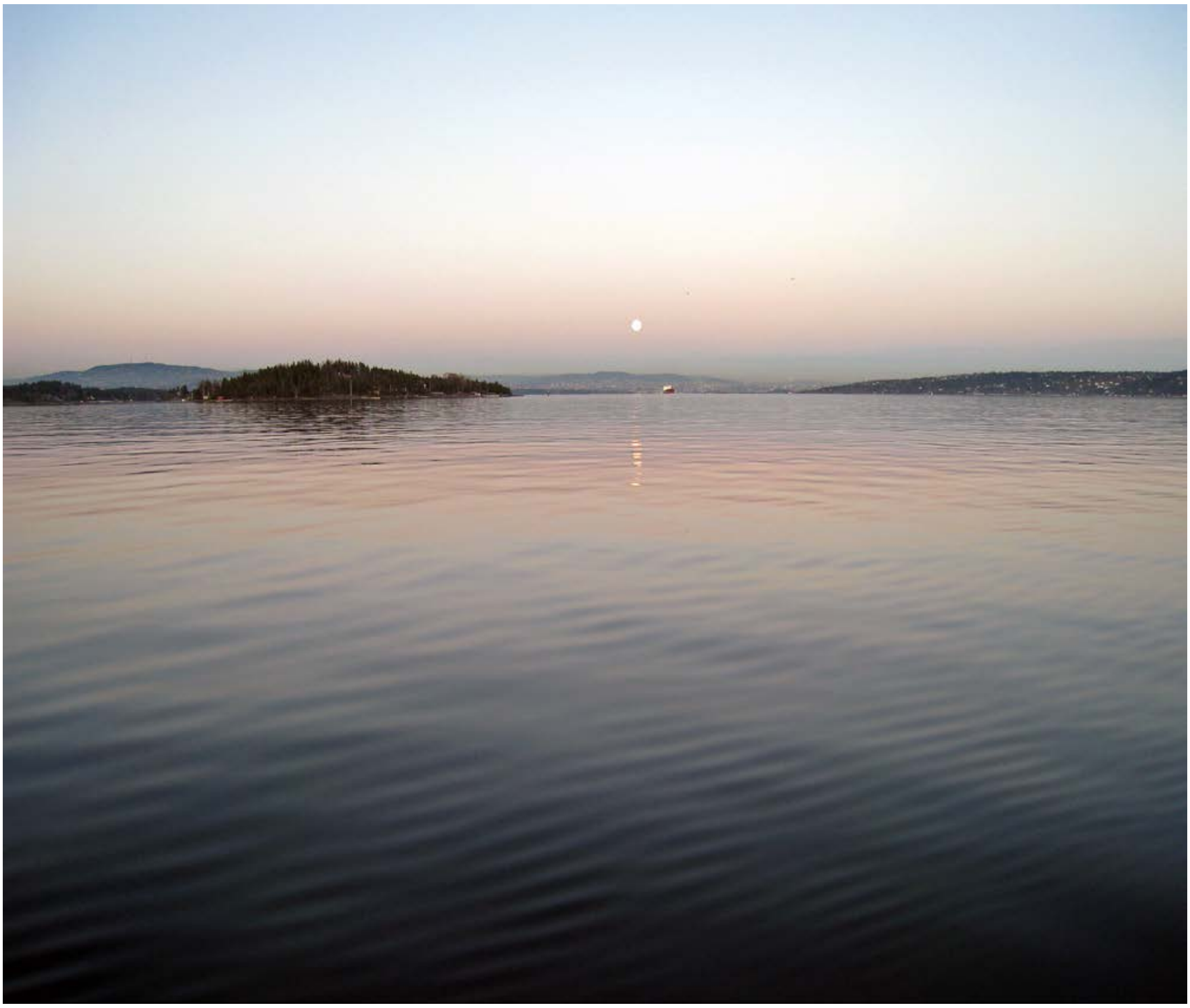
ENVIRONMENTAL MONITORING

M205-2014

Environmental Contaminants in an Urban Fjord



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Miljøgifter i en urban fjord
Environmental Contaminants in an Urban Fjord

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Summary - sammendrag

This programme, "Environmental Contaminants in an Urban Fjord" has covered sampling and analysis of organisms in a marine food web of the Inner Oslofjord, in addition to samples of sediment, blue mussel and polychaetes at selected locations in the fjord. The programme also included inputs of pollutants via surface water (storm water). Results from other monitoring programmes such as "Contaminants in coastal areas" (MILKYS) and "Riverine inputs and direct discharges to Norwegian coastal waters" (RID), as well as results from other input measurements to the inner Oslofjord, and measurements of contaminants at Bekkelaget sewage treatment plant are referred and placed in context with the results of the present programme. A vast number of chemical parameters have been quantified, and the report serves as valuable documentation of the concentrations of these chemicals in different compartments of the Inner Oslofjord marine ecosystem. Furthermore, this report presents relationships between the contaminant concentrations and various biological variables.

4 emneord

Miljøgifter, urban, næringskjede, bioakkumulering

4 subject words

Contaminants, Urban areas, Food web, bioaccumulation

Front page photo

Sigurd Øxnevad

Foreword

The programme covers sampling and analysis of organisms in a marine food web of the Oslofjord in addition to samples of sediment, blue mussel and polychaetes at selected locations in the fjord. The programme also includes inputs of pollutants via surface water (stormwater). Results from other monitoring programmes such as "Contaminants in coastal areas" (MILKYS) and "Riverine inputs and direct discharges to Norwegian coastal waters" (RID), as well as results from other input measurements to the inner Oslofjord, and measurements of contaminants at Bekkelaget sewage treatment plant are referred and placed in context with the results of the present programme.

The study was carried out by NIVA, with a majority of the chemical analyses performed by the Norwegian Institute for Air Research, NILU. Collection of herring gulls was done with assistance from the University of Oslo (Morten Helberg, Centre for Ecological and Evolutionary Synthesis).

Besides the authors of this report, several persons are acknowledged for their contribution in sample collection, sample preparation and analysis: Thomas Rundberget, Gunhild Borgersen, Ingar Johansen, Sigurd Øxnevad, Norman Green, Åse Kristine Rogne, Andreas Høgfeldt, Alfhild Kringstad, Camilla With Fagerli, Katherine Langford, Espen Lund, Katarzyna Iwona Kruk and Sven Hofgaard.

Oslo, august 2014

Anders Ruus
Forsker I, Marin Forurensning

Sammendrag

Dette programmet, "Miljøgifter i en Urban Fjord" har omfattet prøvetaking og analyse av organismer i en marin næringskjede i Indre Oslofjord, i tillegg til prøver av sediment, blåskjell og børstemark på utvalgte lokaliteter i fjorden. Programmet omfattet også undersøkelser av tilførsler av miljøgifter via overvann. Resultater fra andre overvåkingsprogrammer som "Miljøgifter i kystnære områder" (MILKYS) og "Elvetilførselsprogrammet" (RID), og resultater fra tilførselsundersøkelser, samt målinger av miljøgifter ved Bekkelaget kloakkrenseanlegg er omtalt og satt i sammenheng med resultatene fra den foreliggende undersøkelsen.

Målet med programmet var å undersøke tilførsler av miljøgifter som er tilstede i et tett befolket område og studere hvordan disse påvirker et fjordsystem. Denne undersøkelsen er ett skritt mot Miljødirektoratets generelle mål om å:

- Anslå graden av bioakkumulering av utvalgte miljøgifter på flere trofiske nivåer i marine næringskjeder.
- Koble eksponeringen av miljøgifter på marine organismer til toksiske effekter på ulike biologiske nivåer, inkludert hormonforstyrrende effekter og interaksjonseffekter ("cocktaileffekter").
- Identifisere kilder og sluk for miljøgifter i fjordsystemer ("skjebnen" til miljøgifter i en fjord), og utforme målrettede tiltak.

Programmet var også ment å frembringe data som vil være til hjelp i å gjennomføre kravene i Vanndirektivet ("Vannforskriften") i forbindelse med statlig basisovervåking.

Konsentrasjonene av et stort antall kjemiske parametre er kvantifisert i denne undersøkelsen, og rapporten fungerer som verdifull dokumentasjon av konsentrasjonene av disse kjemikaliene i ulike deler ("compartments") av det marine økosystemet i Indre Oslofjord. Videre presenterer denne rapporten sammenhenger mellom forurensnings-konsentrasjoner og forskjellige biologiske variabler, for eksempel:

- En signifikant negativ sammenheng ble funnet mellom konsentrasjoner av bisfenol A (BPA) og eggeskalltykkelse i egg av gråmåke, men datagrunnlaget var ikke tilstrekkelig til å avgjøre om dette var en reell årsakssammenheng eller om det var et resultat av en tilfeldig variasjon. Ytterligere undersøkelser er nødvendig for å belyse dette.
- For gråmåkeegg ble det observert en signifikant positiv sammenheng mellom trofisk nivå og (log) konsentrasjoner av siloksan-forbindelsen 'D5'. Det har tidligere vært ulike rapporteringer av de bioakkumulerende/biomagnifiserende egenskapene til siloksaner, og fremtidige undersøkelser vil igjen være verdifulle i å indikere om denne korrelasjonen var en "tilfeldig" observasjon, eller om et slikt forhold er å forvente. I tillegg til dette (slik som for alle andre forbindelser i denne rapporten), vil det være verdifullt å studere oppførselen til D5 i næringsnettet i Indre Oslofjord, når artene som prøvetas i større grad representerer trofiske interaksjoner (mer reelle predator-bytte-forhold).

Resultatene av stabile isotoper antydet at artene som er samlet inn i denne undersøkelsen ikke fullt ut utgjør et representativt næringsnett. De benyttede artene representerer med

andre ord kanskje ikke viktige predator-bytte-forhold. Videre antyder isotop-signaturene at Oslofjordtorsken, som har vært overvåket gjennom MILKYS-programmet, kan være en gunstig art å inkludere i næringsnettet i lignende fremtidige undersøkelser. Spesielt gjelder dette for studier av de bioakkumulerende/biomagnifiserende egenskapene til "nye" miljøgifter ("emerging contaminants") i Indre Oslofjord, hvor for eksempel PCB kan tjene som "benchmark".

Det er kjent at måkene i denne studien viser ulik beiteatferd og migrasjonsmønster, som vil påvirke resultatene. Den generalistiske beiteoppførselen til gråmåke ble også reflektert i isotop- signaturene ved at gråmåke viste lav $\delta^{15}N$ (og dermed en lav trofisk posisjon) og $\delta^{13}C$ sammenlignet de andre artene. Dette antyder at viktige komponenter av dietten hos gråmåke ikke var knyttet til det utvalgte næringsnettet. Gråmåke ble derfor utelatt fra næringskjeden i evalueringer av biomagnifisering av miljøgifter, unntatt i spesielle komparative øvelser. De enkelte gråmåkene (eller eggene) viste imidlertid et spenn av $\delta^{15}N$-verdier, noe som antyder ulik beiteatferd og som plasserer individene i forskjellige trofiske posisjoner. På grunn av dette ble de bioakkumulerende egenskapene til miljøgiftene også vurdert ved å analysere forholdet mellom trofisk nivå og konsentrasjoner i gråmåke (separat). Videre ble sammenhenger mellom forurensningskonsentrasjon og andre biometriske variabler undersøkt for måkene. Dette avdekket flere interessante forhold som det er verdt å undersøke videre (slik som ovennevnte eksempler med BPA og D5).

Summary

This programme, “Environmental Contaminants in an Urban Fjord” has covered sampling and analysis of organisms in a marine food web of the Inner Oslofjord, in addition to samples of sediment, blue mussel and polychaetes at selected locations in the fjord. The programme also included inputs of pollutants via surface water (storm water). Results from other monitoring programmes such as "Contaminants in coastal areas" (MILKYS) and "Riverine inputs and direct discharges to Norwegian coastal waters" (RID), as well as results from other input measurements to the inner Oslofjord, and measurements of contaminants at Bekkelaget sewage treatment plant are referred and placed in context with the results of the present programme.

The objective of the programme was to monitor the discharges of chemicals used in a densely populated area and to study how this contaminant input affects a fjord system. The present study represents one step towards the Norwegian Environment Agency’s general aim to:

- Estimate the degree of bioaccumulation of selected contaminants at several trophic levels in marine food chains.
- Connect pollutant exposure of marine organisms to toxic effects at different biological levels, including endocrine disruption and contaminant interactions ("cocktail effects").
- Identify sources and sinks (i.e. the fate) of environmental contaminants in fjord systems and design targeted actions.

The programme was also meant to provide data from governmental monitoring in Norway to comply with the requirements of Water Framework Directive (The Water Regulation/“Vannforskriften”).

A large number of chemical parameters have been quantified, and the present report provides documentation of the concentrations of these chemicals in different compartments of the Inner Oslofjord marine ecosystem. Furthermore, the report presents relationships between the contaminant concentrations and various biological variables in the addressed organisms, for instance:

- A significant negative relationship was found between the concentration of bisphenol A (BPA) and eggshell thickness in herring gull eggs. However, the data set was insufficient to determine whether this observation represented a causal relationship or merely a random effect. Further studies are required to elucidate this issue.
- For herring gull eggs, a significant positive relationship was observed between trophic level and the (log) concentration of the cyclic volatile methylsiloxane ‘D5’. There have previously been some divergences in reports of the bioaccumulative/ biomagnifying properties of siloxanes. Future studies will again be valuable to indicate if this correlation was a “random” observation, or if such a relationship may be expected. In addition, as for all other compounds in this report, it will be valuable to study the disposition of D5 in the Inner Oslofjord food web, when the set of study species represent more accurate predator-prey relationships.

The analytical results of the stable isotopes suggested that the species collected in the present study do not constitute a representative food web, i.e. the species analyzed may not

represent important predator-prey relationships within the studied area. Furthermore, cod have been monitored through the "Contaminants in coastal areas" (MILKYS) monitoring programme, and the isotopic signatures suggests that the Oslofjord cod could be a favorable species to include in future evaluations of the biomagnifying properties of (“emerging”) contaminants in the inner Oslofjord. In these studies, PCBs can serve as “benchmark” in the evaluations of biomagnifying properties.

It is known that the gulls of the present study display different feeding behaviors and migration patterns, which may have influenced on the results. The generalistic feeding behavior of herring gulls was also reflected in the isotopic signatures of the gulls. Herring gull displayed low $\delta^{15}N$ (and thus inhabit a low trophic position) and $\delta^{13}C$ compared the other species, thus indicating that a significant part of its food items was not represented by the selected food web. Herring gull was therefore omitted from the evaluations of biomagnification in the food web, except in specific comparative exercises. The individual herring gull eggs displayed a range of $\delta^{15}N$ values implicating that the mother birds were feeding differently with respect to trophic level. Therefore, the bioaccumulative properties of the contaminants in question were evaluated by analyzing relationships between trophic level and contaminant concentrations in herring gull (separately), as well as relationships between contaminant concentrations and other biometrics. This unveiled very interesting results/relationships, which deserve further scrutiny (such as the examples of BPA and D5, above).

Content

Attachments:

1. *Appendix*

1. Introduction

"Environmental contaminants in an urban fjord" is a programme designed to monitor discharges of anthropogenic chemicals in a densely populated area and to study how this contaminant input affects a fjord system. The programme addresses inputs of pollutants from potential sources, measurements of contaminant concentrations in different marine species, assessment of bioaccumulation patterns within a food web and estimation of effect risks in organisms. The programme contributes to the Norwegian Environment Agency's ongoing monitoring activity in coastal areas and supplements two other monitoring programmes: "RID - Riverine inputs and direct discharges to Norwegian coastal waters" and "MILKYS - Environmental contaminants in coastal areas".

1.1 Objectives

The environmental monitoring activity in the present programme contributes to the Norwegian Environment Agency’s general aim to:

- Estimate the bioaccumulation of selected contaminants at several trophic levels in marine food chains.
- Connect pollutant exposure of marine organisms to toxic effects at different levels of biological organisation, including endocrine disruption and contaminant interactions ("cocktail effects").
- Identify sources and sinks of environmental contaminants in fjord systems ("the fate of the contaminants in a fjord") and designing targeted actions.

The programme will also provide data that will aid to implement the requirements of Water Framework Directive (The Water Regulation/“Vannforskriften”) regarding governmental basic monitoring.

2. Material and Methods

2.1 Sample Collection

2.1.1 Food chain of the Inner Oslofjord

Zooplankton, prawns, polychaetes and flatfish were collected as representatives of a food chain in the inner Oslo Fjord. The organisms were collected in an area between Lysakerfjorden and Midtmeie (southwest of Steilene; Figure 1). Table 1 shows the sampling plan of the programme.

Krill (*Euphausiacea*) were collected as representatives of the zooplankton by Midtmeie, southwest of Steilene. A fry trawl was operated from RV Trygve Braarud for this purpose. Midtmeie is also the area where cod is collected in connection with the MILKYS-programme. Material for three pooled samples was collected.

Prawns (*Pandalus borealis*) were caught with benthic trawl from RV Trygve Braarud in the same area as zooplankton (krill), Midtmeie, southwest of Steilene. Material for three pooled samples was collected.

Polychaetes were collected in the inner Oslofjord (near the sampling sites for other species; Figure 1) using a van Veen grab (0.15 m^2) from RV Trygve Braaarud. When possible, the worms were held in a container of clean seawater for 6-8 hours prior to cryopreservation and analysis. This was done in order to allow the worms to purge any residual sediment from the gut. Material for three pooled samples was collected. The samples consisted of the species listed in Table 2.

Flounder (*Platichthys flesus*) were caught using gill nets in an area of the Lysakerfjord by Sven Hofgaard at Sollerud skole. 15 individuals were caught. Biometric data for the fish are given in Chapter 3.13.

Herring Gull (*Larus argentatus*) blood samples (from adult breeding individuals trapped at nest) and eggs (15 of each) were sampled by Morten Helberg (University of Oslo) and provided by the Norwegian Environment Agency. Biometric data for the birds are given in Chapter 3.13. The birds were captured at Bleikøykalven (59.89126 N, 10.74712 E), while the eggs were collected at the island Søndre Skjælholmen (Nesodden municipality; 59.85317 N, 10.7281 E). The blood samples (~5 ml) were taken from a vein under the wing. The breeding success at Bleikøykalven was very low this year due to fox predation. The gulls were ringed with a colour ring with an alpha-numeric code, which enables individual identification at distance. 12 of 15 birds included in this report were observed at Bleikøya or in the Oslo area after the trapping campaign, and one bird was breeding at the egg collection site, Søndre Skjælholmen (4 km south), in 2014.

Stormwater samples were collected at one occasion at four specific sampling points (Bryn Ring 3/E6, Breivoll/Alnabru terminal, Breivoll E6, downstream terminal and Hasle snow disposal site; Figure 1). The samples were collected from manholes by filling bottles directly in the storm water. Subsequently, the storm water samples were separated into a filtered fraction (hereafter referred to as “dissolved fraction”) and a particulate fraction by filtering (polyethylene (PE) frit, 20 µm porosity prior to analysis of perfluorinated compounds (at NIVA) and Whatman Glass Microfilters GF, pore size 1.2 µm, prior to analysis of other chemical parameters (at NILU)).

2.1.2 Alna River

Mussels were collected near the mouth of Alna River by standard procedures (as in "Contaminants in coastal areas", MILKYS; handpicked, using rake, or snorkelling). A pooled sample of 37 shells in the size 3 to 4.9 cm (shell length) was prepared.

Sediment was collected at the mouth of Alna River by means of a van Veen grab (0.15 m^2) from RV Trygve Braarud. Three samples of the top layer (0-2 cm in grab samples with undisturbed surface) were prepared*.

Polychaetes were collected at the mouth of Alna River, using the same approach as for the food chain of the Inner Oslofjord (above). One pooled sample was prepared. The samples consisted of the species listed in Table 2.

2.1.3 Bekkelaget

Mussels were collected at Bekkelaget by standard procedures (as in "Contaminants in coastal areas", MILKYS; handpicked, using rake, or snorkelling). A pooled sample of 36 shells in the size 3 to 4.9 cm (shell length) was prepared.

Sediment was collected at Bekkelaget by means of a van Veen grab (0.15 m^2) from RV Trygve Braarud. Three samples of the top layer (0-2 cm in grab samples with undisturbed surface) were prepared*.

Polychaetes were collected at Bekkelaget, using the same approach as for the food chain of the Inner Oslofjord (above). One pooled sample was prepared. The samples consisted of the species listed in Table 2.

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* According to the Norwegian Environment Agency guidelines for risk assessment of contaminated sediment (TA-2802/2011), the samples should preferably consist of pooled material from 4 grab shots at the same station. The present samples consisted of material from one grab shot.

2.1.4 Frognerkilen

Mussels were collected in Frognerkilen using standard procedures (as in "Contaminants in coastal areas", MILKYS; handpicked, using rake, or snorkelling). A pooled sample of 54 shells in the size 3 to 4.8 cm (shell length) was prepared.

Sediment was collected in Frognerkilen by means of a grab van Veen grab (0.15 m^2) from RV Trygve Braarud. Three samples of the top layer (0-2 cm in grab samples with undisturbed surface) were prepared*.

Polychaetes were collected in Frognerkilen, using the same approach as for the food chain of the Inner Oslofjord (above). One pooled sample was prepared. The samples consisted of the species listed in Table 2.

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* According to the Norwegian Environment Agency guidelines for risk assessment of contaminated sediment (TA-2802/2011), the samples should preferably consist of pooled material from 4 grab shots at the same station. The present samples consisted of material from one grab shot.

Table 1
Overview of samples collected for the "Urban Fjord" programme.

Species/matrix	Locality	Frequency	No. for analysis
Zooplankton	Food chain, Inner Oslofjord	Once per year	3 pooled samples
Prawns	Food chain, Inner Oslofjord	Once per year	3 pooled samples
Polychaetes	Food chain, Inner Oslofjord	Once per year	3 pooled samples
Flatfish	Food chain, Inner Oslofjord	Once per year	15 individuals
Inputs stormwater	See Figure 1	Once per year*	4 samples (4 samples of dissolved fraction plus 4 of particulate fraction)
Alna blue mussel	Mouth of Alna River	Once per year	1 pooled sample
Alna sediment	Mouth of Alna River	Once per year	3 pooled samples
Alna polychaetes	Mouth of Alna River	Once per year	1 pooled sample
Bekkelaget blue mussel	Bekkelaget STP	Once per year	1 pooled sample
Bekkelaget sediment	Bekkelaget STP	Once per year	3 pooled samples
Bekkelaget polychaetes	Bekkelaget STP	Once per year	1 pooled sample
Frognerkilen blue mussel	Frognerkilen	Once per year	1 pooled sample
Frognerkilen sediment	Frognerkilen	Once per year	3 pooled samples
Frognerkilen polychaetes	Frognerkilen	Once per year	1 pooled sample

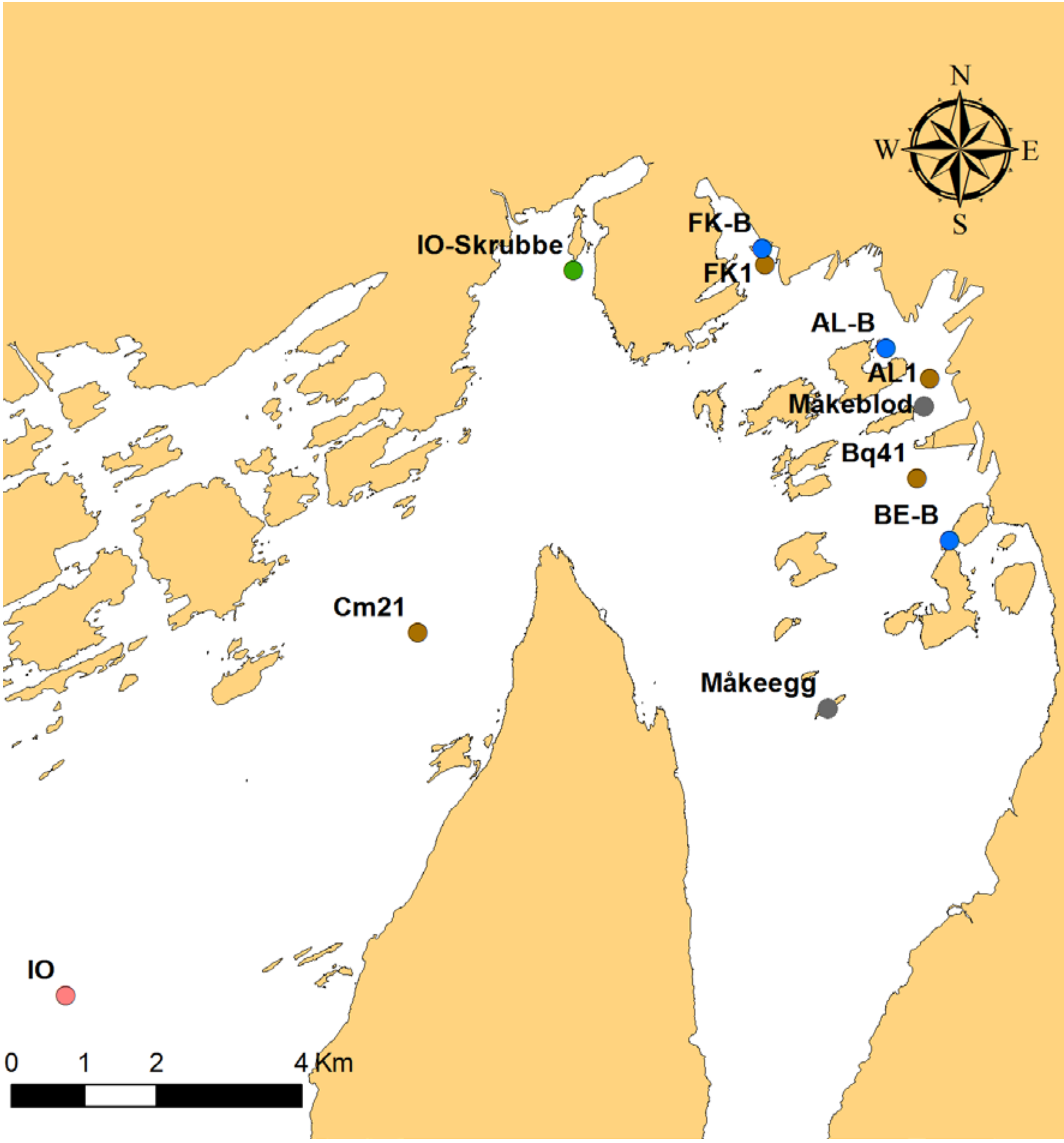
* Original plan was two localities, twice per year.

Table 2.
Species constituting polychaete samples (grams of each species).

	Frognerkilen (FK1)	Mouth of Alna River (AL1)	Bekkelaget (Bq41)	Inner Oslofjord * (Cm21)
Glycera sp.	18.9	4.7	8.2	13.0
Nephtys sp.	22.1	9.6		
Goniada sp.	13.9	6.9	2.7	9.4
P.crassa		28.2	72.7	111.9
Lumbrineridae indet				47.0
Misc. (undetermined)	5.7	8.0	8.7	23.0
Total (grams)	**60.6**	**57.4**	**83.6**	**204.3**

* The polychaete catch was divided in three separate (replicate) samples (with similar weight proportion of each species), before homogenization and chemical analysis.

A.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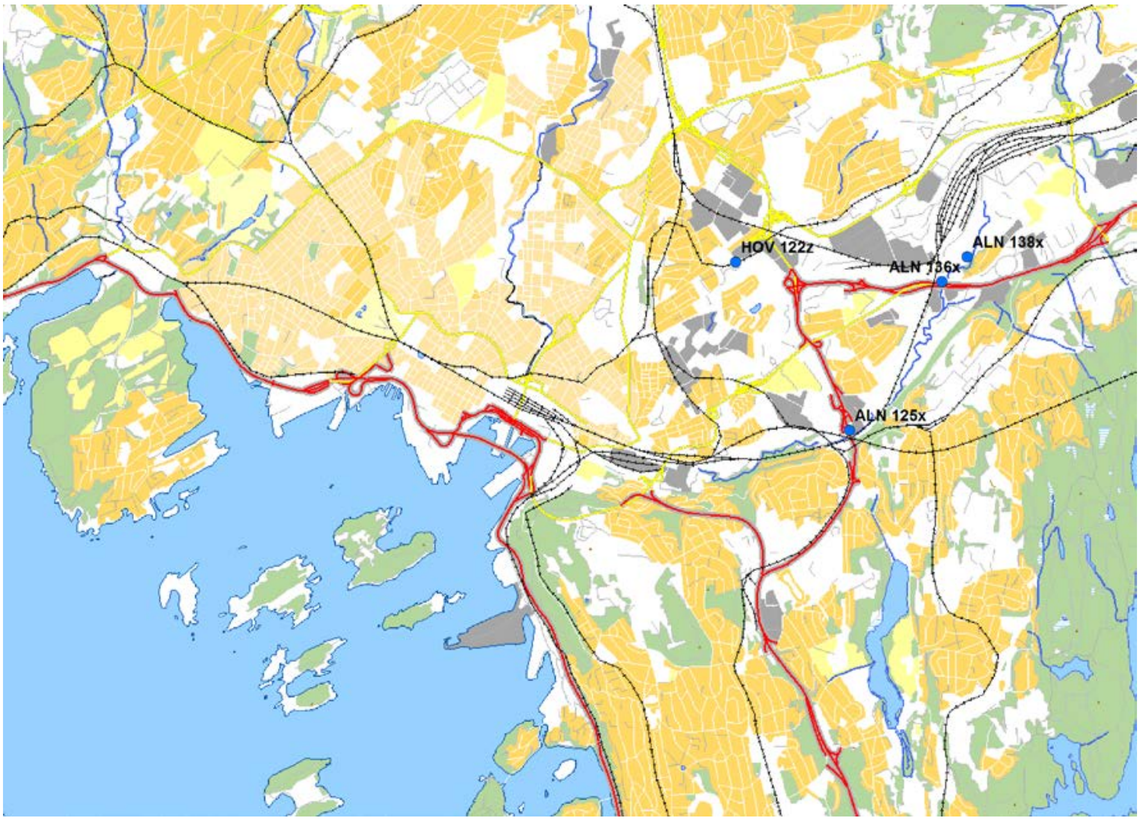

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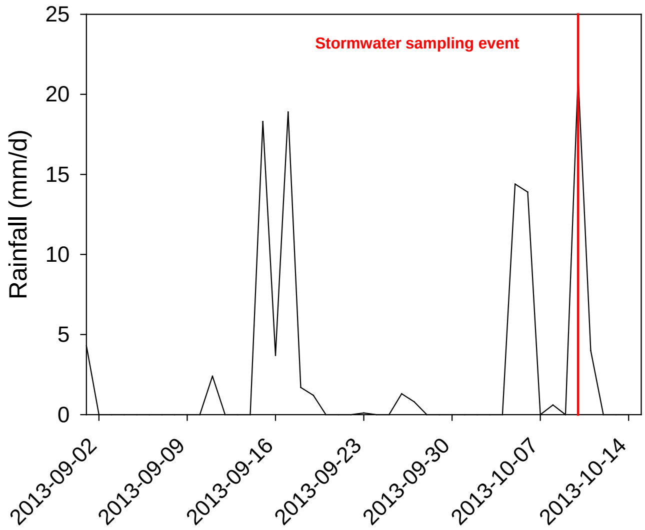


Figure 1. A.: (previous page) Map depicting stations for collection of blue mussel (blue dots) at Frognerkilen (FK-B), the mouth of Alna River (AL-B) and Bekkelaget (BE-B), collection of sediment and polychaetes (Brown dots) at at Frognerkilen (FK1), the mouth of Alna River (AL1), Bekkelaget (Bq41) and Inner Oslofjord (Cm21; only polychaetes), collection of flounder (green dot) in the Inner Oslofjord (IO-skrubbe), collection of Krill and prawns (pink dot) in the Inner Oslofjord (IO), as well as collection of herring gull eggs (Måkeegg) and blood (Måkeblod), respectively (grey dots). B.: Map depicting sites for collection of storm water/surface water samples. C.: Overview of time of sampling of storm water/surface water in relation to rainfall (mm/d).

