 2009	pg/g ww	1.7	1.7	0.33	0.33	1.0	0.54	0.042	0.13	0.075	ND	1.2	0.072	ND	0.017	0.77	2.2%
3430:29	Backgr.	Herring	Ängskärsklubb 2009	pg/g ww	1.6	1.6	0.35	0.45	1.0	0.59	0.051	0.17	0.11	ND	1.5	0.17	ND	0.016	0.80	2.1%
2857:17	Backgr.	Herring, spring	Ängskärsklubb 2001	pg/g ww	11	12	1.7	1.9	8	3.6	0.21	0.39	0.29	ND	11	0.39	ND	0.12	1.1	11%
2857:18	Backgr.	Herring, spring	Ängskärsklubb 2002	pg/g ww	24	25	3.8	ND	15	6.4	0.57	1.0	0.54	0.22	26	1.1	ND	0.26	0.62	42%
2857:19	Backgr.	Herring, spring	Ängskärsklubb 2003	pg/g ww	8.6	9.0	1.5	1.4	5.0	2.4	0.20	0.36	0.20	0.12	7.4	0.42	ND	0.088	2.6	3.3%
3373:1	Diffuse	Human milk	Uppsala	pg/g ww	2.3	3.8	ND	0.23	6.4	0.56	0.35	0.86	0.51	ND	0.55	0.23	ND	0.026	0.018	146%
3373:2	Diffuse	Human milk	Uppsala	pg/g ww	2.4	3.9	ND	ND	0.48	0.038	0.028	0.057	ND	ND	0.17	0.044	ND	0.023	0.018	130%
3373:3	Diffuse	Human milk	Uppsala	pg/g ww	1.1	1.8	ND	ND	0.58	0.078	0.035	0.067	ND	ND	0.11	0.021	ND	0.011	0.018	61%
3373:4	Diffuse	Human milk	Uppsala	pg/g ww	0.62	1.0	ND	ND	0.14	0.020	0.014	0.021	ND	ND	0.088	0.024	ND	0.006	0.018	35%
		Regional screening																		
3474:33	Backgr.	Herring	Norrb. Storfjärden	pg/g ww	2.7	2.7	0.67	0.84	1.5	1.4	0.10	0.18	0.10	ND	2.2	0.25	ND	0.026	0.59	4.5%
3474:34	Backgr.	Herring	Norrb. Seskaröfj.	pg/g ww	2.9	2.6	0.91	0.89	1.6	1.4	0.15	0.29	0.20	ND	2.7	0.40	ND	0.029	0.68	4.2%
3474:48	Diffuse	Perch	Värm.Varnumsviken	pg/g ww	1.1	0.78	0.4	0.51	1.4	1.9	0.34	0.35	0.60	ND	0.35	0.22	ND	0.009	0.17	5.1%
3474:49	Source	Sediment	Värm. Strandmossen	pg/g dw	27	34	10	18	57	58	13	24	29	3.4	56	63	9.4	0.46	7.1	6.5%
3474:50	Diffuse	Sediment	Värm. Varnum	pg/g dw	2.1	2.3	ND	1.5	3.0	2.2	0.54	1.3	1.5	0.26	7.7	2.7	ND	0.043	0.45	10%
3474:51	Source	Sed., scrap	Västerb. Tvärån	pg/g dw	0.37	0.43	0.14	0.40	0.74	0.33	ND	0.58	0.27	ND	3.9	0.23	ND	0.016	0.34	4.7%