2.2 Chemical analysis and support parameters

Tables 3-6 provide a detailed overview of the compounds/parameters analysed in the different samples. Optional parameters (Table 7) were included in the original programme. The samples were analysed at NIVA, NILU and Eurofins. Stable isotopes of carbon and nitrogen were analysed at IFE.

Table 3.
Overview: analyses in different matrices from the different localities (original programme).

Species/matrix	Locality	Analytes
Zooplankton	Food chain Inner Oslofjord	Metals, PCB7, PFC, HBCDD, PBDE, Chloroparaffines, siloxanes, PFR, TBBPA
Prawns	Food chain Inner Oslofjord	Metals, PCB7, PFC, HBCDD, PBDE, Chloroparaffines, siloxanes, PFR, TBBPA
Polychaetes	Food chain Inner Oslofjord	Metals, PCB7, PFC, HBCDD, PBDE, Chloroparaffines, siloxanes, PFR, TBBPA
Flounder*	Food chain Inner Oslofjord	Metals, PCB7, PFC, HBCDD, PBDE, Chloroparaffines, siloxanes, PFR, TBBPA
Herring gull (blood)	Food chain Inner Oslofjord	Metals, PCB7, PFC, HBCDD, PBDE, Chloroparaffines, siloxanes, PFR, TBBPA
Herring gull (egg)	Food chain Inner Oslofjord	Metals, PCB7, PFC, HBCDD, PBDE, BPA, oktyl-/nonylphenol, Chloroparaffines, ΣDDT, siloxanes, PFR, TBBPA
Stormwater **	See Figure 1	Metals, PCB7, PFC, HBCDD, PBDE, BPA, oktyl-/nonylphenol, Chloroparaffines, siloxanes, PFR, TBBPA
Alna blue mussel	Mouth of Alna River	Metals, PCB7, PFC, HBCDD, PBDE, BPA, oktyl-/nonylphenol, Chloroparaffines, siloxanes, PFR, TBBPA
Alna sediment	Mouth of Alna River	Metals, PCB7, PFC, HBCDD, PBDE, BPA, oktyl-/nonylphenol, Chloroparaffines, siloxanes, PFR, TBBPA
Alna polychaetes	Mouth of Alna River	Metals, PCB7, PFC, HBCDD, PBDE, BPA, oktyl-/nonylphenol, Chloroparaffines, siloxanes, PFR, TBBPA
Bekkelaget blue mussel	Bekkelaget STP	Metals, PCB7, PFC, HBCDD, PBDE, BPA, oktyl-/nonylphenol, Chloroparaffines, siloxanes, PFR, TBBPA
Bekkelaget sediment	Bekkelaget STP	Metals, PCB7, PFC, HBCDD, PBDE, BPA, oktyl-/nonylphenol, Chloroparaffines, siloxanes, PFR, TBBPA
Bekkelaget polychaetes	Bekkelaget STP	Metals, PCB7, PFC, HBCDD, PBDE, BPA, oktyl-/nonylphenol, Chloroparaffines, siloxanes, PFR, TBBPA
Frognerkilen blue mussel	Frognerkilen	Metals, PCB7, PFC, HBCDD, PBDE, BPA, oktyl-/nonylphenol, Chloroparaffines, antifouling agents, siloxanes, PFR, TBBPA
Frognerkilen sediment	Frognerkilen	Metals, PCB7, PFC, HBCDD, PBDE, BPA, oktyl-/nonylphenol, Chloroparaffines, antifouling agents, siloxanes, PFR, TBBPA
Frognerkilen polychaetes	Frognerkilen	Metals, PCB7, PFC, HBCDD, PBDE, BPA, oktyl-/nonylphenol, Chloroparaffines, antifouling agents, siloxanes, PFR, TBBPA

* Analytes were planned analysed in liver, but certain compounds were analysed in muscle tissue. ** Dissolved and particulate fractions.

Table 4.
Analytes included in the programme.

Parameter	Single compounds	Comment
Metals	Hg, Pb, Cd, Ni, Cu, Cr, Ag, Zn, Fe, As	
PCB 7	PCB-28, -52, -101, -118, -138, -153 and -180	
PCB32 (minus those constituting PCB 7)	PCB-18, 31, 33, 37, 47, 66, 74, 99, 105, 114, 122, 123, 128, 141, 149, 156, 157, 167, 170, 183, 187, 189, 194, 206 and 209	
PFC	PFBS, PFHxS, PFOS, br-PFOS, 6:2 FTS, ipPFNS, PFDS, PFDoS, PFOSA N-EtFOSE, N-MeFOSE, N-EtFOSA, N-MeFOSA, N-MeFOSEA, N-EtFOSEA, Perfluorinated carboxylic acids (6-14 C-atoms): PFBA, PFPA, PFHxA, PFHpA, PFOA, PFNA, PFDA, PFUnA, PFDoA, PFTrA, PFTA	
HBCDD	α-, β-, γ-HBCDD	
PBDE *	BDE-28, -47, -99, -100, -153, -154, -183, -196, -202, -206, -207 and -209	
Bisphenol A (BPA)		
Octyl-/nonylphenol		
Chloroparaffines	SCCP (C10-C13) and MCCP (C14-C17)	
Antifouling agents	Monobutyltin (MBT), dibutyltin (DBT), tributyltin (TBT) trifenyltinn (TPhT), irgarol, diuron, Zineb (i.e.. ETU as proxy for Zineb)	
ΣDDT	p,p'-DDT, p,p'-DDE, p,p'-DDD	Only eggs
Siloxanes	D4, D5, D6	
Phosphorus flame retardants (PFR)	tri-iso-butylphosphate (TIBP), tributylphosphate (TBP), tri(2-chloroethyl)phosphate (TCEP), tri(1-chloro-2-propyl)phosphate (TCPP), tri(1,3-dichloro-2-propyl)phosphate (TDCP), tri(2-butoxyethyl)phosphate (TBEP), triphenylphosphate (TPhP), 2-ethylhexyl-di-phenylphosphate (EHDPP), dibutylphenylphosphate (DBPhP), butyldiphenylphosphate (BdPhP), tris(2-ethylhexyl)phosphate (TEHP), tris-o-cresylphosphate (ToCrP), tricresylphosphate (TCrP)	
Tetrabromobisphenol A (TBBPA)		

* The laboratory was not able to quantify congeners -202 and -207 and will continue the effort to have these quantified for inclusion in the report of the 2014-sampling campaign (where they can be compared with the 2014-data). On the other hand, several additional congeners were analysed/quantified: BDE-49, -66, -71, -77, -85, -119 and -138).

Table 5.
Supportparameters included in the programme

Parameter	Specific single parameters	Comment
Stable isotopes	$\delta^{15}N$ and $\delta^{13}C$	In biological matrices
Eggshell thinning	Eggshell thickness	In egg
Lipid content (%) in biota		In biological matrices
Weight and length		Flounder
Assessment of stomach content		Flounder
Age		Flounder
Grain size distribution	Fraction <63 µm	Sediment
TOC		Sediment

Table 6.
Overview of additional optional parameters included in the programme.

Locality	Matrix	Parameters	No. of samples
Food chain Inner Oslofjord	Zooplankton	BDE-126, TBPH/BEHTBP[1], EHTeBB/TBB[2]	3
Food chain Inner Oslofjord	Prawns	BDE-126, TBPH/BEHTBP[1], EHTeBB/TBB[2]	3
Food chain Inner Oslofjord	Polychaetes	BDE-126, TBPH/BEHTBP[1], EHTeBB/TBB[2]	3
Food chain Inner Oslofjord	Flounder	BDE-126, TBPH/BEHTBP[1], EHTeBB/TBB[2]	15
Food chain Inner Oslofjord	Herring gull (blood)	BDE-126, TBPH/BEHTBP[1], EHTeBB/TBB[2]	15
Food chain Inner Oslofjord	Herring gull (egg)	BDE-126, TBPH/BEHTBP[1], EHTeBB/TBB[2]	15
Inner Oslofjord	Stormwater (dissolved fraction)	PAH[3], BDE-126, TBPH/BEHTBP[1], EHTeBB/TBB[2]	3
Inner Oslofjord	Stormwater (particulate fraction)	PAH[3], BDE-126, TBPH/BEHTBP[1], EHTeBB/TBB[2]	3
Mouth of Alna River	Blue mussel	PAH[3], BDE-126, TBPH/BEHTBP[1], EHTeBB/TBB[2]	1
Mouth of Alna River	Sediment	PAH[3], BDE-126, TBPH/BEHTBP[1], EHTeBB/TBB[2]	3
Mouth of Alna River	Polychaetes	PAH[3], BDE-126, TBPH/BEHTBP[1], EHTeBB/TBB[2]	1
Bekkelaget STP	Blue mussel	PAH[3], BDE-126, TBPH/BEHTBP[1], EHTeBB/TBB[2]	1
Bekkelaget STP	Sediment	PAH[3], BDE-126, TBPH/BEHTBP[1], EHTeBB/TBB[2]	3
Bekkelaget STP	Polychaetes	PAH[3], BDE-126, TBPH/BEHTBP[1], EHTeBB/TBB[2]	1
Frognerkilen	Blue mussel	PAH[3], BDE-126, TBPH/BEHTBP[1], EHTeBB/TBB[2]	1
Frognerkilen	Sediment	PAH[3], BDE-126, TBPH/BEHTBP[1], EHTeBB/TBB[2]	3
Frognerkilen	Polychaetes	PAH[3], BDE-126, TBPH/BEHTBP[1], EHTeBB/TBB[2]	1

[1.] Bis(2-ethyl-1-hexyl)tetrabromophthalate (TBPH/BEHTBP) – Cas no 26040-51-7
[2.] 2-ethylhexyl-2,3,4,5-tetrabromobenzoate (EHTeBB/TBB) – Cas no 183658-27-7
[3.] Anthracene, naphthalene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(*ghi*)perylene, indeno(1,2,3-*cd*)pyrene, fluoranthene, acenaphthylene, acenaphthene, fluorene, phenanthrene, pyrene, benzo(a)anthracene, chrysene, dibenz(*ah*)anthracene.

2.2.1 Analysis of PCBs, PBDEs, HBCDD, DDT and S/MCCP

Polychlorinated biphenyls (PCBs), polybrominated diphenylethers (PBDEs), hexabromocyclododecane (HBCDD), DDT and short- and medium chained chloroparaffines (S/MCCP) were analysed at NILU.

Extraction

Prior to extraction, the samples were added a mixture of isotope labelled PCBs, PBDEs, HBCCD and DDT standards, for quantification purposes.

The water-, sediment-and biota-samples were extracted with organic solvents and concentrated under nitrogen flow, followed by a clean-up procedure using concentrated sulphuric acid and a silica column to remove lipids and other interferences prior to analysis.

Analysis

With the exception of HBCDD, all compounds were quantified on GC-HRMS (Waters Autospec), while an LC-ToF (Waters Premier) or LC-QToF (Agilent 6530/50) were utilised to quantify HBCDD.

Limits of Detection

The limits of detection (LoD) and quantification (LoQ) were calculated for each sample, using the accepted standard method; three times the signal/noise ratio (z/n) and 9 times z/n, respectively.

Quality assurance and accreditation

NILU's laboratories are accredited by Norwegian Accreditation for ISO/IEC 17025. NILU is accredited for the analysis of PCBs and DDT compounds. For the other compounds, the same quality assurance procedures (as for the accredited compounds) were applied.

2.2.2 Analysis of PFRs

Phosphorus flame retardants (PFRs) were analysed at NILU.

Extraction

Prior to extraction, the samples were added a mixture of isotope labelled PFR standards, for quantification purposes.

The water-, sediment- and biota-samples were extracted with organic solvents and concentrated under nitrogen flow, followed by a clean-up procedure using a silica column to remove lipids and other interferences prior to analysis.

Analysis
PFR compounds were quantified on a GC-MSD (Agilent MSD) and LC-ToF (Waters Premier) or LC-QToF (Agilent 6530/50).

Limits of Detection
The limits of detection (LoD) and quantification (LoQ) were calculated for each sample, using the accepted standard method; three times the signal/noise ratio (z/n) and 9 times z/n, respectively.

Quality assurance and accreditation
NILU's laboratories are accredited by Norwegian Accreditation for ISO/IEC 17025. NILU is not accredited for the analysis of PFRs, but the same quality assurance procedures (as for the accredited compounds) were applied for the analyses of these compounds.

2.2.3 Analysis of alkylphenols and bisphenols
Alkylphenols and bisphenols (BPA and TBBPA) were analysed at NILU.

Extraction
Prior to extraction, the samples were added a mixture of isotope labelled phenols for quantification purposes.

The sediment- and biota-samples were extracted with organic solvents and concentrated under nitrogen flow, followed by a clean-up procedure using an SPE column to remove lipids and other interferences prior to analysis. Water samples were concentrated and purified on a SPE column. After elution from the SPE column, the water sample extracts were further concentrated under nitrogen.

Analysis
All samples were analysed by LC-ToF (Waters Premier) or LC-QToF (Agilent 6530/50).

Limits of Detection
The limits of detection (LoD) and quantification (LoQ) were calculated for each sample, using the accepted standard method; three times the signal/noise ratio (z/n) and 9 times z/n, respectively.

Quality assurance and accreditation
NILU's laboratories are accredited by Norwegian Accreditation for ISO/IEC 17025. NILU is not accredited for the analysis of alkylphenols and bisphenols, but as far as possible, the documentation, sample preparation, analysis and calculation procedures were conducted according to the accredited methods.

2.2.4 Analysis of siloxanes

Siloxanes were analysed at NILU.

Extraction

Established methods based on liquid/liquid extraction (Warner et al. 2010; Warner et al. 2013) were used to extract and quantify siloxanes, in addition to headspace extraction techniques (Sparham et al. 2008) for analysing siloxanes in water and sediment samples.

Analysis

Analysis of siloxanes (D4, D5 and D6) was performed using gas chromatography with mass spectrometric detection (GC-MS).

NILU has extensive experience with analysis of siloxanes. The greatest risk in the analysis is background contamination, as these chemicals (D4, D5 and D6) are applied in e.g. skin care products. Using a state-of-the-art cleanroom, NILU may perform trace analysis of these compounds in matrices from pristine environments, such as the Arctic (Krogseth et al. 2013; Warner et al. 2013).

Limits of Detection

Limits of detection (Method detection limits, MDLs) and quantification (limits of quantification, LoQ) were used to evaluate the detection of analytes. The method used to calculate the MDL has been previously reported (Warner et al. 2013). LoQ was calculated as nine times the signal/noise ratio of the GC-MS instrument.

Quality assurance and accreditation

NILU's laboratories are accredited by Norwegian Accreditation for ISO/IEC 17025. NILU is not accredited for the analysis of siloxanes. However, to the extent possible, documentation, preparation, analysis and calculations were performed in accordance with accredited methods. NILU has previously participated in a laboratory intercalibration of siloxanes (McGoldrick et al. 2011) and has also worked closely with the industry.

Samples were analysed in groups with at least one additive standard sample and a blank control. The data from these were used to calculate the uncertainty for each sample group. To ensure repeatability, a random sample from each matrix was selected for duplicate analysis.

Field blanks were prepared for the sampling of samples for siloxane analyses by packing 2 or 3 grams of XAD resin in filter bags of polypropylene/cellulose, which were thereafter cleaned by ultrasonic treatment in hexane for 30 min. Subsequently, used hexane was removed and substituted with clean hexane and the field blanks were sonicated once more for 30 min. After ultrasonic treatment, the field blanks were dried in a clean cabinet equipped with HEPA- and charcoal filter to prevent contamination from indoor air. After drying, the field blanks were put in sealed polypropylene containers and sent for sampling purposes. Several field-blanks were stored at NILU’s laboratories and analysed to determine reference concentrations before sampling. The field blanks sent for sampling purposes were exposed and handled in the field during sampling and during preparation of samples. The results from the analysis of the field blanks are presented in Table 7.

Table 7.
Results of the analysis of siloxanes in (field) blanks, consisting of XAD resin in filter bags of polypropylene/cellulose.

Description of sampling/purpose	D4 (ng/g)	D5 (ng/g)	D6 (ng/g)
Flounder (liver)	20.14	3.94	2.42
Blue mussel (Bekkelaget)	11.96	3.42	2.33
Polychaeta (Frognerkilen)	12.43	3.84	2.92
Polychaeta (Bekkelaget)	18.74	3.97	2.98
Krill	29.18	4.37	2.96
Polychaeta (Inner Oslofjord)	18.08	3.86	2.63
Stored in cabinet (NILU-lab)	39.04	3.59	2.79
Blank 1 (hexane)	1.8	0.9	0.5
Blank 2 (hexane)	2.1	0.9	0.5
Blank 3 (hexane)	1.4	0.6	0.5

The results from the analysis of (field) blanks show that some contamination of the samples is inevitable, as concentrations in blanks exposed during sampling and preparation were higher than in unexposed blanks. However, there were no notable differences in concentrations between field blanks exposed during sampling/preparation of the different organisms, thus no corrections have been made based on these results.

2.2.5 Analysis of PFCs

Perfluorinated compounds (PFCs) were analysed at NIVA

Extraction

Biota: Biota samples were homogenized and 2 g aliquots taken. Internal standards were added and the samples were shaken and sonicated for 1 hour with MeCN (4 mL) and then centrifuged for 5 min at 3500 rpm. The solvent was decanted off and the procedure was repeated and the two extracts were combined. One ml of the extract was diluted with 0.5 mL 2.6 mM ammonium acetate (aq) and 75 uL acetic acid (cons.) before active coal was added. After mixing, the sample was finally centrifuged with a 0.2 um nylon Spin-X filter (Costar).

Water: Internal standards were added to the water sample (1 L) before extraction using a HLB solid phase extraction cartridge (Waters). The analytes were eluted of the HLB with MeOH. The MeOH extract was evaporated under nitrogen and resolved in 60+40 MeCN and 2.6 mM ammonium acetate (aq).

Particulate fraction: Particles were filtered from 1 L of water with a polyethylene frit (Supelco). The frit was sonicated in MeCN for 30 min. The MeCN extract was reduced under nitrogen and diluted (1+1) with 2.6 mM ammonium acetate (aq).

Analysis

UPLC-HighRes MS analysis: PFAS analytes were separated on a Acquity BEH C8 column (100 x 2 mm x 1.7 µm) with water (2.6 mM ammonium acetate) and MeCN mobile phases using a gradient elution programme over a period of 8 minutes with a flow rate of 0.5 ml/min. The MS parameters are shown in Table 8.

Limits of Detection
The limits of detection (LoD) and quantification (LoQ) were calculated for each sample, using the accepted standard method; three times the signal/noise ratio (z/n) and 9 times z/n, respectively.

Quality assurance and accreditation
NIVA's laboratory is accredited by Norwegian Accreditation for ISO/IEC 17025. NIVA is not accredited for these particular compounds, but to the extent possible, documentation, preparation, analysis and calculations are performed in accordance with accredited methods. NIVA has previously participated in intercalibrations, e.g. in 2013 organized by UNEP-coordinated Global Inter Laboratory Assessment 2012/2013 and the Ontario Ministry of the enviroment/AMPA (NCP) which included analysis of various biological matrices and sediment samples.

Samples were analysed in groups with at least one additive standard sample and a blank control. To ensure repeatability, a random sample from each matrix was selected for duplicate analysis.

Table 8.
Analytes, acronyms, formula and quantifier ions for the High resolution MS detection of PFCs.

PFC compounds	Acronyme	Molecular formula	Quantifier ion	
perfluoro-n-butanoic acid	PFBA	$C_4HF_7O_2$	168.985	[M-CO2]-
perfluoro-n-pentanoic acid	PFPA	$C_5HF_9O_2$	218.980	[M-CO2]-
perfluoro-n-hexanoic acid	PFHxA	$C_6HF_{11}O_2$	268.977	[M-CO2]-
perfluoro-n-heptanoic acid	PFHpA	$C_7HF_{13}O_2$	318.974	[M-CO2]-
perfluoro-n-octanoic acid	PFOA	$C_8HF_{15}O_2$	368.973	[M-CO2]-
perfluoro-n-nonanoic acid	PFNA	$C_9HF_{17}O_2$	418.969	[M-CO2]-
perfluoro-n-decanoic acid	PFDA	$C_{10}HF_{19}O_2$	468.967	[M-CO2]-
perfluoro-n-undecanoic acid	PFUnDA	$C_{11}HF_{21}O_2$	518.966	[M-CO2]-
perfluoro-n-dodecanoic acid	PFDoDA	$C_{12}HF_{23}O_2$	568.964	[M-CO2]-
perfluoro-n-tridecanoic acid	PFTrDA	$C_{13}HF_{25}O_2$	618.960	[M-CO2]-
perfluoro-n-tetradecanoic acid	PFTeDA	$C_{14}HF_{27}O_2$	712.940	[M-H]-
perfluoro-1-butanesulfonate	PFBS	$C_4F_9SO_3$	298.937	[M-H]-
perfluoro-1-hexanesulfonate	PFHxS	$C_6F_{13}SO_3$	398.933	[M-H]-
perfluoro-1-octanesulfonate	PFOS	$C_8F_{17}SO_3$	498.931	[M-H]-
perfluoro-1-decanesulfonate	PFDS	$C_{10}F_{21}SO_3$	598.925	[M-H]-
perfluoro-1-dodecansulfonate	PFDoDS	$C_{12}F_{25}SO_3$	698.920	[M-H]-
perfluoro-7-methyloctanesulfonate	ipPFNS	$C_9F_{19}SO_3$	548.928	[M-H]-
perfluoro-1-octanesulfonamide	PFOSA	$C_8H_2F_{17}NO_2S$	497.945	[M-H]-
N-methylperfluoro-1-octanesulfonamide	N-MeFOSA	$C_9H_4F_{17}NO_2S$	511.960	[M-H]-
N-ethylperfluoro-1-octanesulfonamide	N-EtFOSA	$C_{10}H_6F_{17}NO_2S$	525.969	[M-H]-
2-(N-methylperfluoro-1-octanesulfonamido)-ethanol	N-MeFOSE	$C_{11}H_8F_{17}NO_3S$	616.010	[M+CH3COO]-
2-(N-ethylperfluoro-1-octanesulfonamido)-ethanol	N-EtFOSE	$C_{12}H_{10}F_{17}NO_3S$	630.010	[M+CH3COO]-
1H,2H-perfluorooctane sulfonate (6:2)	6:2FTS	$C_8H_4F_{13}SO_3$	426.963	[M-H]-

2.2.6 Analysis of biocides

Diuron, irgarol and tinorganic compounds were analysed at Eurofins. Ethylene thiourea (ETU; hydrolysis product of Zineb) was analysed at NIVA.

Analysis of tinorganic compounds

Analyses of tinorganic compounds were done according to accredited methods. Samples were extracted followed by derivatisation with sodiumtetraethylborate. Internal standards were added prior to the extraction. After clean-up of the hexane phase a recovery standard was added and analysis was done by means of GC/MS.

Analysis of diuron and irgarol

The samples were extracted with organic solvent, before evaporation and reconstituted in methanol/water. Analysis was done by means of LC-MS/MS.

Analysis of Zineb

Zineb is biocide used in Norway in antifouling paints, however there is currently very little monitoring data for Zineb in the environment. In water, Zineb is rapidly (<96h) transformed to the metabolite ethylene thiourea (ETU; Thomas et al. 2002; Figure 2).

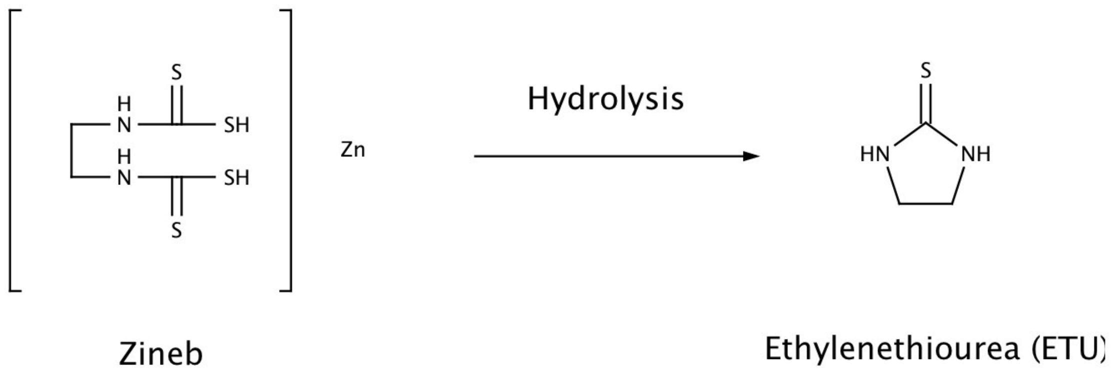


Figure 2. Hydrolysis of Zineb to Ethylene thiourea (ETU).

For this reason, published methods were used to analyze ethylene thiourea (ETU) as a substitute for Zineb in samples of mussels, polychaetes and sediment from Frognerkilen (USEPA Method 509). The analysis was carried out with GC-HR-ToF MS after extraction with dichloromethane and d_4-ETU as quantification standard (Langford et al. 2012).

Limits of Detection

The limits of detection (LoD) and quantification (LoQ) were calculated for each sample, using the accepted standard method; three times the signal/noise ratio (z/n) and 9 times z/n, respectively.

Quality assurance and accreditation
NIVA's laboratory is accredited by Norwegian Accreditation for ISO/IEC 17025 and NIVA used the same quality assurance routines for ETU as for accredited methods/compounds.

Samples were analysed in groups with at least one additive standard sample and a blank control. To ensure repeatability, a random sample from each matrix was selected for duplicate analysis.

2.2.7 Analysis of PAH16

Analysis of polycyclic aromatic hydrocarbons (PAH16) was performed at NIVA.

Extraction and analysis of PAH16
The samples were added internal standard and extracted with organic solvents. Biota samples were added internal standards and boiled in a methanol/lye solution before the samples were extracted with organic solvents. The extracts were cleaned by means of elution chromatography to remove interfering substances. Finally, the extracts were analysed using a gas chromatograph equipped with a mass selective detector (GC/MSD). Quantification was performed using external and internal standards.

Limits of Detection
The limits of detection (LoD) and quantification (LoQ) were calculated for each sample, using the accepted standard method; three times the signal/noise ratio (z/n) and 9 times z/n, respectively.

Quality assurance and accreditation
NIVA's laboratory is accredited by Norwegian Accreditation according to ISO/IEC 17025. NIVA is not accredited for these particular compounds, but documentation, preparation, analysis and calculations are performed in accordance with accredited methods. NIVA has a long time experience with PAH analysis in different matrixes and participate in several intercalibrationstudies every year e.g. quasimemes twice a year for biota and sediments.

Samples were analysed in groups with at least one additive standard sample/reference sample of biota and sediment, and at least one blank control.

2.2.8 Analysis of Metals

Metal analyses were performed at NILU.

Sample Preparation
Sediment- and biota-samples were added supra pure acid and digested at high pressure and temperature in a microwave- based digestion unit (UltraClave). A minimum of two blanks were included with each digestion. Furthermore, reference material (traceable to NIST) was digested with the samples.

Water samples were preserved in original bottles with 1% (v/v) nitric acid.

Instrumental Analysis
The metals were determined using inductively coupled plasma mass spectrometer (ICP-MS). All samples, standards and blanks were added internal standard prior to analysis.

Limits of Detection
Detection limits (LoD) and Quantification limits (LoQ) were calculated from 3 times and 10 times the standard deviation of blanks, respectively.

2.2.9 Support parameters

Stable isotopes of nitrogen and carbon were analysed at IFE by combustion in an element analyser, reduction of NOx in Cu-oven, separation of N_2 and CO_2 on a GC-column and determination of $\delta^{13}C$ and $\delta^{15}N$ at IRMS (Isotope Ratio Mass Spectrometer).

Trophic level was calculated as follows (assuming a 3.8 increase per full trophic level; Hobson and Welch, 1992; and that blue mussel inhabit trophic level 2, filtrating algal particles on trophic level 1):

$$TL_{consumer} = 2 + (\delta^{15}N_{consumer} - \delta^{15}N_{blue\ mussel})/3.8$$

Captive-rearing studies on piscivorous birds indicate that the $\delta^{15}N$ isotopic fractionation factor between bird diet and tissue is less than that derived for the other trophic steps, most likely linked to the fact that birds produce uric acid (Mizutani et al. 1991). According to Mizutani et al (1991) an isotopic fractionation factor of +2.4 ‰ is appropriate. Thus, the following equation was used to calculate the trophic level of herring gulls:

$$TL_{herring\ gull} = 3 + (\delta^{15}N_{herring\ gull} - (\delta^{15}N_{blue\ mussel} + 2.4))/3.8$$

Eggshell thickness (herring gull eggs) was determined according to procedures described by Nygård (1983).

Lipid content in biological samples was determined gravimetrically during extraction for chemical analyses.

Weight and length of the fish (flounder) were determined before dissection. Assessment of gastric contents was done by recording the number of sufficiently undigested individuals of prey species to an appropriate taxonomic level.

The age of the flounder was read from otoliths. The age was read by counting the number of opaque zones (summer zones) and hyaline zones (winter zones).

Grain size distribution (fraction of particles <63 µm) in sediment was determined according to procedures described by Krumbein and Petttijohn (1938).

Total organic carbon content (TOC) in sediment was determined by catalytic combustion in an element analyser.

3. Results and Discussion

The results of the chemical analyses (and lipid content of biological samples) are given in Appendix, where also analyses falling below LoD are indicated together with the values of the LoDs. There are no chapters/paragraphs (below) dedicated to merely report the concentration levels in flounder *per se*, and we show to the Appendix for this purpose.

When results are below LoD (especially when this occurs in many samples), the value of the information is reduced, and there are challenges regarding presentations and statistical evaluation. For the purpose of calculating mean concentrations, we have assigned these samples/parameters a value of zero (it is noted below when this occurs). In regression models, we have omitted samples with non-detects from processing ("case-wise deletion").

3.1 Stable isotopes

The results of the stable isotope analysis are given in Appendix.

Stable isotopes of carbon and nitrogen are useful indicators of food origin and trophic levels. $\delta^{13}C$ gives an indication of carbon source in the diet or a food web. For instance, it is in principle possible to detect differences in the importance of autochthonous (native marine) and allochthonous (watershed/origin on land) carbon sources in the food web, since the $\delta^{13}C$ signature of the land-based energy sources is lower (greater negative number). Also $\delta^{15}N$ (although to a lesser extent than $\delta^{13}C$) may be lower in allochthonous as compared to autochthonous organic matter (Helland et al. 2002), but more important, it increases in organisms with higher trophic level because of a greater retention of the heavier isotope (^{15}N). The relative increase of ^{15}N over ^{14}N ($\delta^{15}N$) is 3-5‰ per trophic level (Layman et al. 2012; Post 2002). It thus offers a continuous descriptor of trophic position. As such, it is also the basis for Trophic Magnification Factors (TMFs) that give the factor of increase in concentrations of contaminants, and have recently been amended to Annex XIII of the European Community Regulation on chemicals and their safe use (REACH) for possible use in weight of evidence assessments of the bioaccumulative potential of chemicals as contaminants of concern.

In the present report, the stable isotope data have been reviewed partly to indicate any possibilities that there are different energy sources (food chain baselines) at the different localities in the inner Oslofjord that one should be aware of (assessed in polychaetes and blue mussel). Secondly, as organisms (here flounder and herring gull) grow, they may feed on larger prey organisms, thus a small increase in trophic level is likely to occur. For compounds with bioaccumulative potential, a consequence may be higher tissue concentrations. Thirdly, and most important, trophic level is calculated from $\delta^{15}N$ for the organisms to assess possible biomagnification of the compounds/contaminants in question.

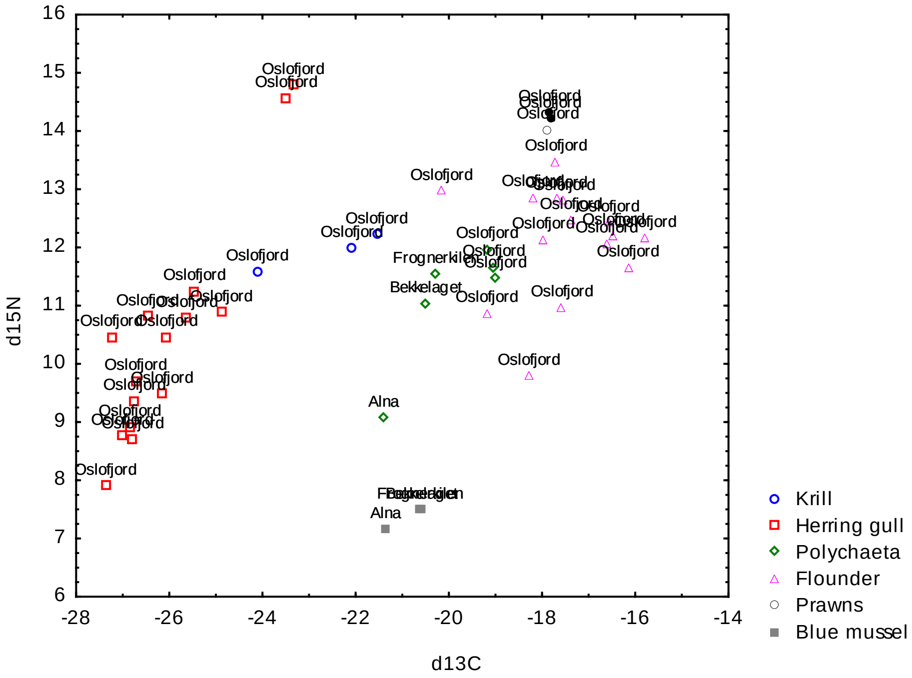
There were no great differences in $\delta^{13}C$ or $\delta^{15}N$ between mussels or polychaetes from the different localities in the inner Oslofjord (Figure 3), indicating a common food chain baseline. As mentioned, an increase in $\delta^{15}N$ of 3 to 5 ‰ represents a step of one full trophic level. The variability in $\delta^{15}N$ signature in flounder spans a maximum of one trophic level. There were two herring gull eggs with markedly higher $\delta^{15}N$ signature than the rest, which could indicate that these were laid by individuals feeding on a higher trophic level. Prawns had a relatively high $\delta^{15}N$ isotope ratio, possibly related to their scavenging behavior.

When herring gull matrices (blood and eggs) are evaluated in isolation/separately (Figure 3), it is evident that the matrices show similar $\delta^{15}N$ (with the exception of two egg samples that showed higher $\delta^{15}N$), thus herring gull would be placed on approximately the same trophic level regardless of matrix. The $\delta^{13}C$ is however higher in blood than eggs.

There were no demonstrable relationships between $\delta^{13}C$ or $\delta^{15}N$ and the age, weight or length of flounder (not shown). Nor were there any demonstrable relationships between $\delta^{13}C$ or $\delta^{15}N$ and the weight or wing length of herring gull (not shown).

Herring gull displayed low $\delta^{15}N$ (and thus inhabit a low trophic position in the sampled food web) and $\delta^{13}C$ compared the other species, indicating important food items not related to the selected food web. Herring gull is therefore omitted from the food web in terms of evaluations of biomagnification in the food web (except in specific comparative exercises). However, since the individual herring gulls (or eggs) display a range of $\delta^{15}N$ values (implicating different feeding behavior placing individuals in different trophic positions) the bioaccumulative properties of the contaminants in question is also evaluated by analyzing relationships between trophic level and contaminant concentrations in herring gull (in isolation). Similar is performed for flounder (where 15 individuals are also analyzed).

A.



B.

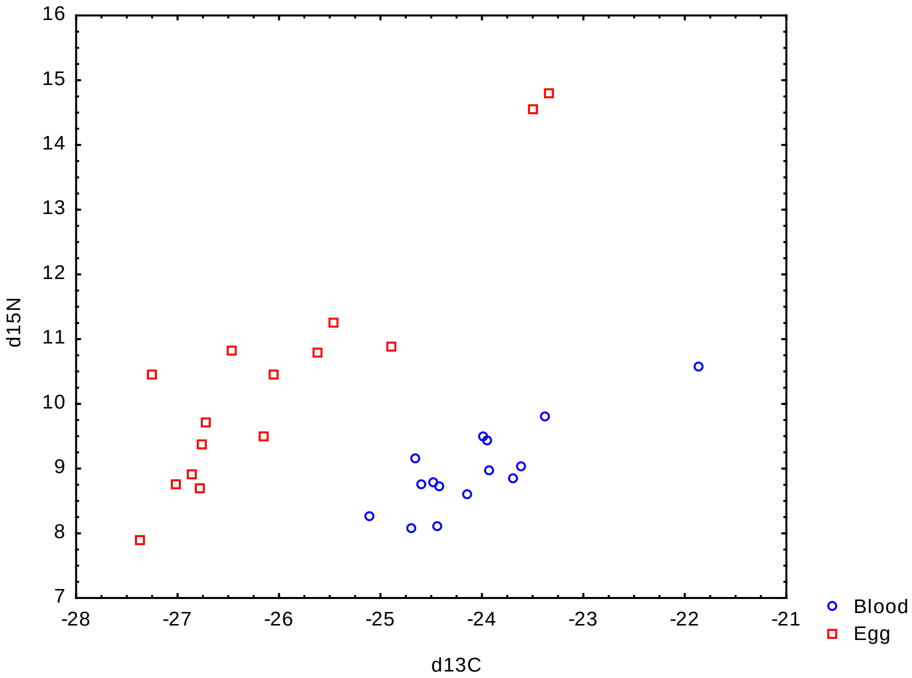


Figure 3. $\delta^{13}C$ plotted against $\delta^{15}N$ in organisms from the inner Oslofjord. (Herring gull = eggs; A.), and $\delta^{13}C$ plotted against $\delta^{15}N$ in herring gull blood and eggs (B.).

3.2 Polychlorinated biphenyls (PCBs)

The results of the analyses of polychlorinated biphenyls (PCBs) are given in Appendix.

Relation to quality standards

According to the Norwegian guidelines on classification of environmental quality in fjords and coastal waters – a revision of the classification of waters and sediments with respect to metals and organic contaminants (Bakke et al. 2007; Bakke et al. 2010), concentrations of ΣPCB_7 in sediments corresponded to "moderate condition" (Class III) at the mouth of Alna River (all three replicates), and from "good" to "moderate condition" (Class II-III) at Bekkelaget and in Frognerkilen.

According to the Norwegian classification of environmental quality in fjords and coastal waters (Molvær et al. 1997), concentrations of ΣPCB_7 in blue mussel corresponded to "moderately polluted" (Class II) at all stations (Frognerkilen, the mouth of Alna River and Bekkelaget).

There are no relevant quality standards for PCBs in water.

Diffuse inputs

Concentrations of PCBs determined in storm water are depicted in Figure 4. The compounds were detected in both the dissolved fraction and in the particulate fraction, surprisingly in approximately similar amounts (exception: PCB-47). Given the hydrophobic properties of these compounds, they have a high affinity for the particulate phase and are usually associated with this. These results may indicate that the dissolved fraction may contain colloids or very small particles (smaller than the pore size of the filters used; 1.2 µm). On the other hand, there were some methodological uncertainties regarding PCB, PBDE and HBCDD separation in these specific samples (and elimination of these uncertainties is planned in 2014, when new samples are collected).

Bekkelaget STP has reported that 0,236 kg PCB ran through the plant in 2012 (BEVAS, 2013).

Contribution of PCB inputs from Alna River in 2013 is available through the programme "Riverine inputs and direct discharges to Norwegian coastal waters" (RID; not reported yet). Alna River was not included in the programme in 2012. The contribution was calculated as follows, and the results are presented in Tables 9-11:

- Use of weekly recording of discharge ($L\ d^{-1}$), STS ($mg\ L^{-1}$) and TOC ($mg\ C\ L^{-1}$) by Oslo Kommune (Vann og Avløp)
- PCB measurement on the suspended particulate matter from RID sampling on three occasions (January, April, September), five consecutive days of continuous flow centrifugation.
- All seven PCB congeners measured above LOD in the particulate matter samples.

- Concentrations of PCBs in the dissolved for the outlet of the Alna River were calculated from passive sampling data from a study conducted in 2012 (Allan et al., 2013). Data were not corrected for exposure temperature. Congener PCB-180 was below limits of quantification. Since, including PCB-180 in the sum concentrations of PCB results in less than 3 % difference in estimate, the ΣPCB_7 is based on substances measured above LOQ
- Calculation of flux to the fjord:

  (1) $F = Q \times C_{STS} \times C_{PCB,STS}$

  Where F is the flux of particle-bound PCB congener (mg per week), Q is the discharge (L s^{-1} on a weekly basis), C_{STS} is the weekly total suspended particulate matter concentration (mg L^{-1}) and $C_{PCB,STS}$ is the PCB concentration in the suspended particulate matter (ng g^{-1} dry weight material)

  (2) $F = Q \times C_{TOC} \times C_{PCB,POC}$

  Where F is the flux of particle-bound PCB (mg per week), Q is the discharge (L s^{-1} on a weekly basis), C_{TOC} is the weekly total organic carbon concentration in water (mg L^{-1}) and the $C_{PCB,POC}$ is the yearly mean PCB congener concentration in the suspended particulate matter on an organic carbon normalized basis (ng g^{-1}). Note that the TOC and POC may not be the same since TOC includes dissolved organic carbon.

  (3) $F = Q \times C_{w,PCB}$

  Where $C_{w,PCB}$ is the freely dissolved concentrations (ng L^{-1}) measured with LDPE samplers in 2011 (through other activity than RID; to give a relative proportion between dissolved and particulate fraction).
- Yearly fluxes are calculated as a sum of the weekly fluxes.

Table 9.
Particulate-bound PCB concentrations (ng/g) measured in three suspended particulate matter samples collected by continuous-flow centrifugation.

	PCB-28 (ng/g)	PCB-52 (ng/g)	PCB-101 (ng/g)	PCB-118 (ng/g)	PCB-153 (ng/g)	PCB-138 (ng/g)	PCB-180 (ng/g)	ΣPCB_7 (ng/g)
January	1.9	2	2.9	1.8	4.3	4.2	2.5	19.6
April	0.62	2.1	1.1	0.66	1.4	1.3	1	8.18
September	1.7	2.9	4.4	3.2	7.1	7.7	4.3	31.3
Mean	**1.41**	**2.33**	**2.80**	**1.89**	**4.27**	**4.40**	**2.60**	**19.69**
SD	0.69	0.49	1.65	1.27	2.85	3.20	1.65	11.56
%RSD	49.0	21.1	59.0	67.4	66.8	72.8	63.5	58.7

Table 10.
Dissolved PCB congener concentrations (ng/L) measured in the Alna River (outlet) in 2011 using LDPE passive samplers.

	PCB-28	PCB-52	PCB-101	PCB-118	PCB-153	PCB-138	PCB-180
$C_{w,PCB}$	0.016	0.017	0.010	0.0044	0.0058	0.0053	<0.0015

Table 11.
Flux estimates for particle-bound PCBs (g/year)

	PCB-28	PCB-52	PCB-101	PCB-118	PCB-153	PCB-138	PCB-180	ΣPCB_7
STS-based	6.1	6.4	9.4	5.8	13.9	13.6	8.1	63.3
TOC-based	4.6	7.8	9.0	6.0	13.6	13.9	8.3	63.1

Table 12.
Flux estimates for dissolved phase PCBs (mg/year) *

	PCB-28	PCB-52	PCB-101	PCB-118	PCB-153	PCB-138	PCB-180	ΣPCB_7
Passive sampling-based	535	568	334.12	147	194	177	< 48	1955

*Note that these estimates are based on data from 2012 (one LDPE exposure, see Allan et al., 2013 for more details). Concentration estimates from silicone passive samplers deployed alongside were lower than those reported for LDPE, so the values presented are conservative, fluxes may be lower.

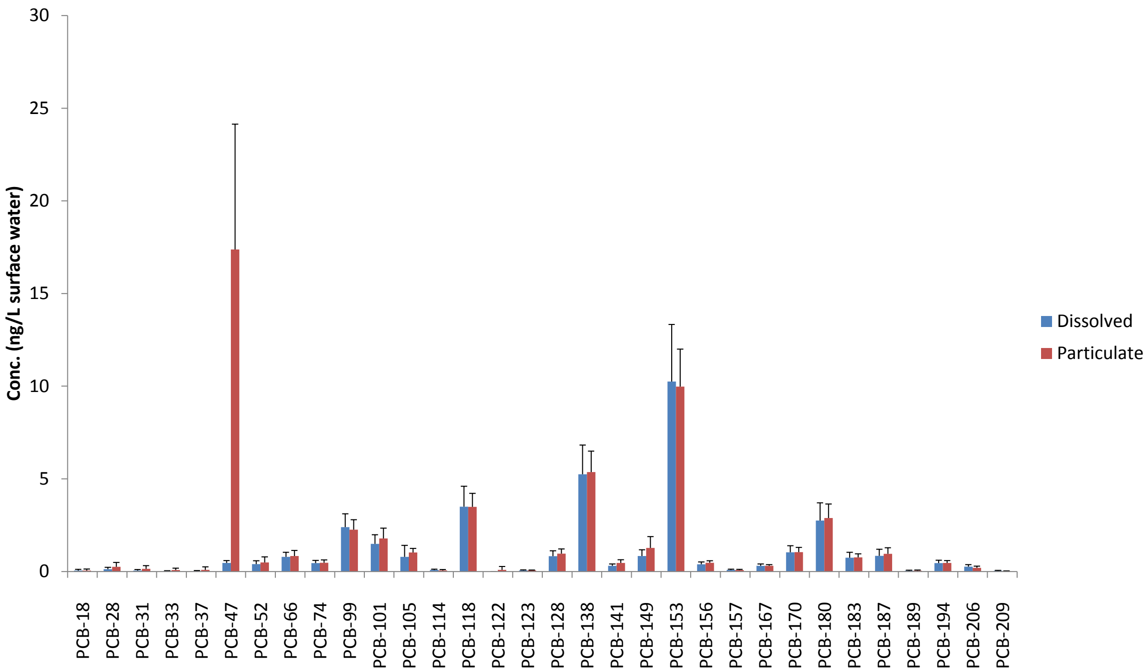


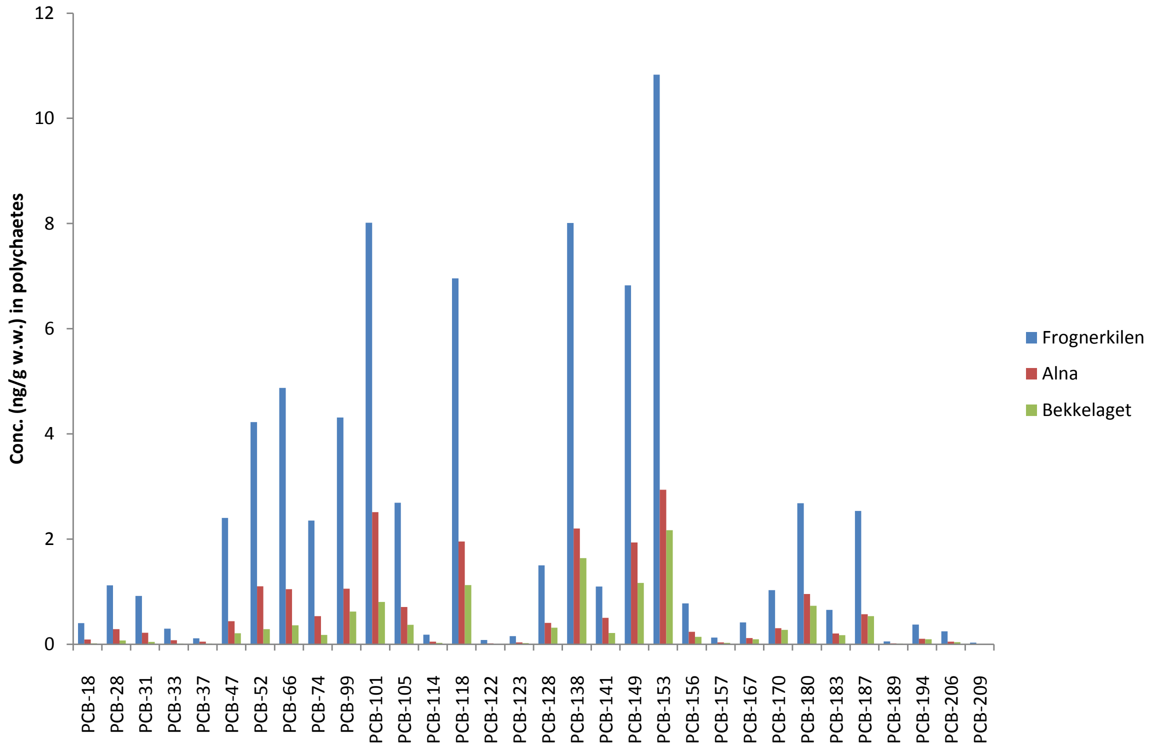
Figure 4. Concentrations of PCBs (ng/L of water) in storm water/surface water (mean and standard deviation; n=4).

Geographical aspects

There were apparent differences in concentrations (statistical evaluation not applicable due to limited number of samples) of PCBs in polychaetes and mussels from Frognerkilen, the mouth of Alna River and Bekkelaget (Figure 5). Concentrations in polychaetes were highest in Frognerkilen and lowest at Bekkelaget, while concentrations in blue mussel were highest at the mouth of Alna River and lowest at Bekkelaget. This suggests an exposure of PCBs in surface water (from Alna River).

The lowest PCB concentrations in polychaetes from Bekkelaget likely reflect that the sediments at this location also contain the lowest mean PCB concentrations (Figure 6; no statistics performed). The highest concentrations in polychaetes from Frognerkilen cannot be explained by correspondingly higher concentrations in the Frognerkilen sediments (Figure 6). Nor can they be explained by a lower amount of organic carbon (thus higher bioavailability) in the Frognerkilen sediments (as the organic carbon content was approximately the same as at the Mouth of Alna River; see chapter 3.13). It must be noted that the variability in PCB concentrations between replicate sediment samples was fairly high (Figure 6) and that the polychaete samples from the different locations consisted of different amounts of different species. The lipid content in polychaetes in Frognerkilen was somewhat higher than at the other two stations (see Appendix), which may influence this result.

A.



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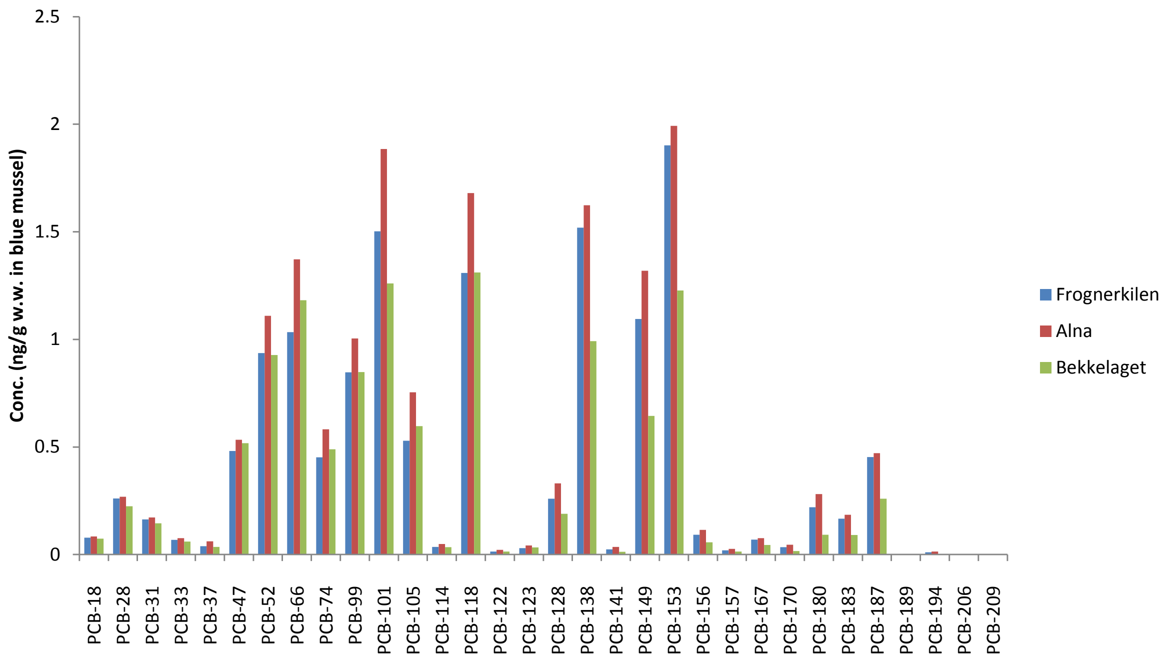


Figure 5. Concentrations of PCBs (ng/g wet wt.) in polychaetes (A.) and blue mussel (B.) from Frognerkilen, the mouth of Alna River and at Bekkelaget. One composite sample per station.

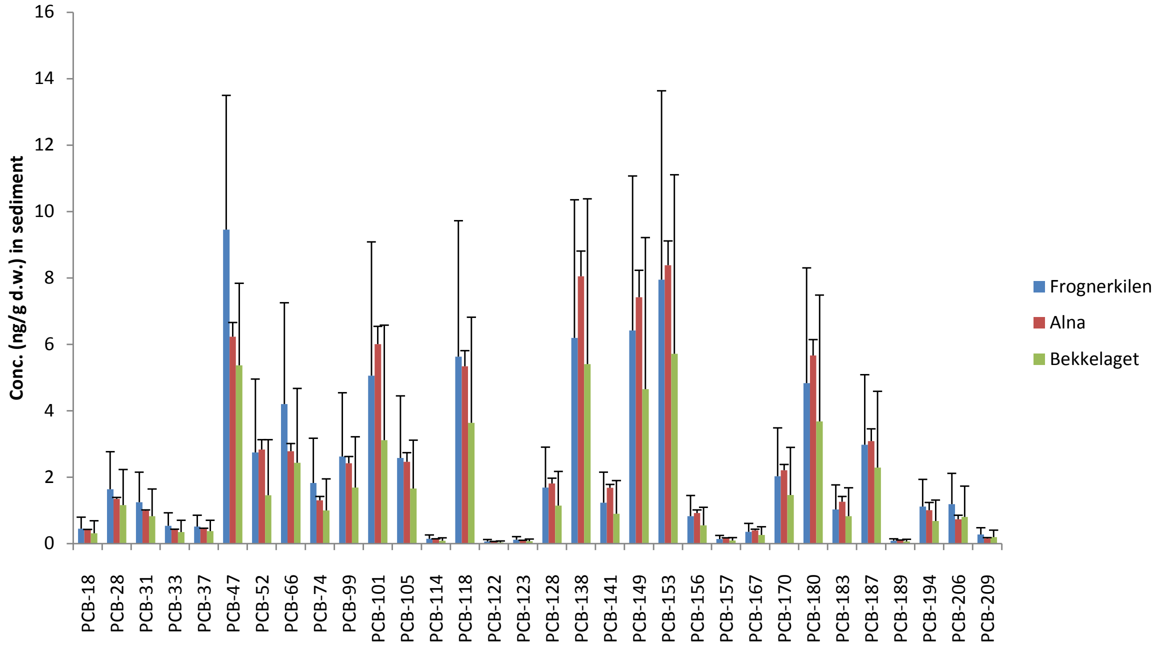


Figure 6. Concentrations of PCBs (ng/g dry wt.) in sediments from Frognerkilen, the mouth of Alna River and at Bekkelaget (mean and standard deviation; n=3).

Herring gull

PCBs were detected in eggs and blood of herring gull (Figure 7). The mean concentrations (on a lipid weight basis) were apparently highest in blood (no statistics performed), however, the variability was high. Furthermore several congeners were not detected (in Figure 7 assigned values of zero).

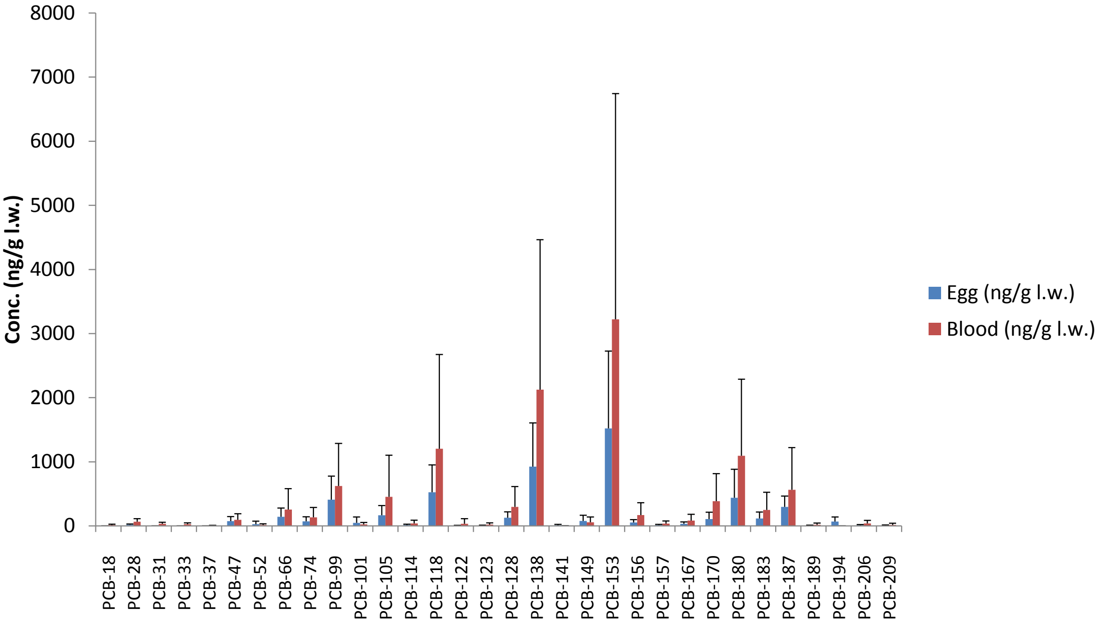


Figure 7. Concentrations of PCBs (ng/g lipid wt.) in herring gull (eggs and blood) from the Inner Oslofjord (mean and standard deviation; n=15; non-detects are assigned values of zero).

Food chain of the Inner Oslofjord

Evaluations of the concentrations of PCBs in the Inner Oslofjord food web were performed on a lipid weight basis.

PCBs are known to bioaccumulate and biomagnify through food chains (e.g. Ruus et al. 1999; 2002; Hallanger et al. 2011). As a result of these characteristics, PCBs are often used to "benchmark" biomagnifying properties, when such is evaluated for other contaminants in the same ecosystem (e.g. Borgå et al. 2012).

There was no demonstrable biomagnification of PCB congeners in the studied Inner Oslofjord food web, when herring gull was included, with the exception of PCB-52 and PCB 101 (Figure 8), when herring gull was represented by blood samples (not when herring gull was represented by egg samples). The increase in concentration corresponded to Trophic Magnification Factors of 5.3 and 9.14, respectively. On the other hand, there were several examples of significant negative regressions (i.e. "trophic dilution"; not specified/shown). It must be noted again that herring gull displayed low $\delta^{15}N$ (and thus inhabit a low trophic position in the sampled food web) and $\delta^{13}C$ compared with the other species, indicating important food items not related to the selected food web. Therefore, as previously mentioned, herring gull will be omitted from the food web in terms of evaluations of biomagnification (except in further specific comparative exercises). Herring gull also in general contained high levels of PCBs, compared with the other species. Even when herring gull was omitted from the regression few significant positive regressions could be shown. This is partly due to the low PCB-concentrations combined with a relatively high trophic position of prawns (the latter likely because of their scavenging behaviour; prawns are described as omnivores, predators and scavengers, and it is likely that they feed on carcasses of higher trophic organisms). There are, however, no good reasons to exclude prawns from the sampled food web. Only PCB-189 showed significant biomagnification R^2=0.29; p=0.02; TMF=3.3). PCB-189 was not detected in prawns, thus prawns were automatically excluded from this specific regression ("casewise deletion"), according to criteria mentioned above.

PCBs have also been analysed in cod liver annually since 1990, through the "Contaminants in coastal areas" (MILKYS) monitoring programme (Green et al. 2013). In 2012, PCB-28, -52, -101, -118, -138, -153 and -180 were analysed in cod liver from the Inner Oslofjord. In addition, stable isotopes of carbon and nitrogen were analysed). If these cod are included in the food web (and herring gull is excluded), significant biomagnification can be demonstrated for PCB-101, -118, -138, -153 and -180 (R^2=0.12 and p=0,02, R^2=0.20 and p=0,004, R^2=0.34 and p=0,00008, R^2=0.44 and p=0,00000, and R^2=0.37 and p=0,00003, respectively; not shown). Thus, the PCBs display known properties, suggesting that it would be favourable to include cod in the sampled food web in similar future evaluations of the biomagnifying properties of ("emerging") contaminants in the inner Oslofjord, where PCBs can serve as "benchmark" (see chapter 3.15).

Looking at flounder, isolated, (log) concentrations showed a significant positive linear relationship with trophic level for PCB-128, -138, -153, -157, and -189 (R^2=0.29, 0.30, 0.29, 0.33 and 0.29, respectively; p=0.04, 0.03, 0.04, 0.02 and 0.04, respectively). The concentration of PCB-194 showed a positive relationship with age (R^2=0.31; p=0.03), while concentrations of no congeners showed a positive relationship with length or weight.

For herring gull in isolation, (log) concentrations in eggs showed a significant positive linear relationship with trophic level for PCB-31, -52, -66, -74, -101, and -149 and (R^2=0.55, 0.33, 0.28, 0.26, 0.27 and 0.30, respectively; p=0.008, 0.02, 0.04, 0.04, 0.04 and 0.03, respectively). In blood, the (log) concentration of PCB-149 showed a significant positive linear relationship with trophic level (R^2=0.21; p=0.03). The concentrations of PCBs (in blood) did not show any significant relationships with wing length or body mass.

Cod from the Inner Oslofjord

PCBs have been analysed in cod liver annually since 1990, through the "Contaminants in coastal areas" (MILKYS) monitoring programme (Green et al. 2013). In 2012, these compounds were analysed in cod liver from 13 stations (including the Inner Oslofjord). It was concluded that the concentration of ΣPCB_7 in cod liver from the Inner Oslofjord was 3065 µg/kg wet wt., over 48 % higher than the four other harbour stations where ΣPCB_7 was measured (Ålesund and Trondheim, Tromsø and Hammerfest harbours). Historical data on entry of PCBs to the Inner Oslofjord is not available. Present entry of PCB to the fjord has however been calculated to be around 3.3 kg/year (Berge et al. 2013). Run-off from urban surfaces is the most important contributor (2.1 kg/year). It is also anticipated that sediments in the fjord store much of the historic inputs of PCB to the fjord. Parts of the Inner Oslofjord are densely populated with much urban activities. The high concentrations of PCB observed in cod liver are probably related to these activities, as well as reduced water exchange with the Outer fjord.

The median concentration of ΣPCB_7 measured in flounder from the Inner Oslofjord in 2013 (present study) were apparently lower (a factor of ~7) than the median concentration measured in cod (2012) (no statistics performed).

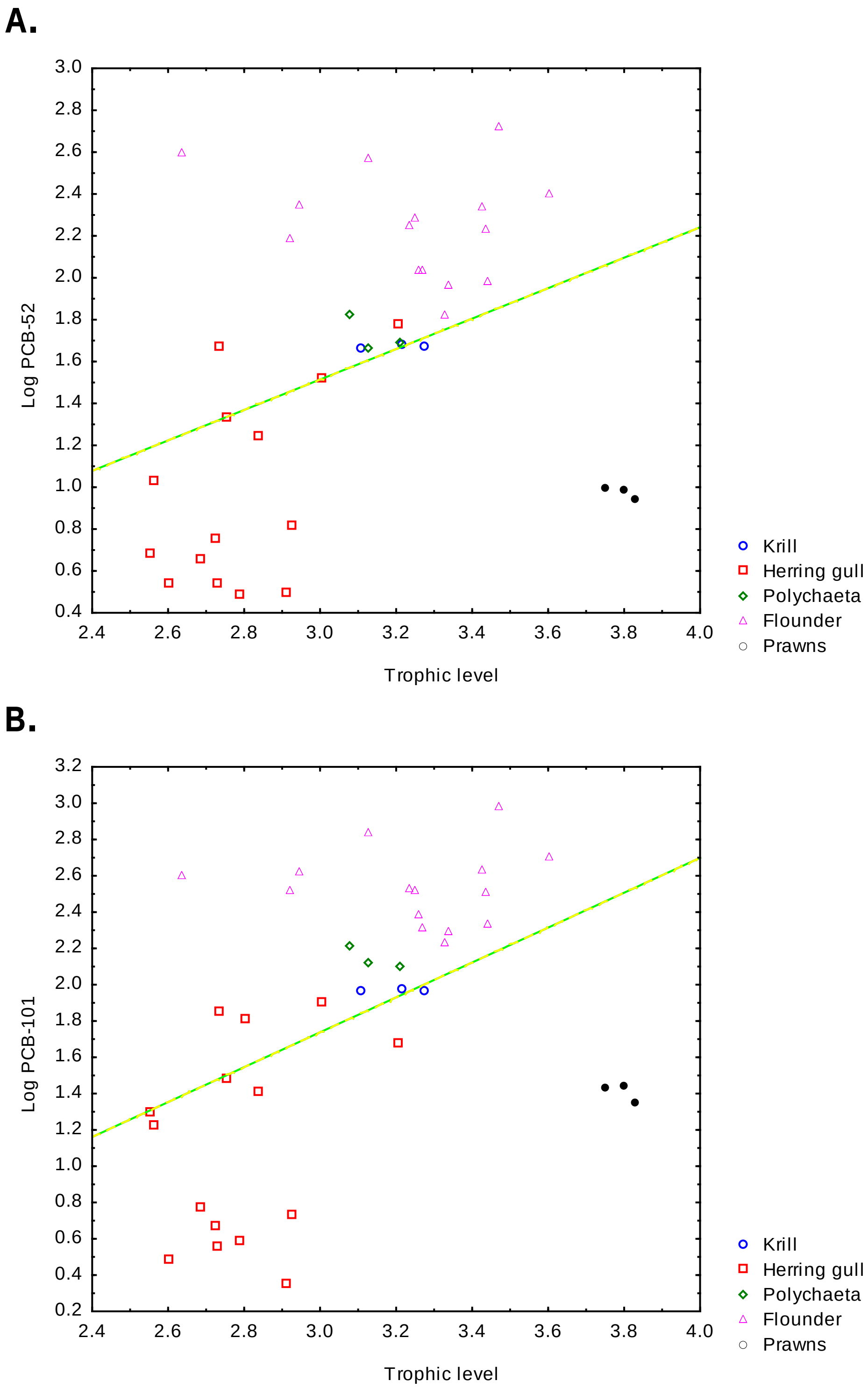


Figure 8. Trophic level against concentrations (ng/g lipid wt.; log-transformed) of PCB-52 (A.) and PCB-101 (B.) in organisms of the Inner Oslofjord food web. Only concentrations above the LoD are included. Concentrations in herring gull blood. R^2 = 0.14 and 0.20, respectively; p = 0.02 and 0.004, respectively.

3.3 DDT and its compounds

DDT and its compounds were only analysed in eggs of herring gull and are given in Appendix. In addition, hexacyclohexane (HCH) isomers were analysed in the eggs (also given in Appendix).

Only the (log) concentration of p,p'-DDD showed a significant positive linear relationship with trophic level of the eggs (Figure 9; R^2=0.37; p=0,02).

DDT-compounds are known to induce a decrease in eggshell calcium (Bitman et al. 1969), thus affecting reproductive success in certain predatory birds (Ratcliffe, 1967). These issues are dealt with below (chapter 3.14).

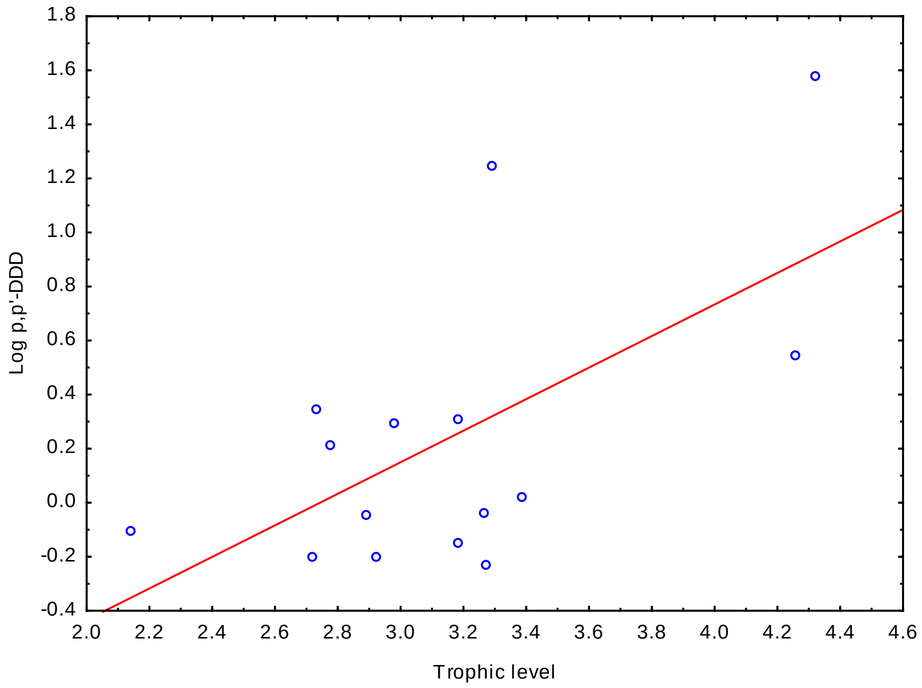


Figure 9. Trophic level against concentration (ng/g lipid wt.; log-transformed) of p,p'-DDD in eggs of herring gull from the Inner Oslofjord. (R^2=0.37; p=0,02).

3.4 Brominated compounds

The results from the PBDE, HBCDD, and TBPH/BEHTBP and EHTeBB/TBB analyses are given in Appendix.

3.4.1 Polybrominated diphenylethers

As mentioned, the results from the PBDE-analyses are given in Appendix. BDE-126 was included as an additional optional parameter (see Table 6, chapter 2.2). This BDE-congener has been shown as a debromination product of BDE 209 (Wan et al. 2013) and is shown to induce weak Ah-receptor (AhR) mediated gene expression *in vitro* (H4IIE-luc recombinant rat hepatoma cells; Villeneuve et al. 2002). BDE-126 was detected in some of the samples (both abiotic and biotic) in this study, indicating its presence in this (urban) environment.

Relation to quality standards

According to "Vannforskriften" (Norwegian Law) the quality standards for PBDEs (sum of congeners 28, 47, 99, 100, 153 and 154) are 0.0005 µg/L (annual average for fresh water) and 0.0002 µg/L (annual average for costal water).

According to the Norwegian guidelines on classification of environmental quality in fjords and coastal waters – a revision of the classification of waters and sediments with respect to metals and organic contaminants (Bakke et al. 2007; Bakke et al. 2010), quality standards for PBDEs (more specifically BDE-99) in sediment are as presented in Table 13.

Table 13.
Quality standards (ng/g dry wt.) for BDE-99 in sediment according to the Norwegian guidelines on classification of environmental quality in fjords and coastal waters – a revision of the classification of waters and sediments with respect to metals and organic contaminants (Bakke et al. 2007; Bakke et al. 2010).

	Class I (Background)	Class II (Good)	Class III (Moderate)	Class IV (Poor)	Class V (Very Poor)
BDE-99	-	<62	62 – 7800	7800 - 16000	>16000

The mean concentration of BDE-99 measured in storm water/surface water (dissolved phase) did not exceed the quality standard. Neither did any of the (four) individual measurements. In sediments, all concentrations were well below the upper limit of good condition (class II).

Diffuse inputs

Concentrations of PBDEs determined in storm water are depicted in Figure 10. As expected, the higher brominated congeners were mainly detected in the particulate fraction. Several congeners were, however, found in approximately similar amounts in the dissolved and the particulate fraction. These results may suggest that the dissolved fraction may contain colloids or very small particles (smaller than the pore size of the filters used; 1.2 µm). However, as mentioned there were some methodological uncertainties regarding PCB, PBDE and HBCDD separation in these specific samples (and elimination of these uncertainties are planned in 2014, when new samples are collected).

Amounts of PBDEs reported to enter/exit Bekkelaget STP in 2012 is presented in Table 18(BEVAS, 2013).

Contribution of PBDE inputs from Alna River in 2013 is available through the programme "Riverine inputs and direct discharges to Norwegian coastal waters" (RID; not reported yet). Alna River was not included in the programme in 2012. The contribution was calculated as follows, and the results are presented in Tables 14 to 17:

- Use of weekly recording of discharge (L d^{-1}), STS (mg L^{-1}) and TOC (mg C L^{-1}) by Oslo Kommune (Vann og Avløp)
- PBDE measurement on the suspended particulate matter from RID sampling on three occasions (January, April, September), five consecutive days of continuous flow centrifugation.
- Most PBDE congeners were measured above LOD in the particulate matter samples. Congener 183 and 196 were consistently below LOD while 154 was below LOD in one SPM sample (concentration equal to the limit of detection was used for flux estimations)
- Concentrations of PBDEs in the dissolved for the outlet of the Alna River were calculated from passive sampling data from a study conducted in 2012 (Allan et al., 2013). Data were not corrected for exposure temperature. Congener 183 and 196 not quantified. Calculation of flux to the fjord:

  (1) $F = Q \times C_{STS} \times C_{PBDE,STS}$

  Where F the flux of particle-bound PBDE congener (mg per week), Q is the discharge (L s^{-1} on a weekly basis), C_{STS} is the weekly total suspended particulate matter concentration (mg L^{-1}) and $C_{PCB,STS}$ is the PBDE concentration in the suspended particulate matter (ng g^{-1} dry weight material)

  (2) $F = Q \times C_{TOC} \times C_{PBDE,POC}$

  Where F the flux of particle-bound PBDE (mg per week), Q is the discharge (L s^{-1} on a weekly basis), C_{TOC} is the weekly total organic carbon concentration in water (mg L^{-1}) and the $C_{PBDE,POC}$ is the yearly mean PCB congener concentration in the suspended particulate matter on an organic carbon normalized basis (ng g^{-1}). Note that the TOC and POC may not be the same since TOC includes dissolved organic carbon.

  (3) $F = Q \times C_{w,PBDE}$

  Where $C_{w,PBDE}$ is the freely dissolved concentrations (ng L^{-1}) measured with silicone samplers in 2012.
- Yearly fluxes are calculated as a sum of the weekly fluxes.

Table 14.
Particulate-bound PBDE concentrations (ng/g) measured in three suspended particulate matter samples collected by continuous-flow centrifugation

	BDE-47 (ng/g)	BDE-99 (ng/g)	BDE-100 (ng/g)	BDE-153 (ng/g)	BDE-154 (ng/g)	BDE-183 (ng/g)	BDE-196 (ng/g)	BDE-209 (ng/g)
January	0.82	1.4	0.27	0.71	0.14	<0.3	<0.5	15
April	0.31	0.53	0.1	0.66	<0.1	<0.3	<0.3	11
September	1.4	2.8	0.48	2.7	0.44	<0.5	<0.8	50
Mean	**0.84**	**1.58**	**0.28**	**1.36**	**0.23**			**25.33**
SD	0.55	1.15	0.19	1.16	0.19			21.46
%RSD	64.7	72.6	67.2	85.8	82.0			84.7

Table 15.
Dissolved PBDE congener concentrations (ng/L) measured in the Alna River (outlet) in 2012 using silicone passive samplers. Nd: Not determined

	BDE-47	BDE-99	BDE-100	BDE-153	BDE-154	BDE-183	BDE-196	BDE-209
$C_{w,PBDE}$	0.0015	0.0013	0.0002	0.00009	0.00006	nd	nd	0.003

Table 16.
Estimates of particulate-bound PBDE fluxes (g/year) for the Alna River estimated from continuous flow centrifugation measurements (RID programme)

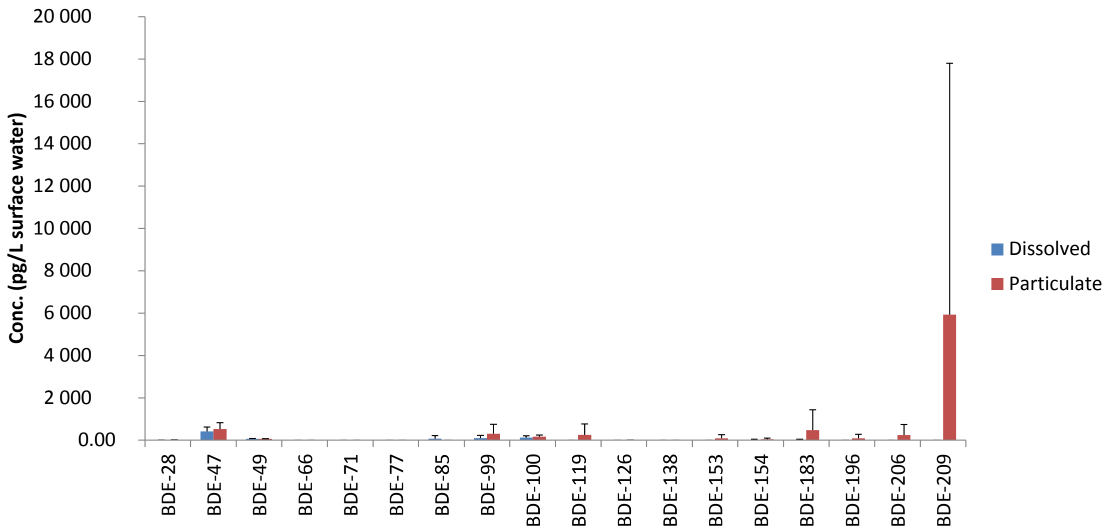
	BDE-47	BDE-99	BDE-100	BDE-153	BDE-154	BDE-183	BDE-196	BDE-209
STS-based	2.65	4.52	0.87	2.29	0.45	<1.0	<1.6	48.4
TOC-based	2.69	5.00	0.90	4.30	0.72	<1.2	<1.7	16.6

Table 17.
Estimates of PBDE fluxes (mg/year) for the Alna River estimated from silicone passive sampler measurements *

	BDE-47	BDE-99	BDE-100	BDE-153	BDE-154	BDE-183	BDE-196	BDE-209
Passive sampling-based	50.1	43.4	6.7	3.0	2.0	nd	nd	100

*Note that these estimates are based on data from 2012 (one silicone exposure, see Allan et al., 2013 for more details).

A.



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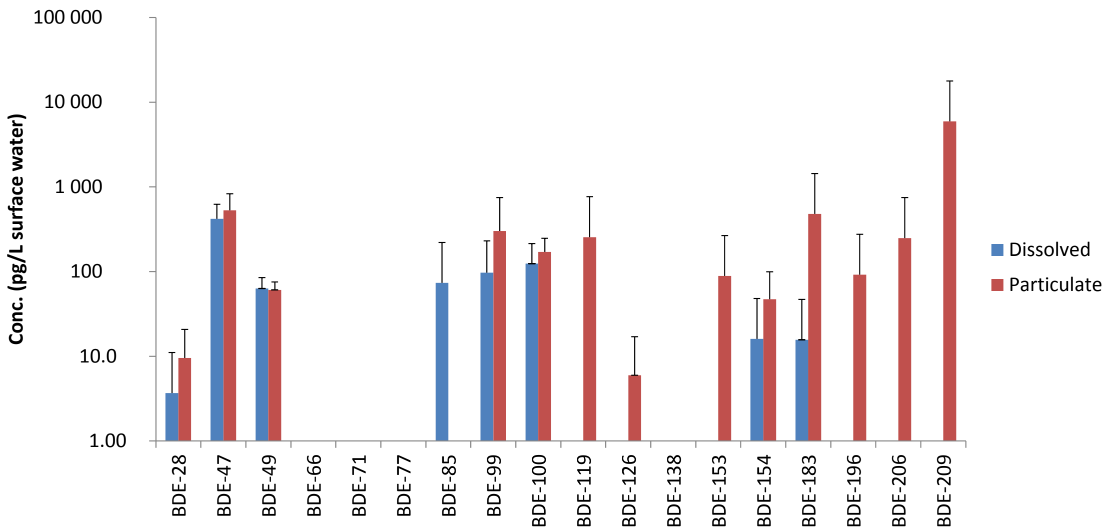


Figure 10. Concentrations of PBDEs (pg/L of water) in stormwater/surface water. Linear scale (A.) and logarithmic scale (B.). Mean and standard deviation; n=4; non-detects are assigned values of zero.

Table 18.
Amounts (kg) of PBDEs reported to enter and exit Bekkelaget STP in 2012

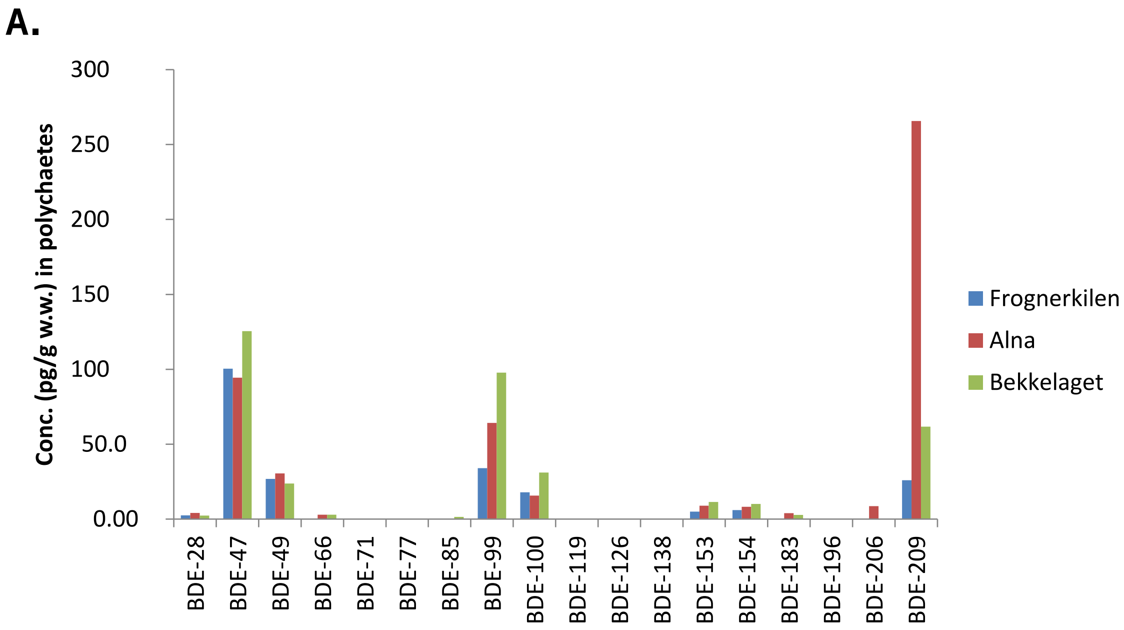
Congener	In (kg)	Out (kg)
-47	0.168	0.118
-99	0.369	0.118
-100	0.168	0.118
-183	0.168	0.118
-209	0.516	0.236

Geographical aspects

There were apparently some differences in concentrations (statistical evaluation not applicable due to limited number of samples) of PBDEs in polychaetes from Frognerkilen, the mouth of Alna River and Bekkelaget (Figure 11). BDE-209 showed the highest concentration at the mouth of Alna River. Otherwise, this location showed the highest concentration only for a few congeners. BDE-47 and -99 showed the highest concentrations in polychaetes from Bekkelaget.

Regarding blue mussel, the highest concentration of BDE-209 was shown in Frognerkilen, while the highest concentrations of BDE-47 and -99 were found at the mouth of Alna River (Figure 11).

In sediments, BDE-209 displayed the highest concentrations (Figure 12). As for the polychaetes, the concentration of BDE-209 was highest at the mouth of Alna River, followed by Bekkelaget and Frognerkilen (no statistics performed).



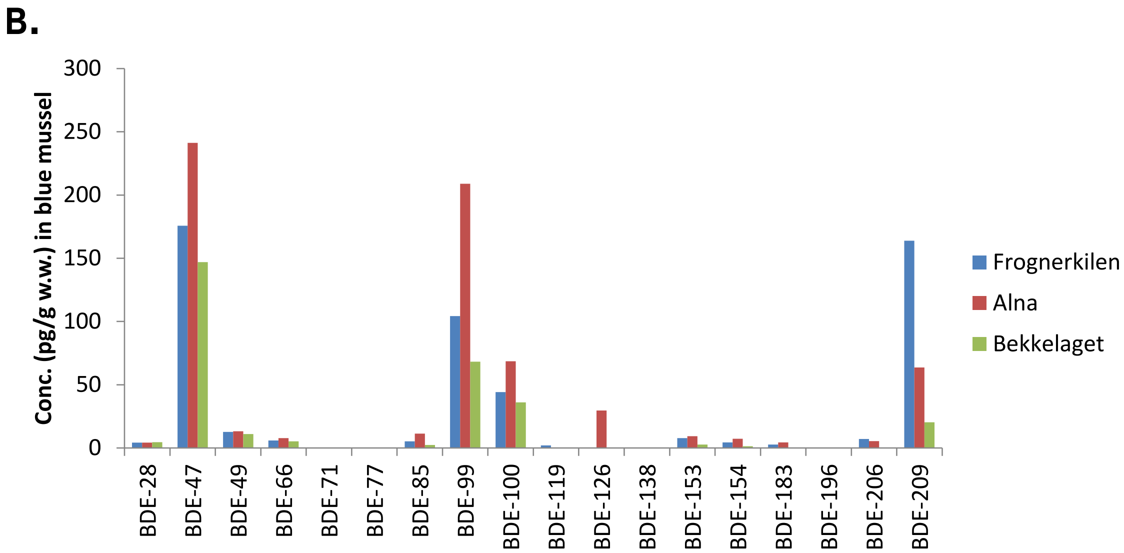


Figure 11. Concentrations of PBDEs (pg/g wet. wt.) in polychaetes (A.) and blue mussel (B.) from Frognerkilen, the mouth of Alna River and at Bekkelaget. One composite sample per station.

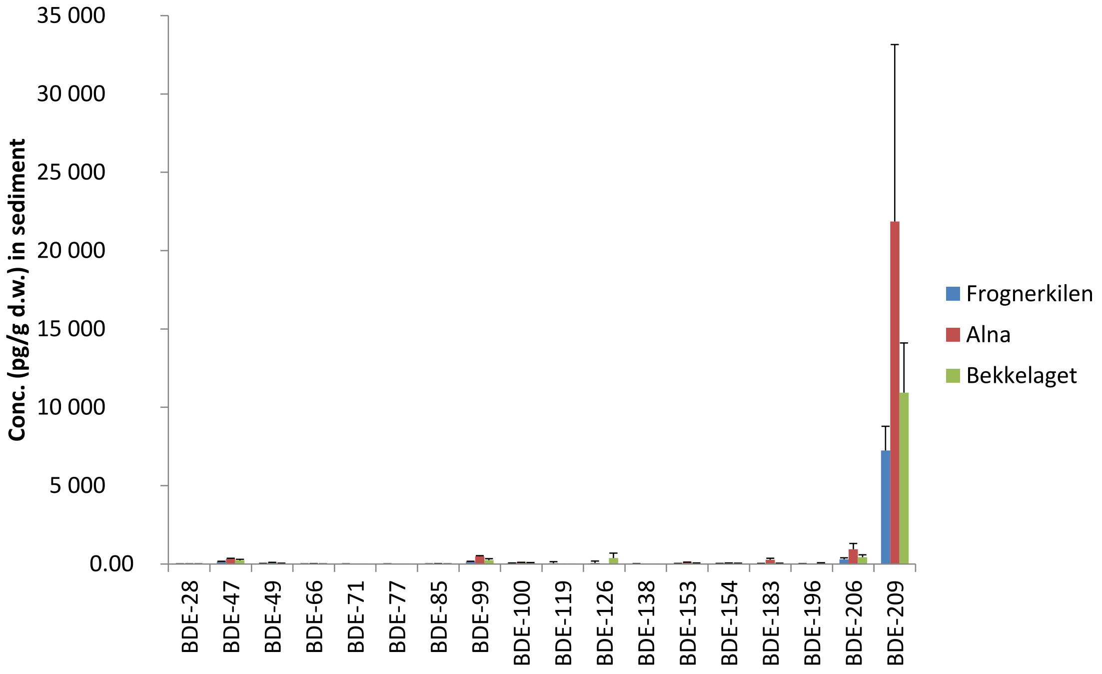


Figure 12. Concentrations of PBDEs (pg/g dry wt.) in sediments from Frognerkilen, the mouth of Alna River and at Bekkelaget (mean and standard deviation; n=3; non-detects are assigned values of zero).

Herring gull

PBDEs were detected in eggs and blood of herring gull (Figure 13). The mean concentrations (on a lipid weight basis) were apparently highest in blood (no statistics performed), however, the variability was high.

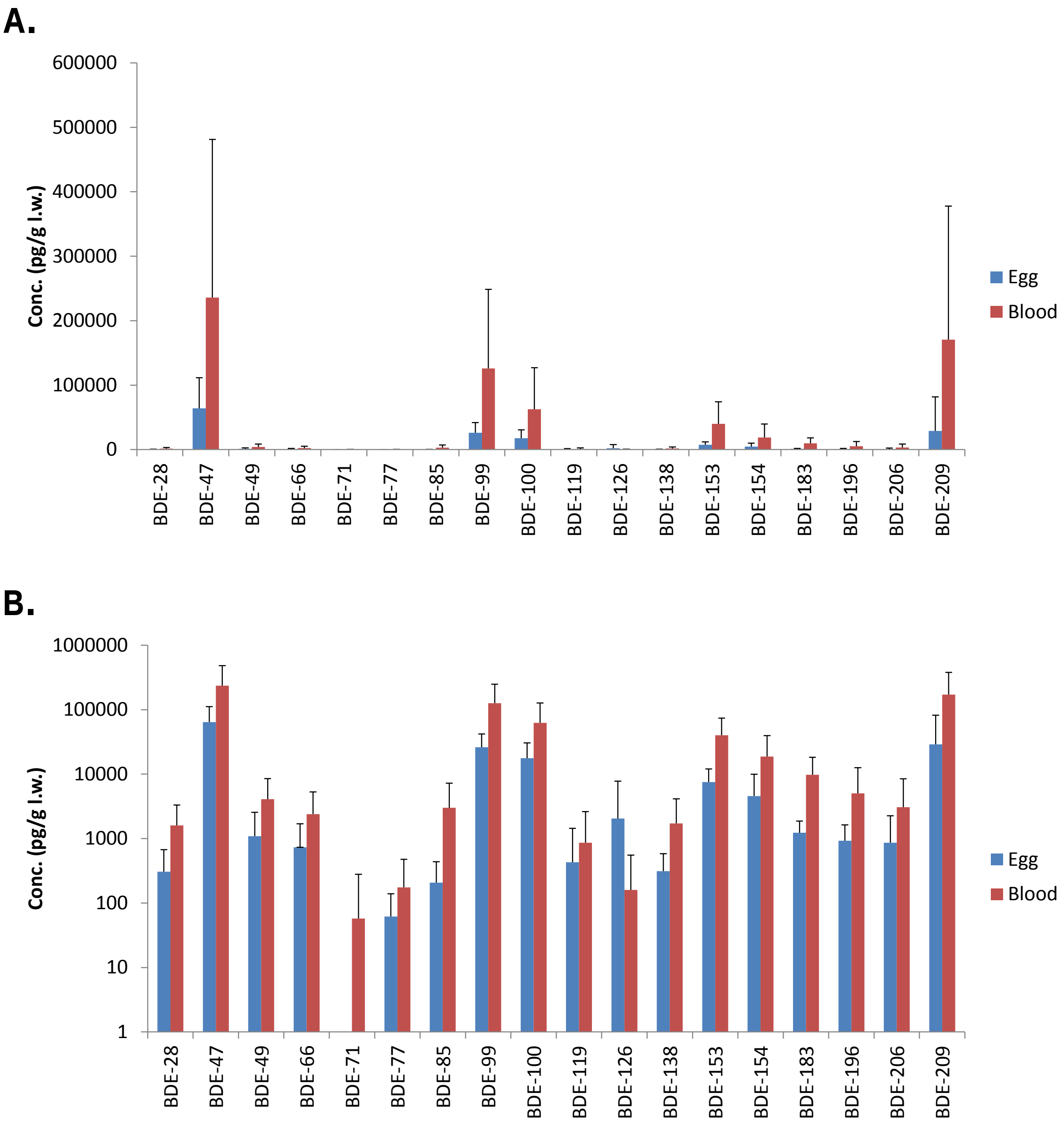


Figure 13. Concentrations of PBDEs (pg/g lipid wt.) in Herring gull (eggs and blood) from the Inner Oslofjord (mean and standard deviation; n=15; non-detects are assigned values of zero). Linear scale (A.) and logarithmic scale (B.).

Food chain of the Inner Oslofjord

Evaluations of the concentrations of PBDEs in the Inner Oslofjord food web were done on a lipid weight basis.

There was no demonstrable biomagnification of PBDE congeners in the studied Inner Oslofjord food web (Herring gull excluded).

Looking at flounder, isolated, (log) concentrations did not show significant linear relationships with trophic level. Nor were there any significant relationships between PBDE-concentrations and age, length or weight.

For herring gull in isolation, (log) concentrations in eggs showed a significant linear relationship with trophic level only for BDE-126 (R^2=0.84; p=0.03; not shown). This congener was only detected in five eggs (on which the regression was based). In blood, the (log) PBDE-concentrations did not show significant linear relationships with trophic level. Nor were there any significant positive relationships between concentrations and wing length or weight. Interestingly, there were several significant negative regressions between gull body weight and PBDE-concentrations (BDE-85, -99, -138 and -153) in blood (R^2=0.37, 0.48, 0.74 and 0.38, respectively; p=0.04,0.004, 0.006 and 0.01, respectively; not shown). This may suggest that individuals with lower body mass have higher blood concentrations of PBDEs, likely due to mobilisation from reserves.

Cod from the Inner Oslofjord

PBDEs have also been analysed in cod liver annually since 2005, through the "Contaminants in coastal areas" (MILKYS) monitoring programme (Green et al. 2013). In 2012, these compounds were analysed in cod liver from 9 stations (including the Inner Oslofjord). The highest concentrations were found in the inner Oslofjord. The Inner Oslofjord is densely populated with much urban activities and the high concentrations of PBDEs observed in cod liver are probably related to these activities, as well as reduced water exchange with the Outer fjord.

The concentration of PBDEs measured in flounder from the Inner Oslofjord in 2013 (present study) were generally substantially lower (e.g. a factor of ~35 for BDE-47) than the median concentration measured in cod (2012; no statistics performed).

3.4.2 Hexabromocyclododecane (HBCDD)

Relation to quality standards

According to the Norwegian guidelines on classification of environmental quality in fjords and coastal waters – a revision of the classification of waters and sediments with respect to metals and organic contaminants (Bakke et al. 2007; Bakke et al. 2010), quality standards for HBCDD in water and sediment are as presented in Tables 19 and 20, respectively.

Table 19.
Quality standards (µg/L) for HBCDD in water according to the Norwegian guidelines on classification of environmental quality in fjords and coastal waters – a revision of the classification of waters and sediments with respect to metals and organic contaminants (Bakke et al. 2007; Bakke et al. 2010).

	Class I (Background)	Class II (Good)	Class III (Moderate)	Class IV (Poor)	Class V (Very Poor)
HBCDD	-	<0.31	0.31 – 1.1	1.1 – 2.2	>2.2

Table 20.
Quality standards (ng/g dry wt.) for HBCDD in sediment according to the Norwegian guidelines on classification of environmental quality in fjords and coastal waters – a revision of the classification of waters and sediments with respect to metals and organic contaminants (Bakke et al. 2007; Bakke et al. 2010).

	Class I (Background)	Class II (Good)	Class III (Moderate)	Class IV (Poor)	Class V (Very Poor)
HBCDD	<0.3	0.3-86	86 – 310	310 - 610	>610

The concentrations of HBCDD measured in storm water/surface water (dissolved phase) were well below the upper limit for good condition (class II). In sediments, concentrations of HBCDD corresponded to good condition (class II) at all stations.

Diffuse inputs

Concentrations of HBCDD determined in storm water are depicted in Figure 14. As expected, the compounds were detected in the highest concentrations in the particulate fraction. The variability was high.

HBCDD (α, β, γ) was below limits of detection (5 ng/g for each isomer) in suspended particulate matter samples from the Alna River collected through the RID programme in 2013. This mean the flux of particulate-bound HBCDD (sum of the three isomers) was below 50 g/year. No measurements in the dissolved phase are currently available.

Bekkelaget STP has reported that 0,236 kg HBCDD ran through the plant in 2012 (BEVAS, 2013).

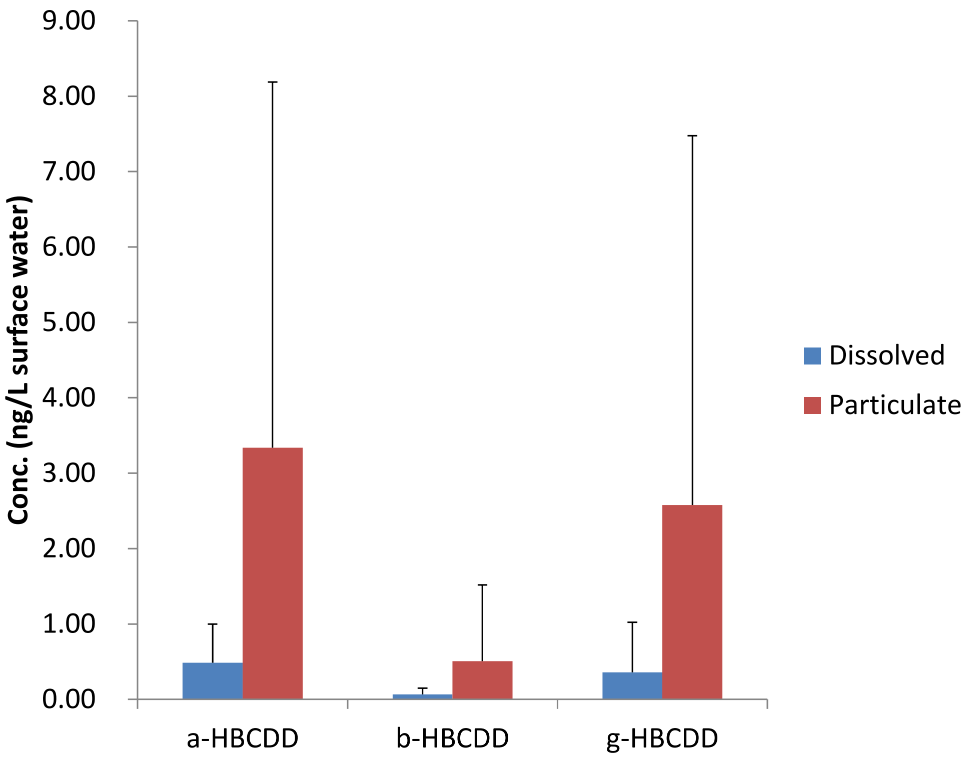


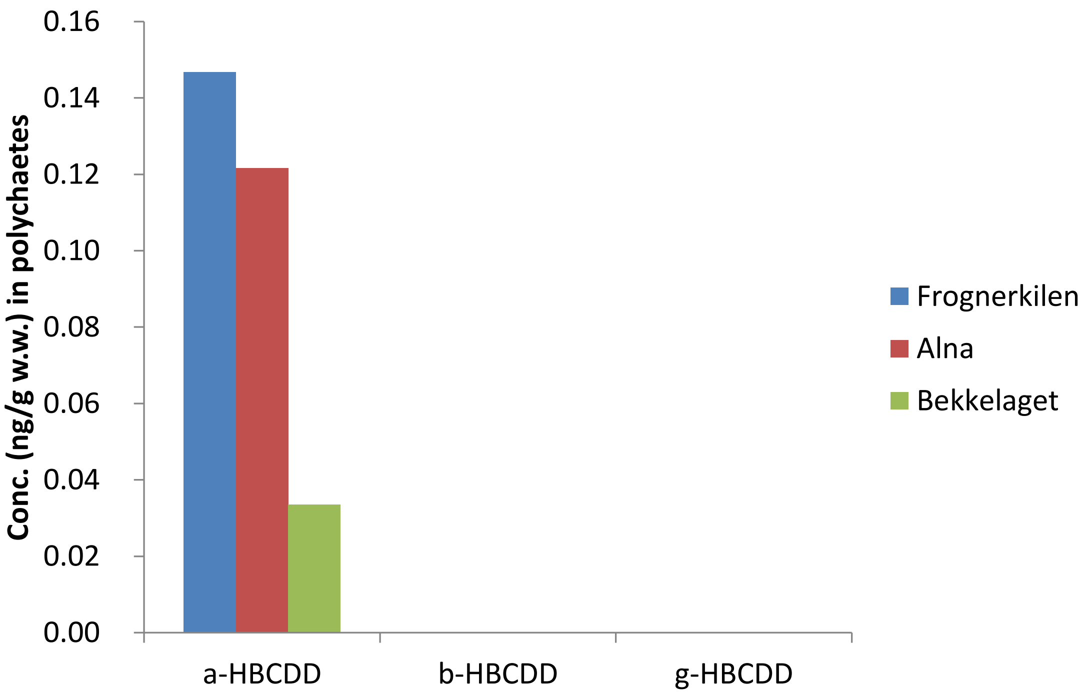
Figure 14. Concentrations of HBCDD (ng/L of water) in storm water/surface water (mean and standard deviation; n=4; non-detects are assigned values of zero).

Geographical aspects

It was mainly the stereoisomer α–HBCDD that was detected in polychaetes and blue mussel (Figure 15), and the lowest concentrations were found at Bekkelaget (both for polychaetes and blue mussel).

Also in sediments, the lowest concentrations were generally found at Bekkelaget (Figure 16).

A.



B.

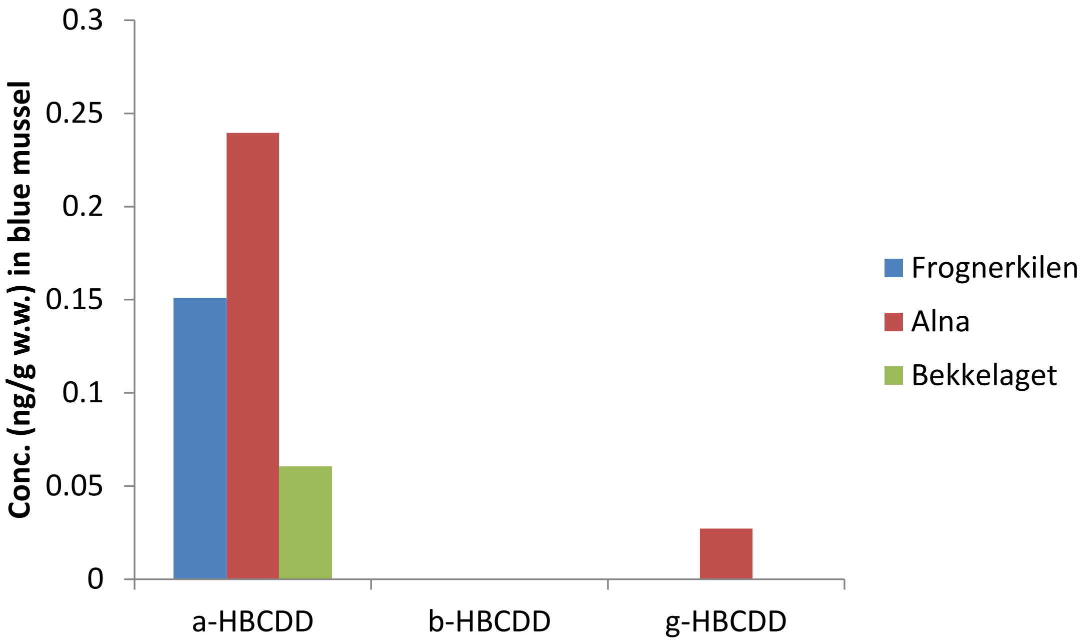


Figure 15. Concentrations of HBCDD stereoisomers (ng/g wet wt.) in polychaetes (A.) and blue mussel (B.) from Frognerkilen, the mouth of Alna River and at Bekkelaget. One composite sample per station.

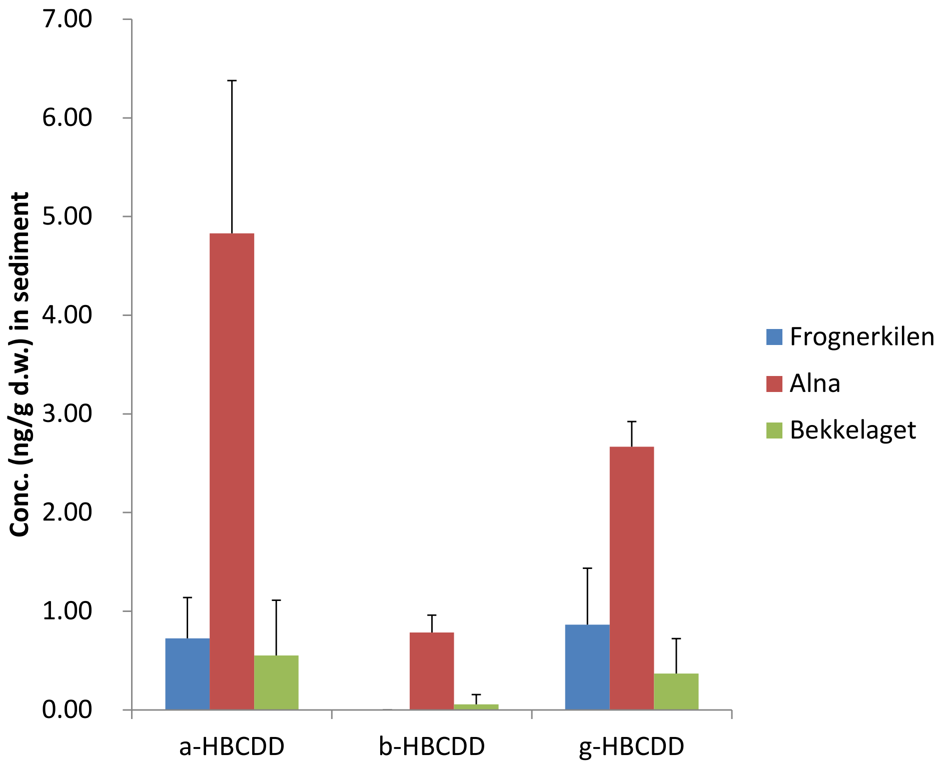


Figure 16. Concentrations of HBCDD stereoisomers (ng/g dry wt.) in sediments from Frognerkilen, the mouth of Alna River and at Bekkelaget (mean and standard deviation; n=3; non-detects are assigned values of zero).

Herring gull

As for polychaetes and blue mussel, the stereoisomer that was found in the highest concentrations in Herring gull (both egg and blood) was α–HBCDD (Figure 17). Only α–HBCDD was detected in blood (in approximately half of the samples).

In a comprehensive study by Haukås (2009), it was suggested that selective uptake and biotransformation had more influence on the fate of HBCDD in the ecosystem than physicochemical partitioning in the environment. There were indications of biomagnification of the α–diastereomer, while β– and γ–HBCDD seemed to be eliminated up the food chain.

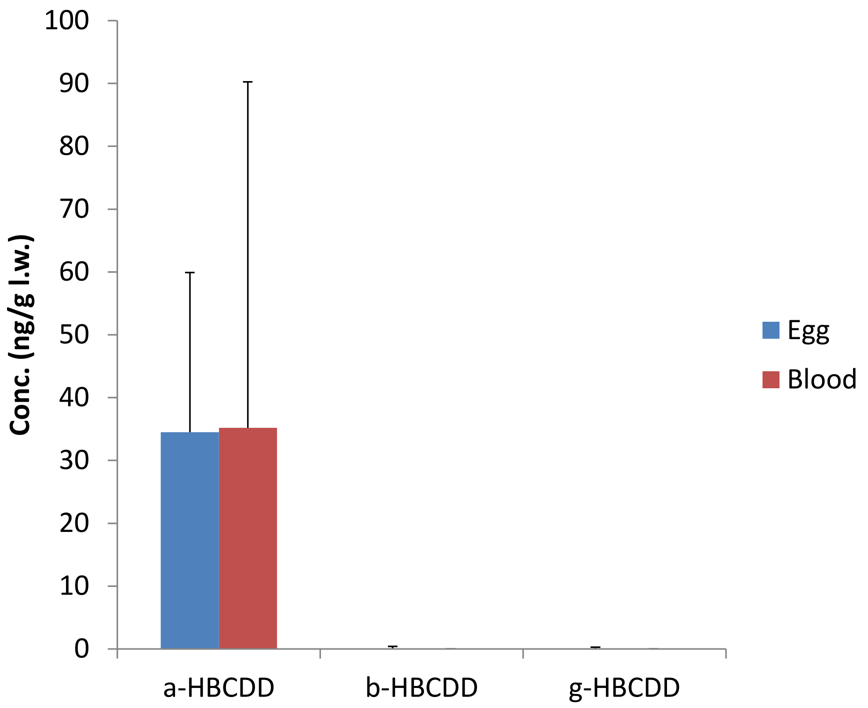


Figure 17. Concentrations of HBCDD stereoisomers (ng/g lipid wt.) in Herring gull (eggs and blood) from the Inner Oslofjord (mean and standard deviation; n=15; non-detects are assigned values of zero).

Food chain of the Inner Oslofjord

Evaluations of the concentrations of HBCDD in the Inner Oslofjord food web were performed on a lipid weight basis.

Biomagnification was not observed for HBCDD-diastereomers in the Inner Oslofjord food web (Herring gull excluded).

Looking at flounder, isolated, (log) concentrations did not show significant linear relationships with trophic level. Nor were there any significant relationships between HBCDD-concentrations and age, length or weight.

For herring gull in isolation, (log) concentrations in eggs did not show significant linear relationships with trophic level. Neither in blood did the (log) HBCDD-concentrations how significant linear relationships with trophic level. Nor were there any significant relationships with wing length or weight.

Cod from the Inner Oslofjord

HBCDD has also been analysed in cod liver, through the "Contaminants in coastal areas" (MILKYS) monitoring programme (Green et al. 2013). In 2012, these compounds were analysed in cod liver from 11 stations (including the Inner Oslofjord). The highest concentrations were found in the inner Oslofjord. It was concluded that parts of the Inner Oslofjord are densely populated with much urban activities and the high concentrations of HBCDD observed in cod liver are probably related to these activities, as well as reduced water exchange with the Outer fjord.

The concentration of HBCDD measured in flounder from the Inner Oslofjord in 2013 (present study) were generally substantially lower (a factor of >100) than the median concentration measured in cod (2012; no statistics performed).

3.4.3 Bis(2-ethyl-1-hexyl)tetrabromophthalate (TBPH/BEHTBP) and 2-ethylhexyl-2,3,4,5-tetrabromobenzoate (EHTeBB/TBB)

Relation to quality standards

There are no relevant quality standards to relate to.

Diffuse inputs

Concentrations of TBPH/BEHTBP and EHTeBB/TBB determined in storm water are depicted in Figure 18. The concentrations of TBPH/BEHTBP were higher than the concentrations of EHTeBB/TBB (no statistics performed).

Bekkelaget STP did not report measurements of any discharge of TBPH/BEHTBP and EHTeBB/TBB in 2012.

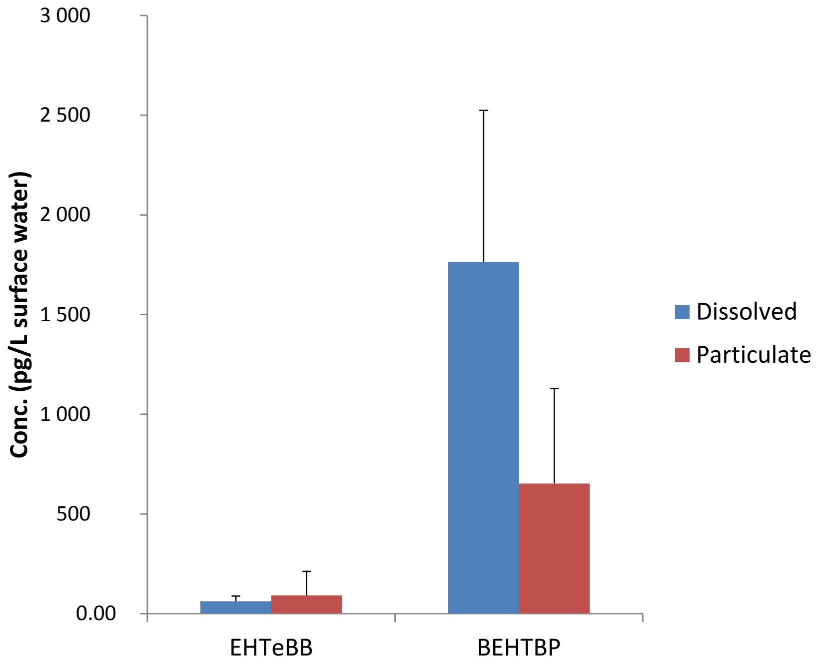


Figure 18. Concentrations of TBPH/BEHTBP and EHTeBB/TBB (pg/L of water) in storm water/surface water (mean and standard deviation; n=4).

Geographical aspects

TBPH/BEHTBP and EHTeBB/TBB were not detected in polychaetes at any of the locations. Only TBPH/BEHTBP was detected in blue mussel, and the highest concentration was found at the mouth of Alna River (Figure 19).

Also in sediments, there were higher concentrations of TBPH/BEHTBP than EHTeBB/TBB. The lowest concentrations were found in Frognerkilen (Figure 20; no statistics performed).

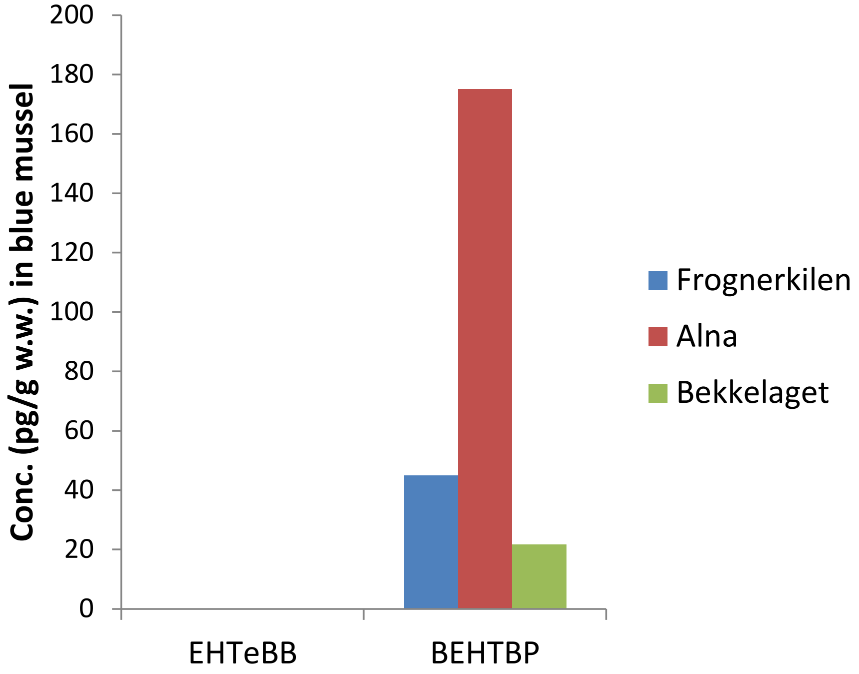


Figure 19. Concentrations of TBPH/BEHTBP and EHTeBB/TBB (pg/g wet wt.) in blue mussel from Frognerkilen, the mouth of Alna River and at Bekkelaget. One composite sample per station.

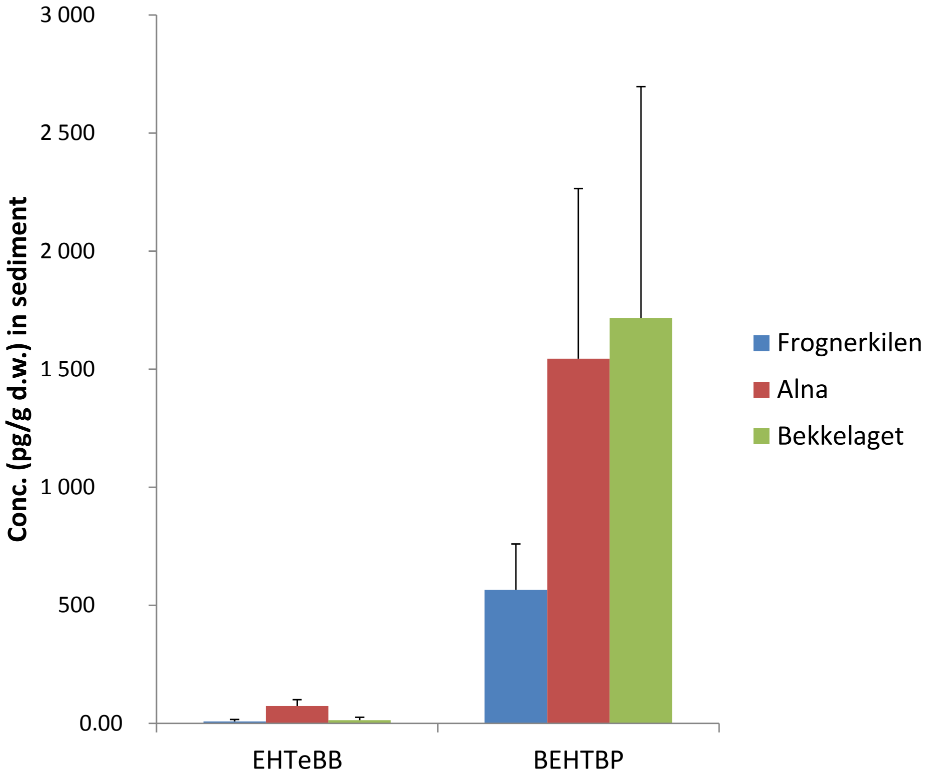


Figure 20. Concentrations of TBPH/BEHTBP and EHTeBB/TBB (pg/g dry wt.) in sediments from Frognerkilen, the mouth of Alna River and at Bekkelaget (mean and standard deviation; n=3).

Herring gull

TBPH/BEHTBP and EHTeBB/TBB were only detected in herring gull blood (not eggs). Concentrations of TBPH/BEHTBP was higher than concentrations of EHTeBB/TBB, but variability was high (Figure 21; no statistics performed).

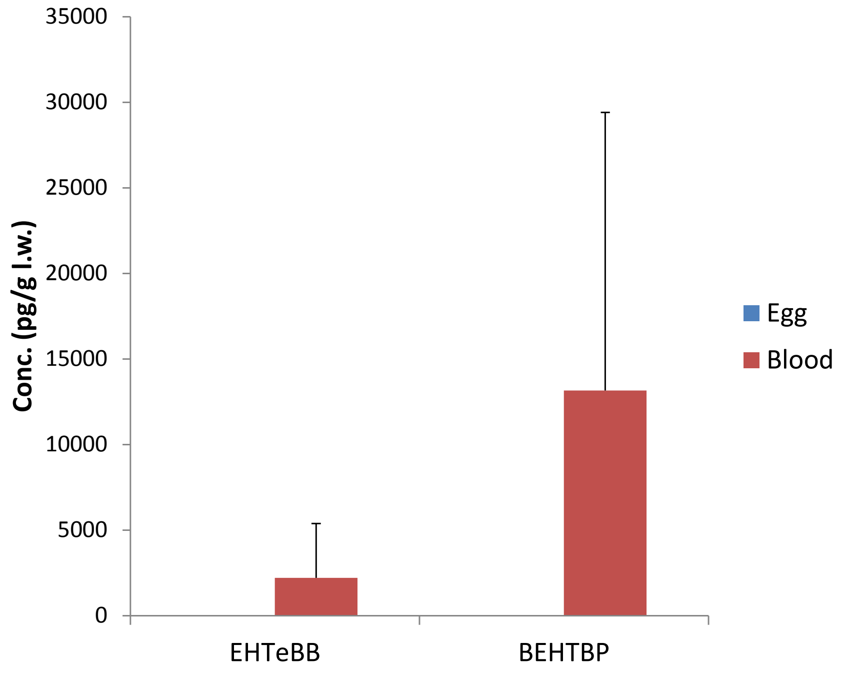


Figure 21. Concentrations of TBPH/BEHTBP and EHTeBB/TBB (pg/g lipid wt.) in Herring gull (eggs and blood) from the Inner Oslofjord (mean and standard deviation; n=15; non-detects are assigned values of zero).

Food chain of the Inner Oslofjord

Evaluations of the concentrations of TBPH/BEHTBP and EHTeBB/TBB in the Inner Oslofjord food web were done on a lipid weight basis.

TBPH/BEHTBP and EHTeBB/TBB were detected in very few biological samples except for herring gull blood. Therefore, biomagnification of these compounds could not be assessed.

For herring gull in isolation, no relationship between (log) TBPH/BEHTBP- or EHTeBB/TBB concentration and trophic level could be observed. Neither were there any relationships between TBPH/BEHTBP- or EHTeBB/TBB concentration and wing length or weight.

3.5 Short and medium chained chloroparaffines (S/MCCPs)

The results from the analysis of short and medium chained chloroparaffines (S/MCCPs) are given in Appendix.

Relation to quality standards

According to "Vannforskriften" (Norwegian Law) the quality standards for SCCPs are 0.4 µg/L (annual average for fresh water or coastal water) and 1.4 µg/L (maximum value for fresh water or costal water).

According to the Norwegian guidelines on classification of environmental quality in fjords and coastal waters – a revision of the classification of waters and sediments with respect to metals and organic contaminants (Bakke et al. 2007; Bakke et al. 2010), quality standards for SCCPs and MCCPs in sediment are as presented in Table 21.

Table 21.
Quality standards (ng/g dry wt.) for SCCP and MCCP in sediment according to the Norwegian guidelines on classification of environmental quality in fjords and coastal waters – a revision of the classification of waters and sediments with respect to metals and organic contaminants (Bakke et al. 2007; Bakke et al. 2010).

	Class I (Background)	Class II (Good)	Class III (Moderate)	Class IV (Poor)	Class V (Very Poor)
SCCP	-	<1000	1000 – 2800	2800 - 5600	>5600
MCCP	-	<4600	4600 – 27000	27000 – 54000	>54000

The concentrations of S/MCCPs measured in storm water/surface water (dissolved phase) did not exceed the EQSs. In sediments, concentrations of S/MCCPs were well below the upper limit for good condition (class II) at all stations.

Diffuse inputs

SCCPs and MCCPs were detected in storm water (both water phase and particulate fraction). Apparently, the concentrations were highest in the particulate phase (no statistics performed), however, the variability was high (Figure 22). In fact the median concentrations in the particulate fraction were a factor of 12 and 3 higher than the mean concentration (for SCCPs and MCCPs, respectively), because of particularly high concentrations in one sample (see Appendix).

Bekkelaget STP did not report measurements of discharge of S/MCCPs in 2012.

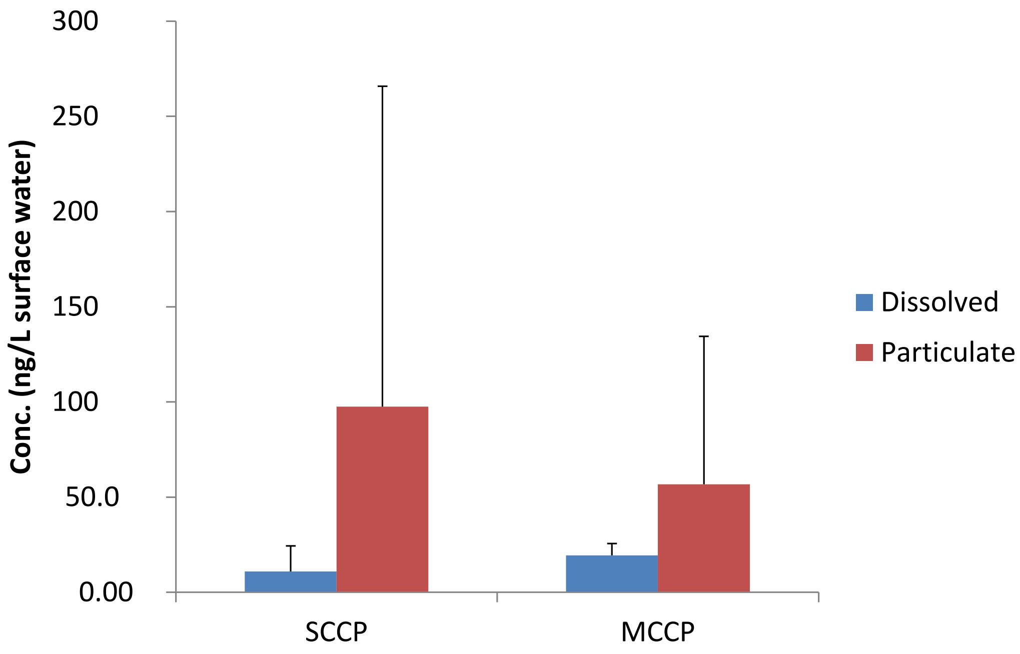
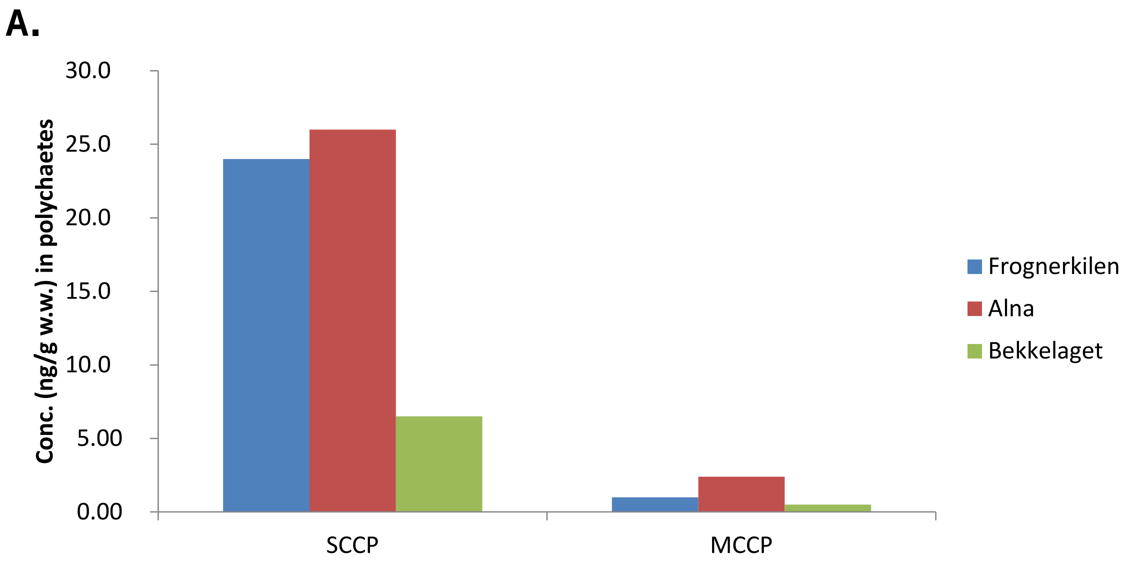


Figure 22. Concentrations of short and medium chained chloroparaffines (S/MCCPs; ng/L of water) in storm water/surface water (mean and standard deviation; n=4).

Geographical aspects

SCCPs and MCCPs were detected in polychaetes and blue mussel from Frognerkilen, the mouth of Alna River and at Bekkelaget (Figure 23). It was SCCPs that were found in the highest concentrations. The highest concentrations were found at the mouth of Alna River, followed by Frognerkilen for both polychaetes and blue mussel.

Also in sediments,the highest concentations of SCCPs were found at the mouth of Alna River, however, the ratio of concentrations of SCCPs to MCCPs were not as high as in the organisms (Figure 24).



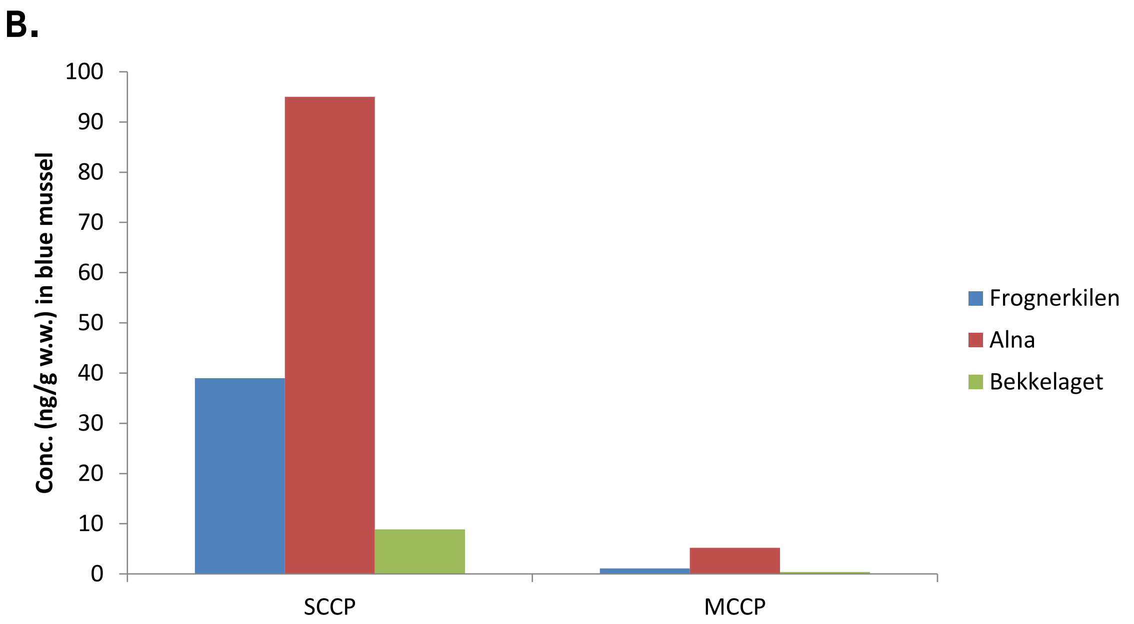


Figure 23. Concentrations of short and medium chained chloroparaffines (S/MCCPs; ng/g wet wt.) in polychaetes (A.) and blue mussel (B.) from Frognerkilen, the mouth of Alna River and at Bekkelaget. One composite sample per station.

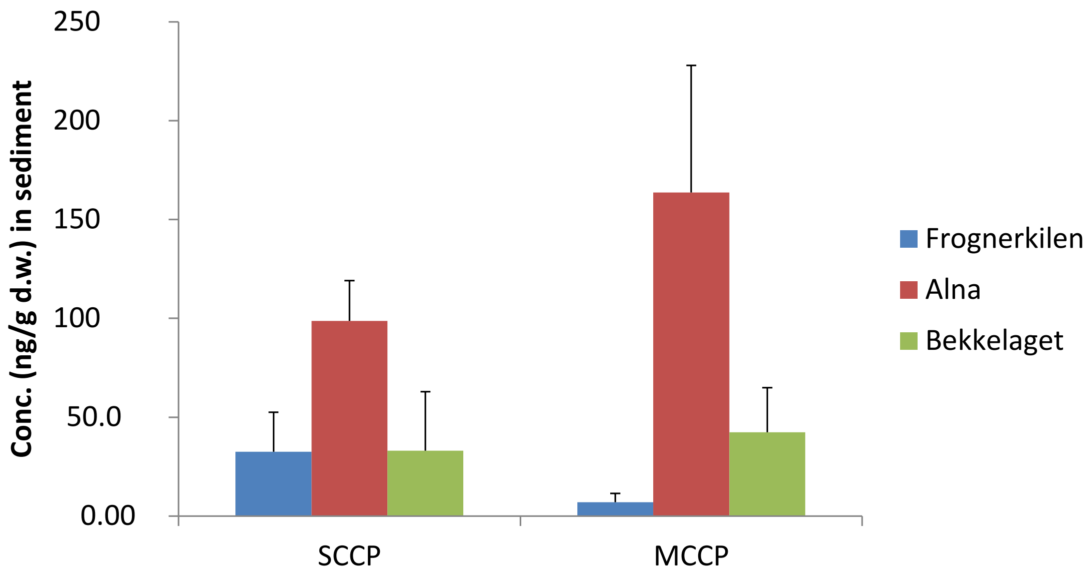


Figure 24. Concentrations of short and medium chained chloroparaffines (S/MCCPs; ng/g dry wt.) in sediments from Frognerkilen, the mouth of Alna River and at Bekkelaget (mean and standard deviation; n=3).

Herring gull

SCCPs and MCCPs were detected in eggs and blood of Herring gull (Figure 25). However, MCCPs were not detected in 8 of 15 eggs, and not detected in 13 of 15 blood samples. I.e. the median concentration in these samples was “not detected”, and variability was high (Figure 25). SCCPs were not detected in 9 of 15 blood samples. Thus, the median concentration was “not detected” (although the mean concentration was apparently higher than in eggs, but with a very large standard deviation).

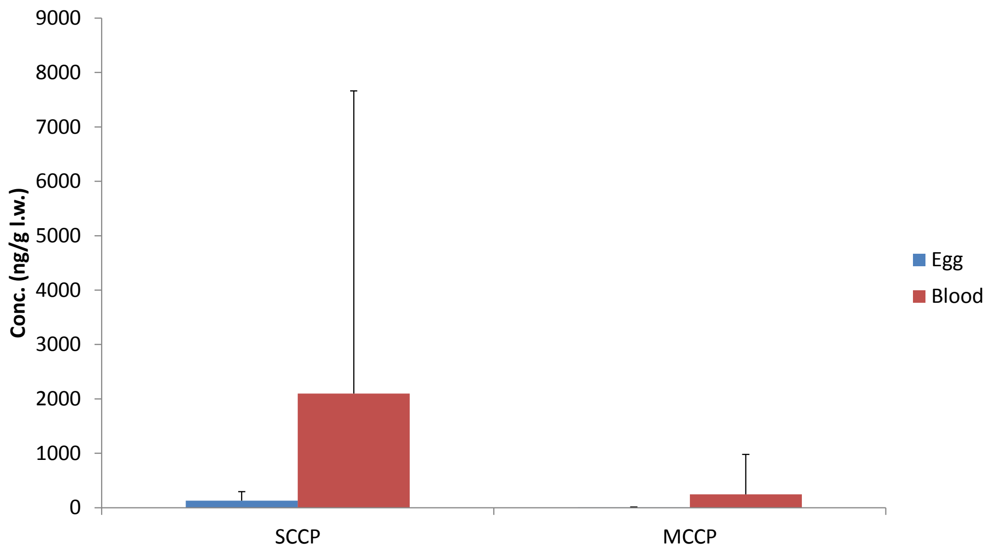


Figure 25. Concentrations of short and medium chained chloroparaffines (S/MCCPs; ng/g lipid wt.) in Herring gull (eggs and blood) from the Inner Oslofjord (mean and standard deviation; n=15; non-detects are assigned values of zero).

Food chain of the Inner Oslofjord

Evaluations of the concentrations of S/MCCPs in the Inner Oslofjord food web were done on a lipid weight basis.

No positive relationships could be demonstrated between trophic position and (log) S/MCCP concentrations (including herring gull). On the other hand, (when herring gull was excluded from the food web) a significant negative relationship was observed for MCCPs (R^2=0.37, p=0.01; not shown).

For herring gull eggs, isolated, no significant relationship could be observed between trophic level and the (log) concentrations of S/MCCPs. For herring gull blood (where there were few detected concentrations of S/MCCPs), no relationship between (log) concentrations of S/MCCPs and trophic level could be demonstrated. Neither was there any relationships observed between concentrations of S/MCCPs and wing length nor weight.

Looking at flounder, isolated, (log) concentrations did not show significant linear relationships with trophic level. Nor were there any significant relationships between S/MCCPs-concentrations and age, length or weight.

Cod from the Inner Oslofjord

SCCPs and MCCPs have also been analysed in cod liver through the "Contaminants in coastal areas" (MILKYS) monitoring programme (Green et al. 2013). These compounds were analysed in cod liver from 11 stations (including the Inner Oslofjord). Among the stations investigated, cod liver from the inner Oslofjord displayed intermediate concentrations of S/MCCPs.

The concentration of S/MCCPs measured in flounder from the Inner Oslofjord in 2013 (present study) were substantially lower (a factor of 4 and 24, respectively) than the median concentration measured in cod (2012; no statistics performed).

3.6 Phosphorus flame retardants (PFRs)

The results from the analysis of PFRs are given in Appendix.

Relation to quality standards

There are no relevant quality standards to relate to.

Diffuse inputs

Most of the PFRs were detected in some of the storm water samples (either water fraction or particulate fraction; Figure 26). The variability was very large for some compounds.

Bekkelaget STP did not report measurements of discharge of PFRs in 2012.

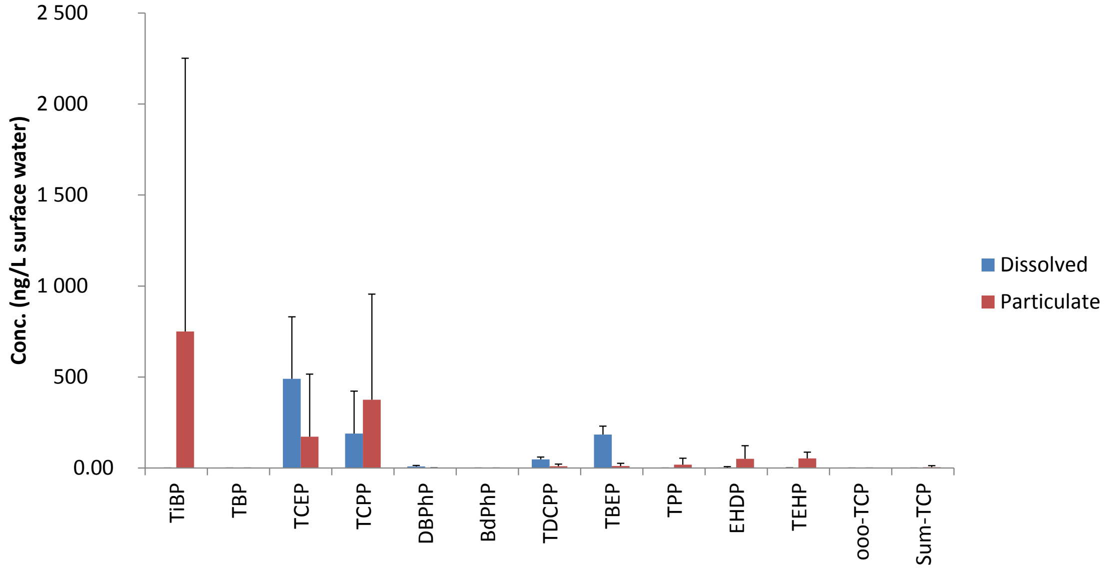


Figure 26. Concentrations of PFRs (ng/L of water) in storm water/surface water (mean and standard deviation; n=4; non-detects are assigned values of zero).

Geographical aspects

No PFRs were detected in polychaetes, except for TDCPP, which were found in a concentration of 1.4 ng/g wet wt. at the mouth of Alna River. Only a few PFRs were detected in mussels in Frognerkilen and at Bekkelaget (Figure 27).

Most PFRs were detected in sediments from Frognerkilen, the mouth of Alna River and Bekkelaget (Figure 28). TiBP was only detected in one sample from Frognerkilen (531.9 ng/g dry wt.).

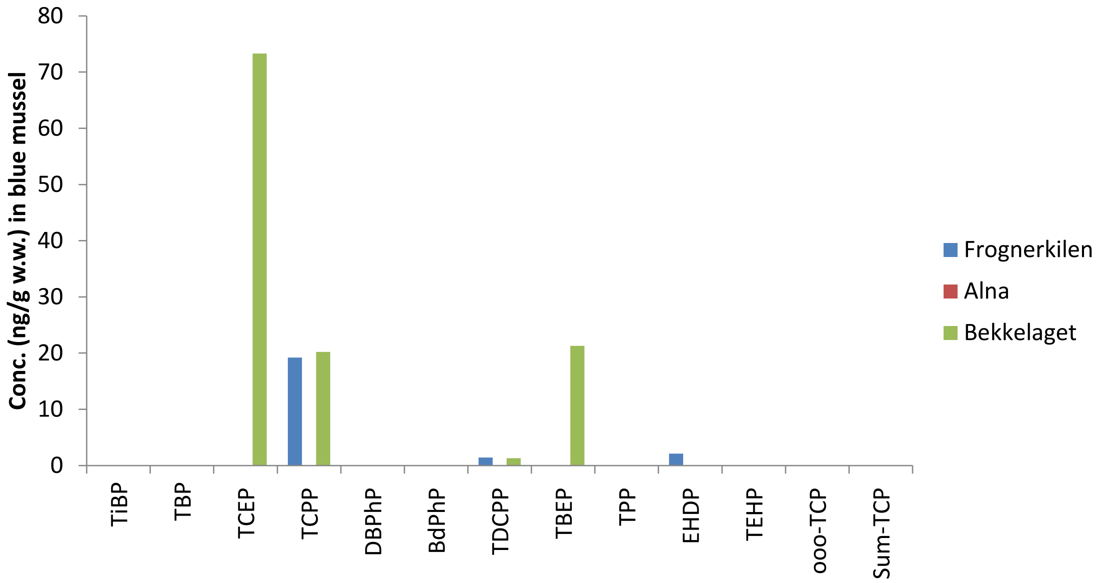


Figure 27. Concentrations of PFRs (ng/g wet wt.) in blue mussel from Frognerkilen, the mouth of Alna River (no PFRs detected) and at Bekkelaget. One composite sample per station.

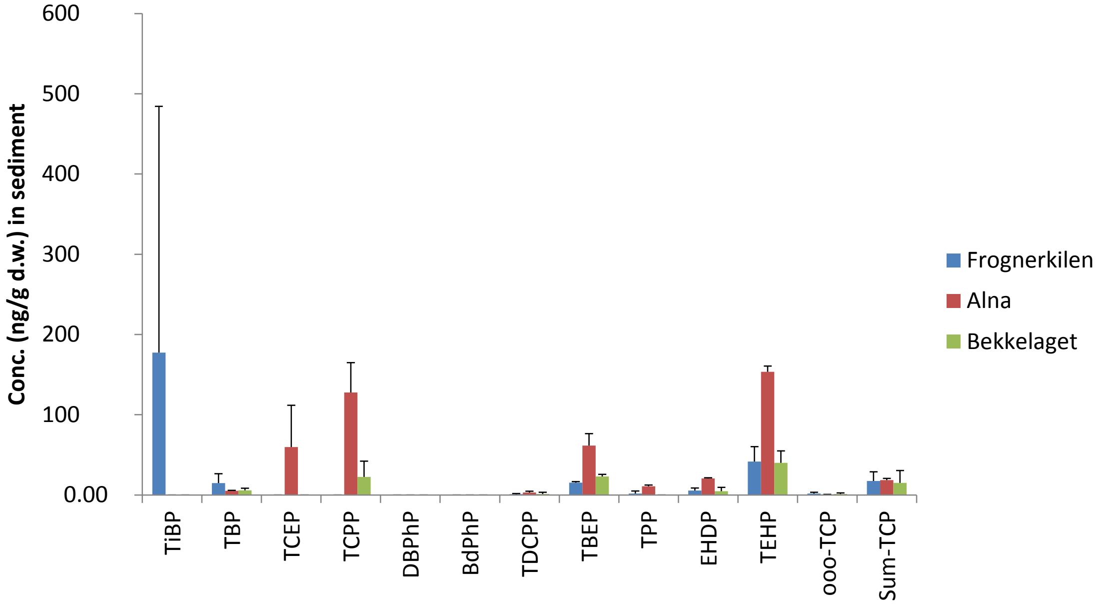


Figure 28. Concentrations of PFRs (ng/g dry wt.) in sediments from Frognerkilen, the mouth of Alna River and at Bekkelaget (mean and standard deviation; n=3; non-detects are assigned values of zero; TiBP was only detected in one sample from Frognerkilen; 531.9 ng/g dry wt.).

Herring gull

Only some of the PFRs were detected in a few samples of gull eggs and/or blood, except TiBP and TBP, which were detected in all blood samples (Figure 29).

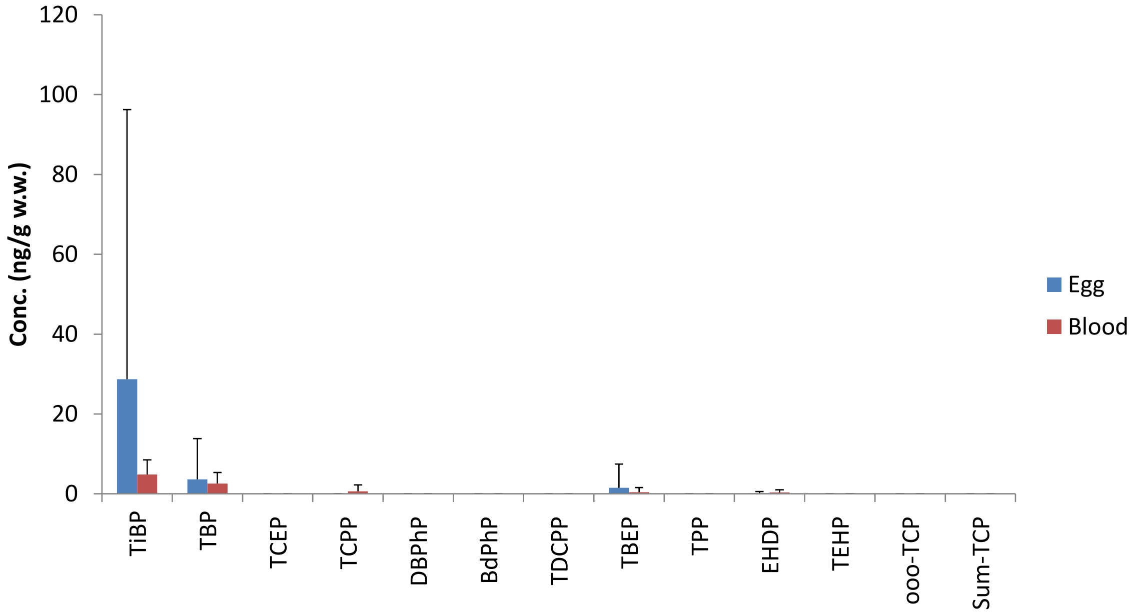


Figure 29. Concentrations of PFRs (ng/g wet wt.) in Herring gull (eggs and blood) from the Inner Oslofjord (mean and standard deviation; n=15; non-detects are assigned values of zero).

Food chain of the Inner Oslofjord

Evaluations of the concentrations of PFRs in the Inner Oslofjord food web were done on a wet weight basis.

There were no demonstrable relationships between trophic level and (log) concentration of PFRs in the studied Inner Oslofjord food web (Herring gull excluded). No compounds were detected in more than one third of the samples.

Looking at flounder, isolated, (log) concentrations did not show significant linear relationships with trophic level. Nor were there any significant relationships between PFR-concentrations and age, length or weight, except for EHDP. EHDP showed a significant negative relationship with age (p=0.04; R^2=0.78), length (p=0.02; R^2=0.84) and weight (p=0.02; R^2=0.86; not shown). This compound was, however, only detected in five of the samples.

For herring gull in isolation, in blood, the (log) PBDE-concentrations did not show significant linear relationships with trophic level. Nor were there any significant relationships between PFR concentrations and wing length or weight. No PFRs were detected in more than 3 egg samples.

Cod from the Inner Oslofjord

PFRs have also been analysed in cod liver, through the "Contaminants in coastal areas" (MILKYS) monitoring programme (Green et al. 2013). In 2012, these compounds were analysed in cod liver from 10 stations (including the Inner Oslofjord).

There were no notable differences between the median concentrations of PFRs in the cod livers from the inner Oslofjord, 2012, and the (few) flounder livers (2013) where PFRs were detected (no statistics performed).

3.7 Alkylphenols and bisphenols

The results from the analyses of alkylphenols and bisphenols are given in Appendix. Additional compounds (4,4'-sulfonylbisphenol or bisphenol S; 4,4'-methylenebisphenol or 4,4'-bisphenol F; 2,2'-methylenebisphenol or 2,2'-bisphenol F; 4,4'-[2,2,2-trifluoro-1-(trifluoromethyl)ethylidene]bisphenol or bisphenol AF; 4,4'-(diphenylmethylene)bisphenol or bisphenol BP) are also presented in the Appendix, and not referred to in the text below.

3.7.1 Alkylphenols

Alkylphenols refer here to octylphenol and nonylphenol.

Relation to quality standards

According to “Vannforskriften” (Norwegian Law) the quality standards for octylphenol are 0.1 µg/L (annual average for fresh water) and 0.01 µg/L (annual average for costal water). For nonylphenol the quality standards are 0.3 µg/L (annual average for fresh water or coastal water) and 2.0 µg/L (maximum value for fresh water or costal water).

According to the Norwegian guidelines on classification of environmental quality in fjords and coastal waters – a revision of the classification of waters and sediments with respect to metals and organic contaminants (Bakke et al. 2007; Bakke et al. 2010), quality standards for alkylphenols in sediment are as presented in Table 22.

Table 22.
Quality standards (ng/g dry wt.) for alkylphenols in sediment according to the Norwegian guidelines on classification of environmental quality in fjords and coastal waters – a revision of the classification of waters and sediments with respect to metals and organic contaminants (Bakke et al. 2007; Bakke et al. 2010).

Alkylphenol	Class I (Background)	Class II (Good)	Class III (Moderate)	Class IV (Poor)	Class V (Very Poor)
Octylphenol	-	<3.3	3.3 – 7.3	7.3 - 36	>36
Nonylphenol	-	<18	18 - 110	110 - 220	>220

Phenolic compounds could be analysed in one (out of four) water samples (dissolved phase). The concentrations of alkylphenols in this sample did not exceed the EQSs. With respect to octylphenol in sediments, Frognerkilen showed poor condition (class IV), while Bekkelaget and the mouth of Alna showed moderate (class III) and good (class II) conditions. With respect to nonylphenol in sediments, all stations showed good condition.

Diffuse inputs

Phenolic compounds could be analysed in one (out of four) water samples (dissolved phase) and four samples (particulate phase). Neither octylphenol, nor nonylphenol could be detected in any particulate phase samples. In the one dissolved phase samples, octylphenol was measured at a concentration of 0.53 ng/L, while nonylphenol could not be detected.

Bekkelaget STP has reported that 6171 kg of nonylphenol ran into the plant, and 28.12 kg ran out of the plant in 2012. Furthermore, they report that the concentration of nonylphenol was apparently very high, mainly due to one measurement significantly increasing the annual average.

Geographical aspects

Concentrations of alkylphenols in polychaetes, blue mussel and sediments, respectively, from Frognerkilen, the mouth of Alna River and Bekkelaget are presented in Tables 23, 24 and 25. Apparently, concentrations were highest in Frognerkilen and the variability in sediment samples (triplicate samples) was high overall.

Table 23.
Concentrations of alkylphenols (ng/g wet wt.) in polychaetes from Frognerkilen, the mouth of Alna River and Bekkelaget.

	Octylphenol	Nonylphenol
Frognerkilen	1.07	0.06
Mouth of Alna River	0.79	0.04
Bekkelaget	0.78	0.005

Table 24.
Concentrations of alkylphenols (ng/g wet wt.) in blue mussel from Frognerkilen, the mouth of Alna River and Bekkelaget.

	Octylphenol	Nonylphenol
Frognerkilen	34.6	2.25
Mouth of Alna River	20.3	n.d.
Bekkelaget	n.d.	0.10

Table 25.
Concentrations of alkylphenols (ng/g dry wt.) in sediments from Frognerkilen, the mouth of Alna River and Bekkelaget (mean and standard deviation; n=3; non-detects are assigned values of zero).

	Octylphenol	Nonylphenol
Frognerkilen	14.6 (24.7)	13.0 (22.5)
Mouth of Alna River	0.48 (0.4)	0.49 (0.4)
Bekkelaget	4.24 (7.3)	2.60 (2.3)

Herring gull

Alkylphenols were detected in eggs and blood of herring gull (Table 26). The mean concentrations (on a wet weight basis) were apparently highest in blood (no statistics performed), however, the variability was high (although nonylphenol was not detected in one egg sample and two blood samples only). Concentrations of octylphenol were substantially higher than concentrations of nonylphenol (no statistics performed). One blood sample had particularly high concentration of octylphenol (see Appendix).

Table 26.
Concentrations of alkylphenols (ng/g wet wt.) in Herring gull (eggs and blood) from the Inner Oslofjord (mean and standard deviation; n=15; non-detects are assigned values of zero).

	Octylphenol	Nonylphenol
Egg	398.6 (1134.6)	2.4 (5.5)
Blood	608.1 (2224.9)	10.0 (13.4)

Food chain of the Inner Oslofjord

Evaluations of the concentrations of alkylphenols in the Inner Oslofjord food web were performed on a wet weight basis.

There was no demonstrable relationships between trophic level and (log) alkylphenol concentrations in the studied Inner Oslofjord food web (Herring gull excluded).

Looking at flounder, isolated, (log) concentrations did not show significant linear relationships with trophic level. Nor were there any significant relationships between alkylphenol-concentrations and age, length or weight. One sample had particularly high concentrations of alkylphenols (see Appendix).

For herring gull in isolation, (log) concentrations of octylphenol in blood displayed a significant negative relationship with trophic level (R^2=0.35; p=0.02; not shown). There were no significant relationships between concentrations and wing length or body mass. In eggs, the (log) concentrations did not show significant linear relationships with trophic level.

3.7.2 Bisphenol A (BPA)

Relation to quality standards

According to the Norwegian guidelines on classification of environmental quality in fjords and coastal waters – a revision of the classification of waters and sediments with respect to metals and organic contaminants (Bakke et al. 2007; Bakke et al. 2010), quality standards for bisphenol A in water and sediment are as presented in Tables 27 and 28, respectively.

Table 27.
Quality standards (µg/L) for bisphenol A in water according to the Norwegian guidelines on classification of environmental quality in fjords and coastal waters – a revision of the classification of waters and sediments with respect to metals and organic contaminants (Bakke et al. 2007; Bakke et al. 2010).

	Class I (Background)	Class II (Good)	Class III (Moderate)	Class IV (Poor)	Class V (Very Poor)
Bisphenol A	-	<1.6	1.6 – 11	11 - 110	>110

Table 28.
Quality standards (ng/g dry wt.) for bisphenol A in sediment according to the Norwegian guidelines on classification of environmental quality in fjords and coastal waters – a revision of the classification of waters and sediments with respect to metals and organic contaminants (Bakke et al. 2007; Bakke et al. 2010).

	Class I (Background)	Class II (Good)	Class III (Moderate)	Class IV (Poor)	Class V (Very Poor)
Bisphenol A	-	<11	11 – 79	79 - 790	>790

Phenolic compounds could be analysed in one (out of four) water samples (dissolved phase). In this sample, the concentration of BPA was below limit of detection. With respect to bisphenol A in sediments, concentrations were below limit of detection at Bekkelaget, while variability was high in Frognerkilen and at the mouth of Alna River (see below). Mean concentrations corresponded to poor condition (class IV) at these stations.

Diffuse inputs

Phenolic compounds could be analysed in one (out of four) water samples (dissolved phase) and four samples (particulate phase). The concentration of bisphenol A in the one water sample (dissolved phase) was below the limit of detection. In the particulate phase, the mean concentration was 143 ng/L (standard deviation: 30.5).

Bekkelaget STP did not report measurements of discharge of bisphenol A in 2012.

Geographical aspects

Concentrations of bisphenol A in polychaetes, blue mussel and sediments, respectively, from Frognerkilen, the mouth of Alna River and Bekkelaget are presented in Tables 29, 30 and 31.

Variability in sediments (triplicate samples) was high. BPA was not detected in sediments from Bekkelaget.

Table 29.
Concentrations of bisphenol A (ng/g wet wt.) in polychaetes from Frognerkilen, the mouth of Alna River and Bekkelaget.

	Bisphenol A
Frognerkilen	4.07
Mouth of Alna River	1.91
Bekkelaget	1.62

Table 30.
Concentrations of bisphenol A (ng/g wet wt.) in blue mussel from Frognerkilen, the mouth of Alna River and Bekkelaget.

	Bisphenol A
Frognerkilen	n.d.
Mouth of Alna River	n.d.
Bekkelaget	0.32

Table 31..
Concentrations of bisphenol A (ng/g dry wt.) in sediments from Frognerkilen, the mouth of Alna River and Bekkelaget (mean and standard deviation; n=3).

	Bisphenol A
Frognerkilen	115 (121)
Mouth of Alna River	298 (456)
Bekkelaget	n.d. (-)

Herring gull

Bisphenol A was measured in eggs and blood of herring gull (Table 32). The variability was high. In eggs, bisphenol A was not detected in 6 of 15 samples, while in blood, bisphenol A was detected in one sample only. A significant relationship was observed between the concentration of BPA in herring gull eggs and eggshell thickness, which is discussed below (chapter 3.14).

Table 32.
Concentrations of bisphenol A (ng/g wet wt.) in Herring gull (eggs and blood) from the Inner Oslofjord (mean and standard deviation; n=15).

	Bisphenol A
Egg *	12.0 (18.8)
Blood **	3.8 (14.5)

* Bisphenol A not detected (assigned a value of zero) in 6 of 15 samples.
** Bisphenol A only detected in one of 15 samples (concentration 56.3 ng/g wet wt.).

Food chain of the Inner Oslofjord

Evaluations of the concentrations of bisphenol A in the Inner Oslofjord food web were done on a wet weight basis.

There were no demonstrable relationships between trophic level and (log) bisphenol A concentrations in the studied Inner Oslofjord food web (Herring gull excluded).

Looking at flounder, isolated, bisphenol A was only detected in 2 of 15 samples.

For herring gull in isolation, bisphenol A was only detected in one blood sample. There were no significant relationships between (log) concentrations of bisphenol A and trophic level in eggs.

3.7.3 Tetrabromobisphenol A (TBBPA)

Relation to quality standards

According to the Norwegian guidelines on classification of environmental quality in fjords and coastal waters – a revision of the classification of waters and sediments with respect to metals and organic contaminants (Bakke et al. 2007; Bakke et al. 2010), quality standards for TBBPA in water and sediment are as presented in Tables 33 and 34, respectively.

Table 33.
Quality standards (µg/L) for TBBPA in water according to the Norwegian guidelines on classification of environmental quality in fjords and coastal waters – a revision of the classification of waters and sediments with respect to metals and organic contaminants (Bakke et al. 2007; Bakke et al. 2010).

	Class I (Background)	**Class II (Good)**	**Class III (Moderate)**	**Class IV (Poor)**	**Class V (Very Poor)**
TBBPA	-	<0.052	0.052 – 0.9	0.9 - 9	>9

Table 34.
Quality standards (ng/g dry wt.) for TBBPA in sediment according to the Norwegian guidelines on classification of environmental quality in fjords and coastal waters – a revision of the classification of waters and sediments with respect to metals and organic contaminants (Bakke et al. 2007; Bakke et al. 2010).

	Class I (Background)	Class II (Good)	Class III (Moderate)	Class IV (Poor)	Class V (Very Poor)
TBBPA		<63	63 – 1100	1100 - 11000	>11000

Phenolic compounds could be analysed in one (out of four) water samples (dissolved phase). The concentrations of TBBPA in this sample was 5.18 ng/L, and corresponding to good environmental condition (class II). With respect to TBBPA in sediments, concentrations at all stations also corresponded to good environmental condition (class II).

Diffuse inputs

Phenolic compounds could be analysed in one (of four) water samples (dissolved phase) and four samples (particulate phase). The concentration of TBBPA in the one water sample (dissolved phase) was 5.18 ng/L. In the particulate phase, the mean concentration was 7.19 ng/L (standard deviation: 4.5).

Bekkelaget STP has reported that 0,236 kg TBBPA ran through the plant in 2012 (BEVAS, 2013).

Geographical aspects

Concentrations of TBBPA in polychaetes, blue mussel and sediments, respectively, from Frognerkilen, the mouth of Alna River and Bekkelaget are presented in Tables 35, 36 and 37.

Table 35.
Concentrations of TBBPA (ng/g wet wt.) in polychaetes from Frognerkilen, the mouth of Alna River and Bekkelaget.

	TBBPA
Frognerkilen	9.03
Mouth of Alna River	7.86
Bekkelaget	8.90

Table 36.
Concentrations of TBBPA (ng/g wet wt.) in blue mussel from Frognerkilen, the mouth of Alna River and Bekkelaget.

	TBBPA
Frognerkilen	212.4
Mouth of Alna River	80.7
Bekkelaget	14.7

Table 37.
Concentrations of TBBPA (ng/g dry wt.) in sediments from Frognerkilen, the mouth of Alna River and Bekkelaget (mean and standard deviation; n=3).

	Bisphenol A
Frognerkilen	0.58 (0.26)
Mouth of Alna River	3.21 (4.10)
Bekkelaget	4.09 (3.98)

Herring gull

TBBPA was measured in eggs and blood of herring gull (Table 38). The variability was high. In blood, TBBPA was detected in 3 of 15 samples.

Table 38.
Concentrations of TBBPA (ng/g wet wt.) in Herring gull (eggs and blood) from the Inner Oslofjord (mean and standard deviation; n=15).

	TBBPA
Egg	1.33 (1.15)
Blood *	0.38 (1.03)

* TBBPA not detected (assigned a value of zero) in 12 of 15 samples.

Food chain of the Inner Oslofjord

Evaluations of the concentrations of TBBPA in the Inner Oslofjord food web were done on a wet weight basis.

There were no demonstrable relationships between trophic level and (log) TBBPA concentrations in the studied Inner Oslofjord food web (Herring gull excluded).

Looking at flounder, isolated, TBBPA was only detected in 2 of 15 samples.

For herring gull in isolation, TBBPA was only detected in 3 blood samples. There were no significant relationships between (log) concentrations of TBBPA and trophic level in eggs.

3.8 Siloxanes

The results from the analysis of cyclic volatile methylsiloxanes are given in Appendix.

Field blanks were prepared, and exposed and handled in the field during sampling and preparation of samples. The results from the analysis of the field blanks are presented in chapter 2.2.4. The results from the analysis of (field) blanks show that some background contamination of the samples is inevitable, as concentrations in blanks exposed during sampling and preparation were higher than in unexposed blanks. However, there were no notable differences in concentrations between field blanks exposed during sampling/preparation of the different organisms, thus no corrections have been made based on these results.

Relation to quality standards

There are no relevant quality standards to relate to.

Diffuse inputs

Siloxanes could not be detected in storm water (neither in the water fraction, nor the particulate fraction.

Bekkelaget STP did not report measurements of discharge of Siloxanes in 2012.

Geographical aspects

Siloxanes were detected in polychaetes and blue mussel from Frognerkilen, the mouth of Alna River and at Bekkelaget (Figure 30). D5 (decamethylcyclopentasiloxane) was found at the highest concentrations. In polychaetes, the highest concentrations (of all three compounds) were found at Bekkelaget. In blue mussel, the highest concentration of D5 was found at the mouth of Alna River

Also in sediments D5 (decamethylcyclopentasiloxane) was found at the highest concentrations. The mouth of Alna displayed the highest concentrations of this compound, followed closely by Bekkelaget (Figure 31; no statistics performed).

High concentrations of D5 have previously been reported in sewage sludge (Andersen et al. 2012).

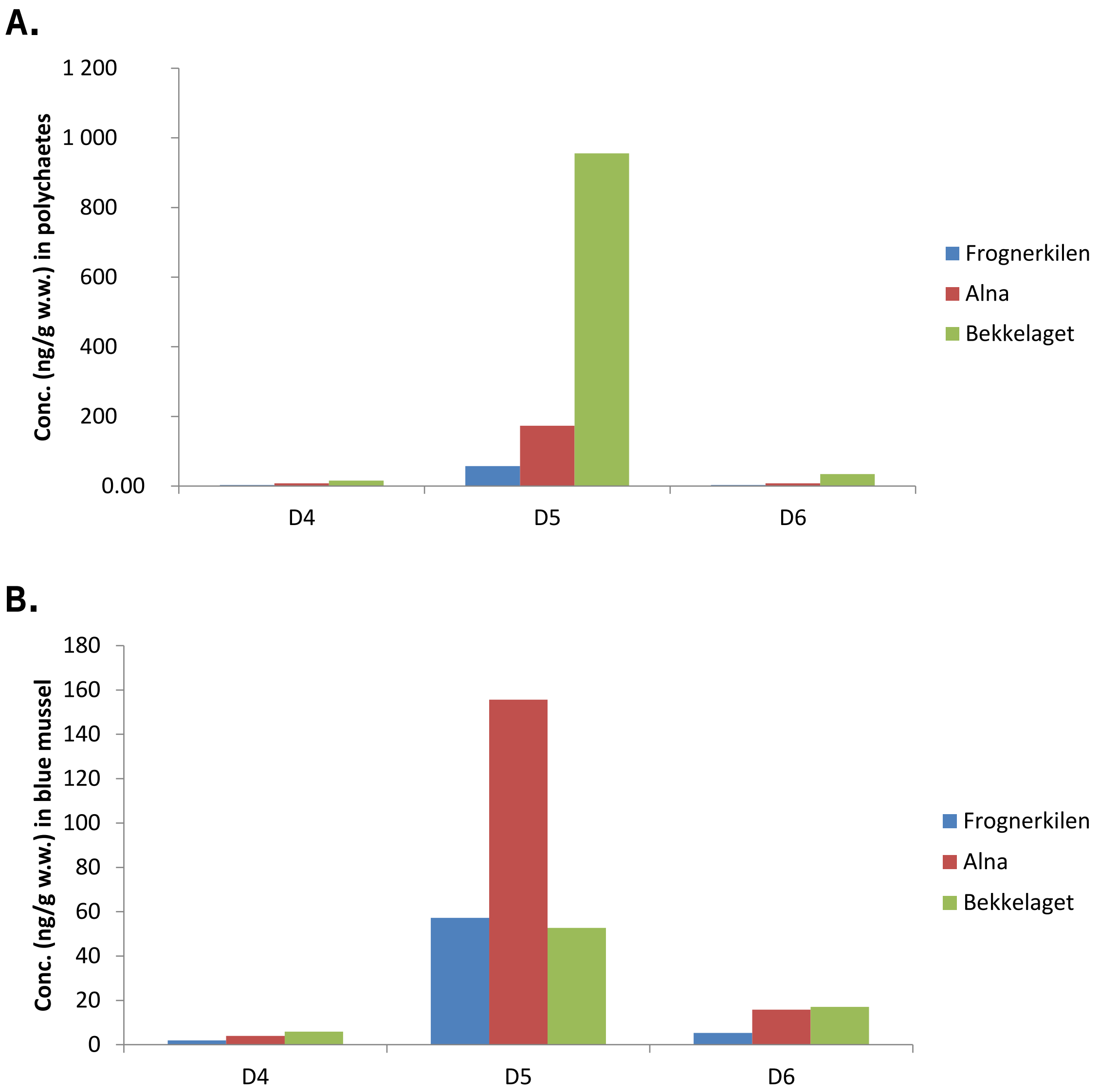


Figure 30. Concentrations of cyclic volatile methylsiloxanes (ng/g wet wt.) in polychaetes (A.) and blue mussel (B.) from Frognerkilen, the mouth of Alna River and at Bekkelaget. One composite sample per station.

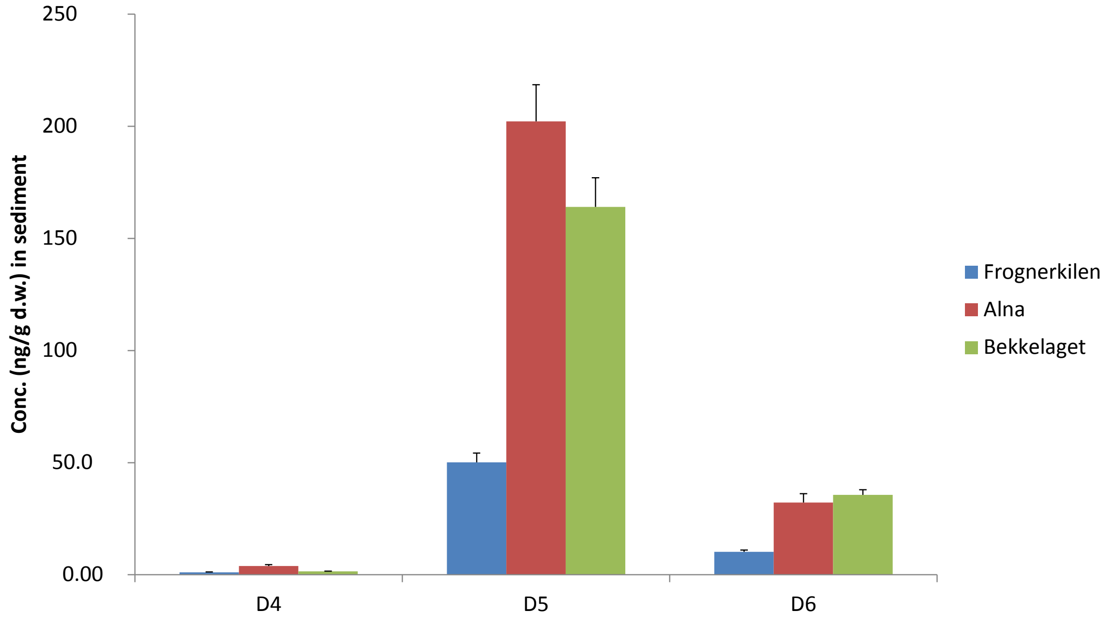


Figure 31. Concentrations of cyclic volatile methylsiloxanes (ng/g dry wt.) in sediments from Frognerkilen, the mouth of Alna River and at Bekkelaget (mean and standard deviation; n=3).

Herring gull

Siloxanes were detected in eggs of Herring gull (Figure 32). D5 displayed the highest concentrations and the variability was high. In blood, only D5 was detected in two (out of 15) samples.

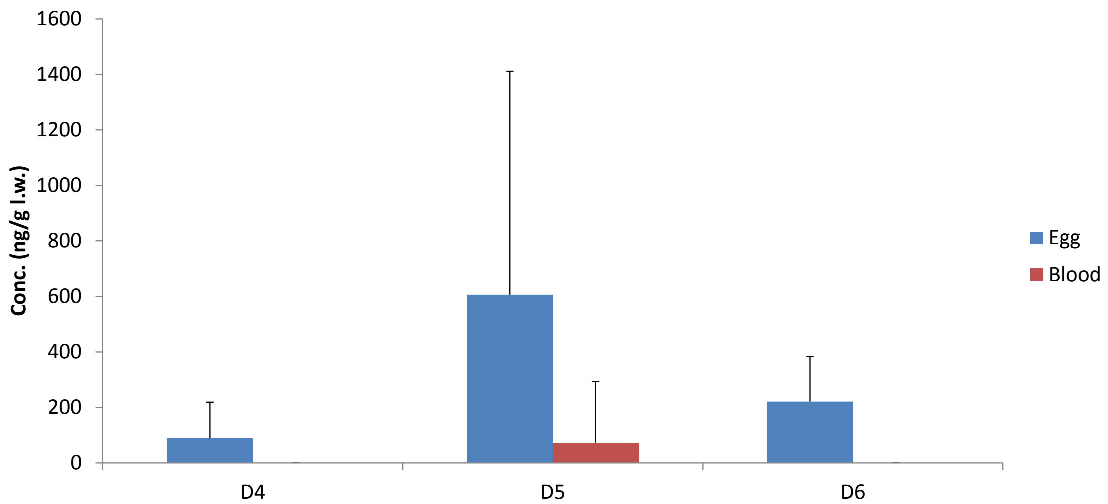


Figure 32. Concentrations of cyclic volatile methylsiloxanes (ng/g lipid wt.) in Herring gull (eggs and blood) from the Inner Oslofjord (mean and standard deviation; n=15; non-detects are assigned values of zero (relevant only for blood, where only D5 was detected in 2 of 15 samples)).

Food chain of the Inner Oslofjord

Evaluations of the concentrations of siloxanes in the Inner Oslofjord food web were performed on a lipid weight basis.

No positive relationships could be demonstrated between trophic position and (log) siloxane concentrations (herring gull included). On the other hand, (when herring gull was excluded from the food web) a significant negative relationship (which was much governed by a combination of low concentrations in and high trophic position of prawns) was observed for D5 (R^2=0.36, p=0.002; Figure 33). This observation was contradictory of what could be observed for herring gull eggs, in isolation.

For herring gull eggs, a significant positive relationship was observed between trophic level and the (log) concentration of D5 (R^2=0.46, p=0.006; Figure 34). Observing a lack of positive relationships between trophic position and concentrations in the investigated Oslofjord food web, but significant positive relationship between trophic position and concentrations in herring gull eggs was also the case for several PCB-congeners (see above; chapter 3.2).

Looking at flounder, isolated, (Log) concentrations did not show significant linear relationships with trophic level. Nor were there any significant relationships between siloxane-concentrations and age, length or weight.

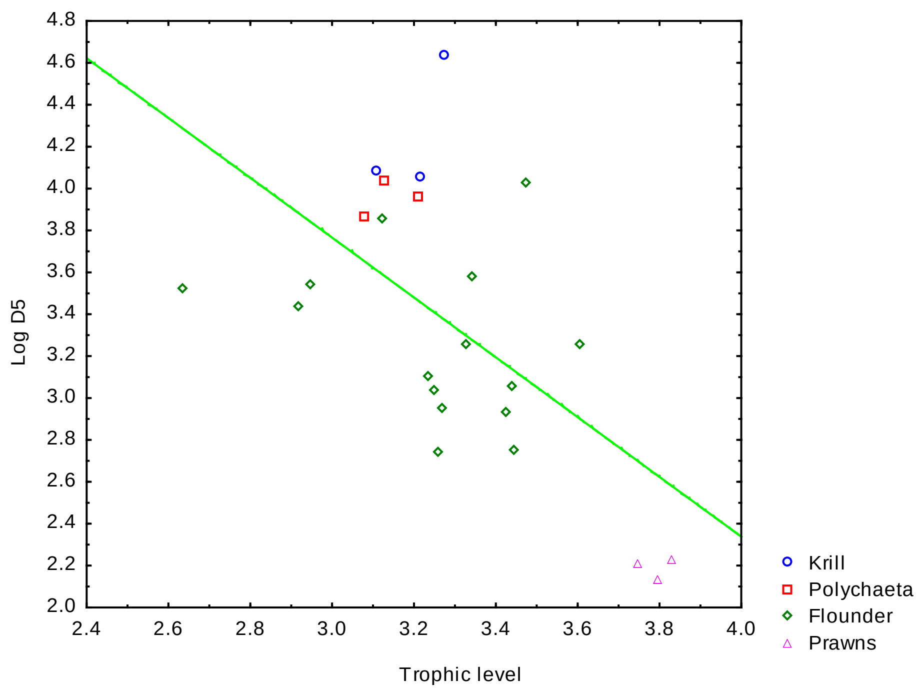


Figure 33. Trophic level against concentrations (ng/g lipid wt.; log-transformed) of D5 (decamethylcyclopentasiloxane) in organisms of the Inner Oslofjord food web. Only concentrations above the LoD are included. R^2=0.36, p=0.002.

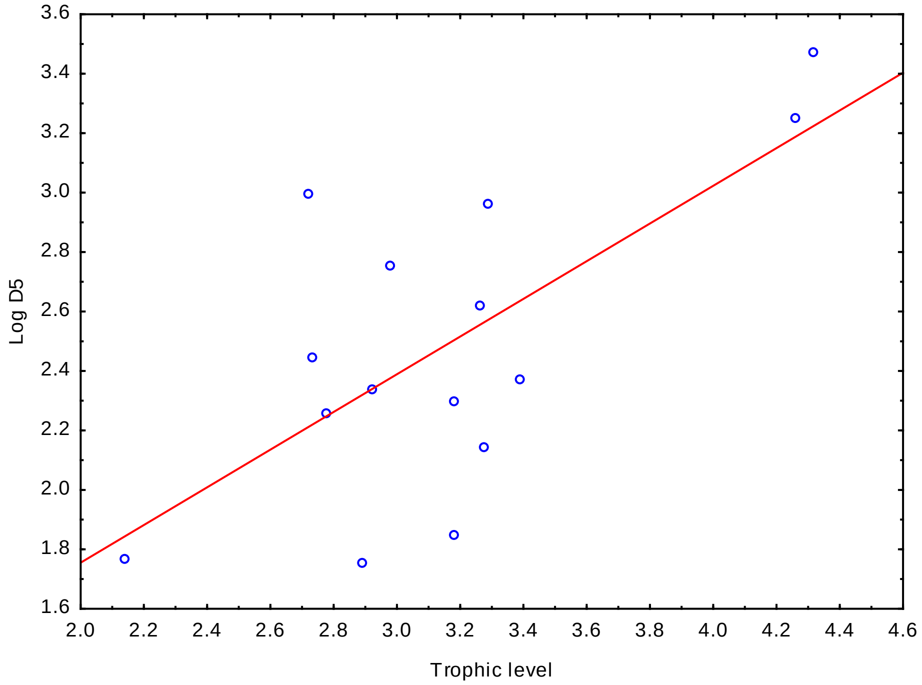


Figure 34. Trophic level against concentrations (ng/g lipid wt.; log-transformed) of D5 (decamethylcyclopentasiloxane) in herring gull eggs. Only concentrations above the LoD are included. R^2=0.46, p=0.006.

3.9 Perfluorinated compounds (PFCs)

The results from the PFC analysis are given in Appendix.

Relation to quality standards

According to the Norwegian guidelines on classification of environmental quality in fjords and coastal waters – a revision of the classification of waters and sediments with respect to metals and organic contaminants (Bakke et al. 2007; Bakke et al. 2010), quality standards for PFCs (more specifically PFOS) in water and sediment are as presented in Tables 39 and 40, respectively.

Table 39.
Quality standards (µg/L) for PFOS in water according to the Norwegian guidelines on classification of environmental quality in fjords and coastal waters – a revision of the classification of waters and sediments with respect to metals and organic contaminants (Bakke et al. 2007; Bakke et al. 2010).

	Class I (Background)	Class II (Good)	Class III (Moderate)	Class IV (Poor)	Class V (Very Poor)
PFOS	-	<25	25 – 72	72 - 360	>360

Table 40.
Quality standards (ng/g dry wt.) for PFOS in sediment according to the Norwegian guidelines on classification of environmental quality in fjords and coastal waters – a revision of the classification of waters and sediments with respect to metals and organic contaminants (Bakke et al. 2007; Bakke et al. 2010).

	Class I (Background)	Class II (Good)	Class III (Moderate)	Class IV (Poor)	Class V (Very Poor)
PFOS	<0.17	0.17 – 220	220 – 630	630 - 3100	>3100

In storm water/surface water samples, PFOS was only detected in the dissolved phase, and the concentrations were well below the upper limit for good environmental condition (class II).

Of the PFCs analysed, only PFOS were detected in two sediment samples from Bekkelaget (0.215 and 0.251 ng/g dry wt.). These concentrations corresponded to good (class II) and moderate (class III) environmental condition, respectively.

Diffuse inputs

Concentrations of PFCs determined in storm water are depicted in Figure 35. The compounds were mainly detected in the dissolved fraction (only small amounts of PFDS in the particulate fraction).

Bekkelaget STP did not report measurements of discharge of PFCs in 2012.

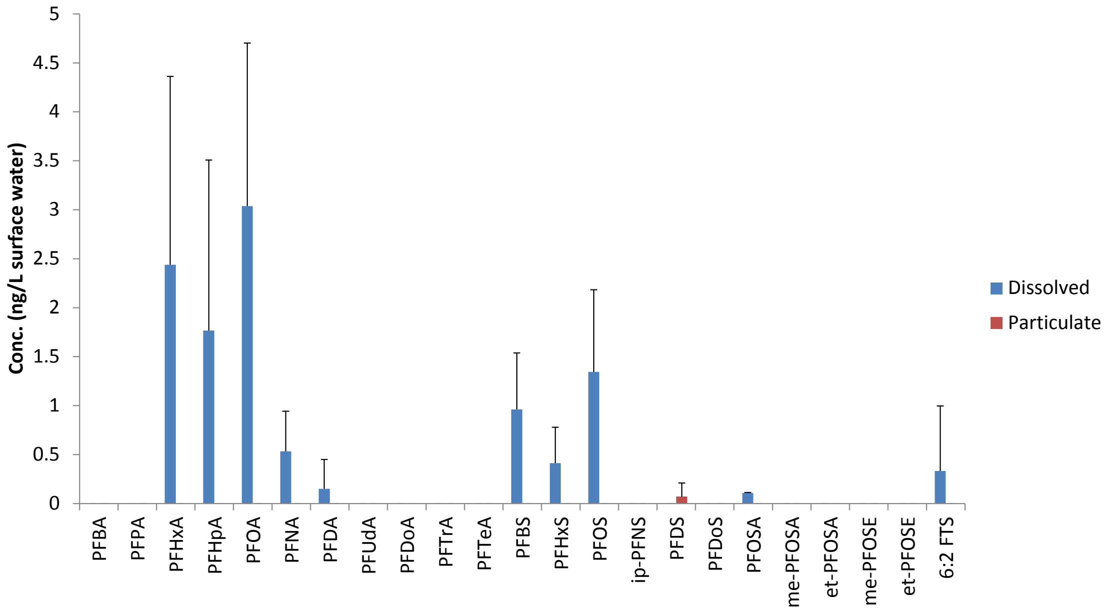


Figure 35. Concentrations of PFCs (ng/L of water) in storm water/surface water (mean and standard deviation; n=4; non-detects are assigned values of zero).

Contribution of PFC inputs from Alna River in 2013 is available through the programme "Riverine inputs and direct discharges to Norwegian coastal waters" (RID;not reported yet). Alna River was not included in the programme in 2012. The contribution was calculated as follows, and the results are presented in Figure 36, and Tables 41 and 42:

- Use of weekly recording of discharge (L d^{-1}), STS (mg L^{-1}) and TOC (mg C L^{-1}) by Oslo Kommune (Vann og Avløp)
- PFC measurement on the suspended particulate matter from RID sampling on three occasions (January, April, September), five consecutive days of continuous flow centrifugation.
- Only PFOS and PFDS measured above LOD in the particulate matter samples.
- Normalising to POC (particulate organic carbon content) reduces the differences between concentrations measured (Relative standard deviations of SPM concentrations normalized to POC are below 15 % for these two substances)
- Calculation of flux to the fjord:

(1) $F = Q \times C_{STS} \times C_{PFC,STS}$

Where F the flux of particle-bound PFOS and PFDS (mg per week), Q is the discharge (L s^{-1} on a weekly basis), C_{STS} is the weekly total suspended particulate matter concentration (mg L^{-1}) and $C_{PFC,STS}$ is the PFC concentration in the suspended particulate matter (ng g^{-1} dry weight material)

(2) $F = Q \times C_{TOC} \times C_{PFC,POC}$

Where F the flux of particle-bound PFOS and PFDS (mg per week), Q is the discharge (L s^{-1} on a weekly basis), C_{TOC} is the weekly total organic carbon concentration in water (mg L^{-1}) and the $C_{PFC,POC}$ is the yearly mean PFC concentration in the suspended particulate matter on an organic carbon normalized basis (ng g^{-1}). Note that the TOC and POC may not be the same since TOC includes dissolved organic carbon.

- Yearly fluxes are calculated as a sum of the weekly fluxes.

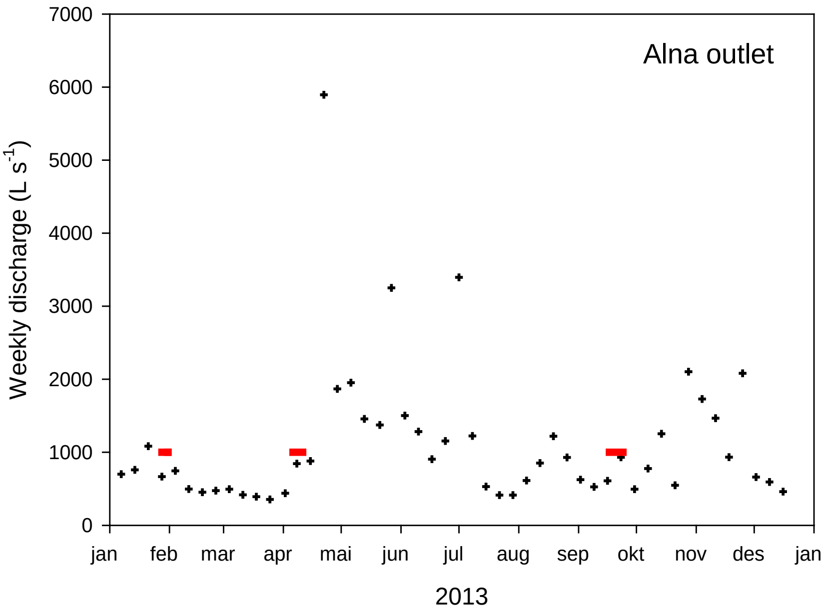


Figure 36. Weekly riverine discharge (L/s) of the Alna River with three continuous flow centrifugation sampling events superimposed (red horizontal lines).

Table 41.
PFC concentrations measured in the suspended particulate matter of the Alna River, collected by continuous flow centrifugation during three sampling events.

Analyte	PFOS (ng/g)	PFDS (ng/g)	POC (%)		PFOS (ng/g OC)	PFDS (ng/g OC)
January	0.11	0.18	6.95		1.58	2.55
April	0.09	0.12	6.00		1.50	2.00
September	0.138	0.17	7.72		1.79	2.19
Mean	**0.11**	**0.16**			**1.62**	**2.25**
SD	0.02	0.03			0.15	0.28
%RSD	22	20			10	13

Table 42.
Yearly fluxes of particle-bound PFOS and PFDS from the Alna River to the inner Oslofjord (mg/year).

PFOS flux (mg $year^{-1}$)		PFDS (mg $year^{-1}$)	
STS-based	TOC-based	STS-based	TOC-based
322	373	422	516

Geographical aspects

There were differences in concentrations (statistical evaluation not applicable due to limited number of samples) of PFCs in polychaetes from Frognerkilen, the mouth of Alna River and Bekkelaget (Figure 37). Concentrations were generally highest at Bekkelaget and lowest in Frognerkilen. However, the highest concentration of PFHxS was found in Frognerkilen. At Bekkelaget, PFOS constituted the highest concentration of the PFCs.

Of all the PFCs, only PFOSA was detected in blue mussel on all three stations.

Only PFOS were detected in two sediment samples from Bekkelaget (0.215 and 0.251 ng/g dry wt.).

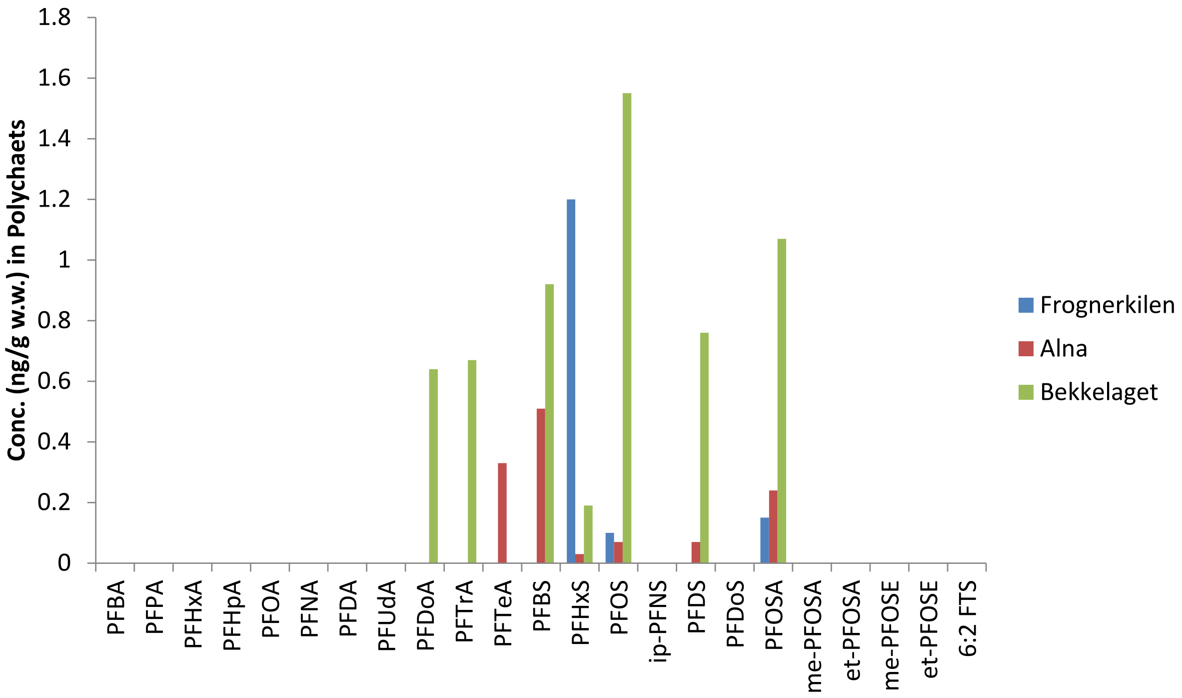


Figure 37. Concentrations of PFCs (ng/g wet wt.) in polychaetes from Frognerkilen, the mouth of Alna River and Bekkelaget. One composite sample per station.

Herring gull

PFCs were detected in eggs and blood of herring gull (Figure 38). PFOS constituted the highest concentrations in both matrices.

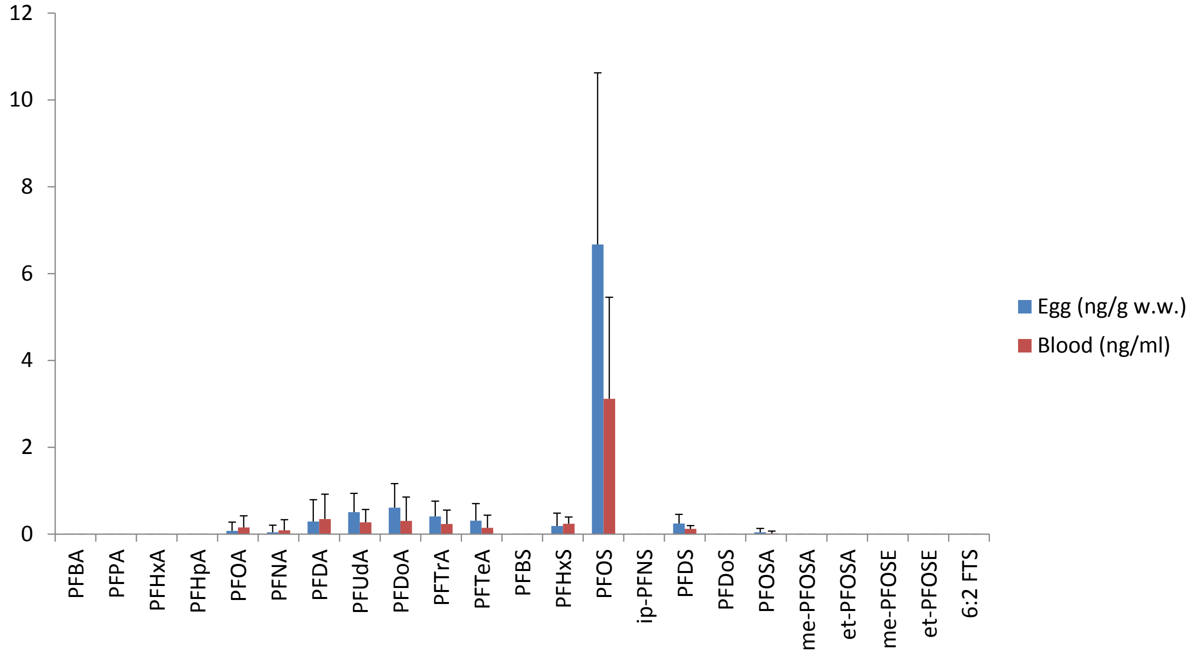


Figure 38. Concentrations of PFCs in eggs (ng/g. wet wt.) and blood (ng/ml) of Herring gull from the Inner Oslofjord (mean and standard deviation; n=15; non-detects are assigned values of zero).

Food chain of the Inner Oslofjord

Evaluations of the concentrations of PFCs in the Inner Oslofjord food web were done on a wet weight basis.

Two PFC compounds showed a significant increase in (log) concentration with higher trophic level in the sampled Inner Oslofjord Food web (herring gull excluded), namely PFDoA and PFTrA (Figure 39; these compounds were not detected in krill and krill was thus omitted from the analysis; "casewise deletion"). The increase in concentration corresponded to Trophic Magnification Factors of 2.8 and 5.2, respectively (wet weight basis). Biomagnification has previously been observed for PFDoA and PFTrA in e.g. a terrestrial lichen-caribou-wolf food chain (Müller et al. 2011). For flounder, there were no demonstrable (significant) relationships between (log) PFC-concentrations and trophic level, nor between PFC-concentrations and age or length. For herring gull, PFUnA showed a significant increase in (log) concentrations with trophic level in both eggs and blood (R^2=0.65; p=0.003 and R^2=0.50; p=0.03, respectively; not shown). PFOSA also showed increasing (log) concentrations in eggs, with higher trophic level (R^2=0.81; p=0.03; not shown). Furthermore, PFOS (R^2=0.54; p=0.001) and PFDS (R^2=0.50; p=0.005) showed increased (log) concentration in blood with higher trophic level of the gulls (not shown). Additionally, concentrations of PFDoA (R^2=0.59; p=0.04) and PFOS (R^2=0.32; p=0.02) showed a significant increase in blood with the body mass (g) of the gulls (not shown; no relationship with wing length).

Cod from the Inner Oslofjord

PFC compounds have also been analysed in cod liver annually since 2005, through the "Contaminants in coastal areas" (MILKYS) monitoring programme (Green et al. 2013). Samples from 1993 have also been analysed for PFAS from the Inner Oslofjord. In 2012, these compounds were analysed in cod liver from eight stations (including the Inner Oslofjord).

The median concentration of perfluoroctonoic sulphonate (PFOS) was highest at Færder in the Outer Oslofjord (6.7 ng/g wet wt.). There were no significant upward trends for PFOS found at any of the eight stations.

Perfluorooctane sulphonamide (PFOSA) had a maximum median concentration of 10 ng/g wet wt. in the Inner Oslofjord. No significant upward trends were found.

The concentration of PFOSA was higher than PFOS in the Inner Oslofjord and Færder.

Parts of the Inner Oslofjord are densely populated with much urban activities including use of PFOSA in certain products. The high concentrations of PFOSA observed in cod are probably related to these activities, as well as reduced water exchange with the Outer fjord (Green et al. 2013).

Apparently, the median concentration of PFOS measured in flounder from the Inner Oslofjord in 2013 (present study) were higher than the median concentration measured in cod (2012), while the median concentration of PFOSA was lower (no statistics performed).

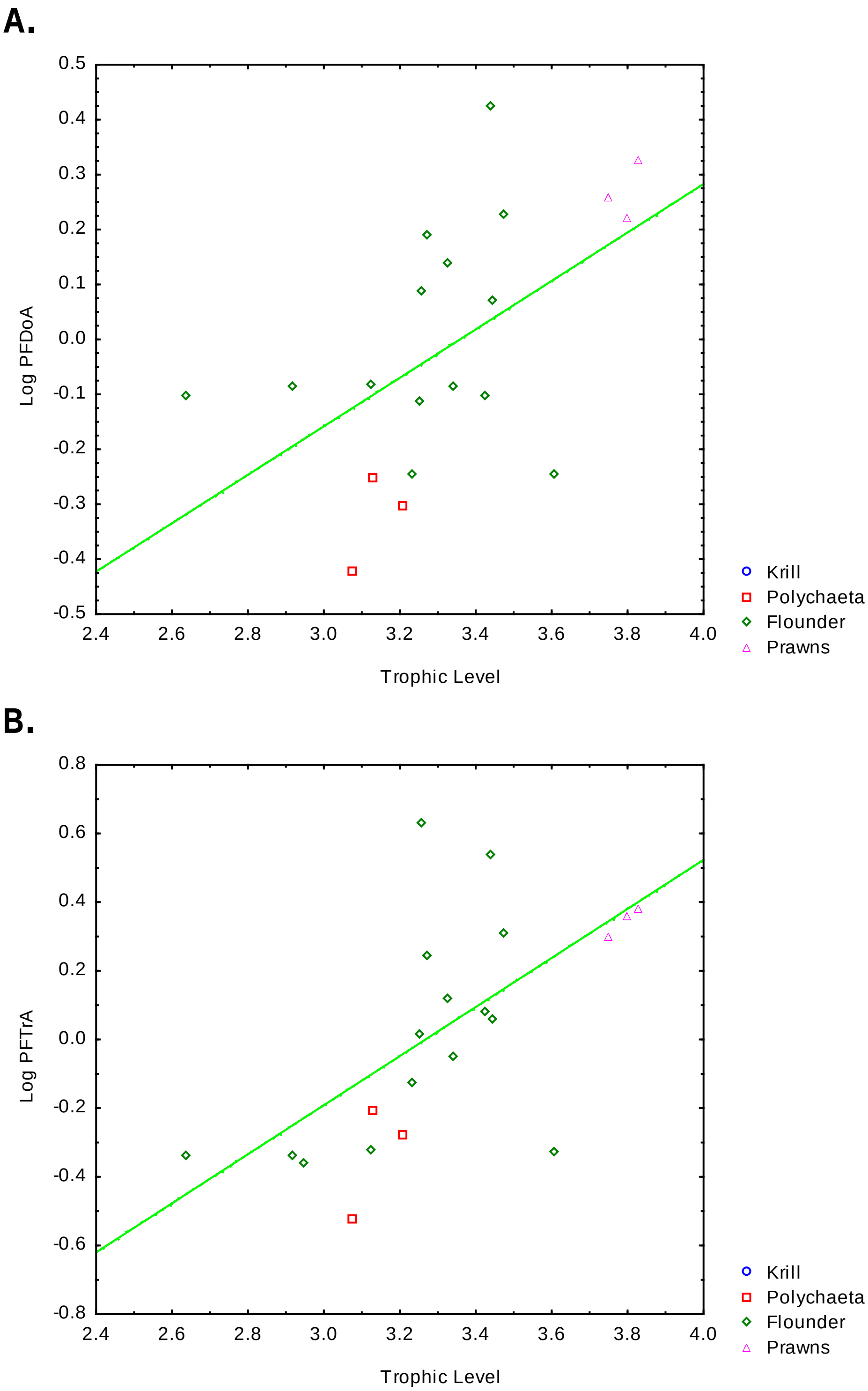


Figure 39. Trophic level against concentrations (ng/g wet wt.; log-transformed) of PFDoA (A.) and PFTrA (B.) in organisms of the Inner Oslofjord food web. Only concentrations above the LoD are included (R^2=0.30 and 0.40, respectively. p=0.01 and 0.002, respectively).

3.10 Biocides

The results from the analyses of biocides are given in Appendix. Regarding tinorganic compounds, additional compounds (tetrabutyltin, TetraBT; monooctyltin, MOT; dioctyltin, DOT; trisyclohexyltin, TCHT) are also presented there, which are not referred to below.

3.10.1 Tinorganic compounds

Relation to quality standards

According to “Vannforskriften” (Norwegian Law) the quality stardards for tributyltin (TBT) are 0.0002 µg/L (annual average for fresh water and coastal water) and 0.0015 µg/L (Maximum value for fresh water and costal water).

According to the Norwegian guidelines on classification of environmental quality in fjords and coastal waters – a revision of the classification of waters and sediments with respect to metals and organic contaminants (Bakke et al. 2007; Bakke et al. 2010), quality standards for TBT in sediment are as presented in Table 43.

According to the Norwegian classification of environmental quality in fjords and coastal waters (Molvær et al. 1997), quality standards for TBT in mussel are as presented in Table 44.

Table 43.
Quality standards (ng/g dry wt.) for TBT in sediment according to the Norwegian guidelines on classification of environmental quality in fjords and coastal waters – a revision of the classification of waters and sediments with respect to metals and organic contaminants (Bakke et al. 2007; Bakke et al. 2010).

	Class I (Background)	Class II (Good)	Class III (Moderate)	Class IV (Poor)	Class V (Very Poor)
TBT (effect based)	<1	<0.002	0.002 – 0.016	0.016 – 0.032	>0.032
TBT (management related)	<1	1 – 5	5 - 20	20 - 100	>100

Table 44.
Quality standards (µg/g dry wt.) for TBT in mussel according to the Norwegian classification of environmental quality in fjords and coastal waters (Molvær et al. 1997).

	Class I Insignificantly polluted	Class II Moderately polluted	Class III Markedly polluted	Class IV Strongly polluted	Class V Very strongly polluted
TBT	< 0.1	0.1 – 0.5	0.5 - 2	2 – 5	> 5

Tinorganic compounds were not measured in water within the current programme. In sediments from Frognerkilen, TBT concentrations corresponded to very poor environmental condition (class V). Lasting elevated levels of TBT in the sediments of most of the Inner Oslofjord are known (Berge et al. 2013).

The quality standards for TBT in mussel are expressed as µg/g dry wt. Total dry matter was not measured in blue mussel within the programme. However, environmental monitoring along the Norwegian coast (Green et al. 2013) has shown that the total dry matter in blue mussel is on average 16.7% (±0.2%; based on analysis of >2000 samples). Thus, the concentration of TBT in blue mussel from Frognerkilen corresponded to moderately polluted (class II).

The concentrations of tinorganic compounds in polychaetes and blue mussel from Frognerkilen are presented in Table 45. The concentrations in sediment from Frognerkilen are presented in Table 46.

Table 45.
Concentrations (ng/g wet wt.) of tinorganic compounds in polychaetes and blue mussel from Frognerkilen (inner Oslofjord).

Compound	Polychaetes	Blue mussel
MBT	19.1	3.18
DBT	33.8	8.31
TBT	124	42
TPhT	4.22	5.63

Table 46.
Concentrations (ng/g dry wt.) of tinorganic compounds in sediment from Frognerkilen (inner Oslofjord; mean and standard deviation; n=3).

Compound	Sediment
MBT	56.1 (8.63)
DBT	133.3 (9.1)
TBT	274.7 (17.0)
TPhT	4.6 (0.4)

3.10.2 Diuron

Diuron was measured in sediment samples from Frognerkilen (n=3). However, all measurements were below the limit of detection (<0.05 µg/g dry wt).

3.10.3 Irgarol

Irgarol was measured in sediment samples from Frognerkilen (n=3). However, all measurements were below the limit of detection (<0.05 µg/g dry wt).

3.10.4 Ethylene thiourea (ETU)

Ethylene thiourea (ETU) is a metabolite of Zineb (biocide used in Norway in antifouling paints), and was measured in sediment samples from Frognerkilen (n=3). However, all measurements were below the limit of detection (<10 ng/g dry wt).

3.11 Polycyclic Aromatic Hydrocarbons (PAHs)

The results of the PAH analyses are given in Appendix.

Relation to quality standards

According to “Vannforskriften” (Norwegian Law), the Environmental Quality Standard (EQS) for specific PAH compounds are as presented in Table 47. According to the Norwegian guidelines on classification of environmental quality in fjords and coastal waters – a revision of the classification of waters and sediments with respect to metals and organic contaminants (Bakke et al. 2007; Bakke et al. 2010), quality standards for PAHs in sediment are as presented in Table 48. According to the Norwegian classification of environmental quality in fjords and coastal waters (Molvær et al. 1997), quality standards for PAHs in mussel are as presented in Table 49.

Table 47.
Environmental Quality Standards for PAH compounds according “Vannforskriften” (Norwegian law; µg/L).

Name of substance	CAS.no.	AA-EQS Inland surface waters	AA-EQS Other surface waters	MAC-EQS Inland surface waters	MAC-EQS Other surface waters
Fluoranthene	206-44-0	0.1	0.1	1.0	1.0
PAH *	Na	Na	Na	Na	Na
Benzo(a)pyrene	50-32-8	0.05	0.05	0.1	0.1
Benzo(b)fluoranthene	205-99-2	Σ = 0.03	Σ = 0.03	Na	Na
Benzo(k)fluoranthene	207-08-9	Σ = 0.03	Σ = 0.03	Na	Na
Benzo(ghi)perylene	191-24-2	Σ = 0.002	Σ = 0.002	Na	Na
Indeno(123cd)pyrene	193-39-5	Σ = 0.002	Σ = 0.002	Na	Na

* For PAHs the EQSs for benzo(a)pyrene, the sum of benzo(b)fluoranthene and Benzo(k)fluoranthene, and the sum of benzo(g,h,i)perylene and indeno(1,2,3-cd)pyrene must be fulfilled.

Table 48.
Quality standards (ng/g dry wt.) for PAHs in sediment according to the Norwegian guidelines on classification of environmental quality in fjords and coastal waters – a revision of the classification of waters and sediments with respect to metals and organic contaminants (Bakke et al. 2007; Bakke et al. 2010).

PAH compound	Class I (Background)	Class II (Good)	Class III (Moderate)	Class IV (Poor)	Class V (Very Poor)
Naphthalene	<2	2 - 290	290 - 1000	1000 - 2000	>2000
Acenaphthtylene	<1.6	1.6 - 33	33 - 85	85 - 850	>850
Acenaphthtene	<4.8	2.4 - 160	160 - 360	360 - 3600	>3600
Fluorene	<6.8	6.8 - 260	260 - 510	510 - 5100	>5100
Phenanthrene	<6.8	6.8 - 500	500 - 1200	1200 - 2300	>2300
Anthracene	<1.2	1.2 - 31	31 - 100	100 - 1000	>1000
Fluoranthene	<8	8 - 170	170 - 1300	1300 - 2600	>2600
Pyrene	<5.2	5.2 - 280	280 - 2800	2800 - 5600	>5600
Benzo[a]anthracene	<3.6	3.6 - 60	60 - 90	90 - 900	>900
Chrysene	<4.4	4.4 - 280	280 - 280	280 - 560	>560
Benzo[b]fluoranthene	<46	46 - 240	240 - 490	490 - 4900	>4900
Benzo[k]fluoranthene		<210	210 - 480	480 - 4800	>4800
Benzo(a)pyrene	<6	6 - 420	420 - 830	830 - 4200	>4200
Indeno[123cd]pyrene	<20	20 - 47	47 - 70	70 - 700	>700
Dibenzo[ah]anthracene	<12	12 - 590	590 - 1200	1200 - 12000	>12000
Benzo[ghi]perylene	<18	18 - 21	21 - 31	31 - 310	>310
PAH16 (sum)	<300	300 - 2000	2000 - 6000	6000 - 20000	> 20000

Table 49.
Quality standards (ng/g wet wt.) for PAHs in mussel according to the Norwegian classification of environmental quality in fjords and coastal waters (Molvær et al. 1997).

Parameter	Class I Insignificantly polluted	Class II Moderately polluted	Class III Markedly polluted	Class IV Strongly polluted	Class V Very strongly polluted
Σ PAH	< 50	50 - 200	200 - 2000	2000 – 5000	> 5000
Benzo(a)pyrene	< 1	1 - 3	3 - 10	10 – 30	> 30

PAHs were hardly detected in the dissolved fraction of storm water/surface water (see Appendix). Fluoranthene was detected in one sample and the concentration was well below the EQS.

Blue mussel was insignificantly polluted with PAHs at all three stations (borderline moderately polluted at the mouth of Alna River). Regarding sediments, all three stations showed concentrations of PAH compounds corresponding to class II (good) to class IV (poor). Benzo(g,h,i)perylene showed concentrations corresponding to class V (very poor) at the mouth of Alna River and in Frognerkilen. The concentration of PAH16 corresponded to class 3 (moderate) at the mouth of Alna River and at Bekkelaget, and class IV (poor) in Frognerkilen.

Diffuse inputs

Concentrations of PAHs determined in storm water are depicted in Figure 40. As expected (given the hydrophobic properties of these compounds), the compounds were mainly detected in the particulate fraction, and variability was high.

Bekkelaget STP has reported that 26,11 kg PAHs (sum) ran into the plant, and 0,236 kg PAHs (sum) ran out of the plant in 2012 (BEVAS, 2013).

Contribution of PAH inputs from Alna River in 2013 are available through the programme "Riverine inputs and direct discharges to Norwegian coastal waters" (RID; not reported yet). Alna River was not included in the programme in 2012. The contribution was calculated as described above (see e.g. for PCBs), and the results are presented in Table 50.

The sum of 16 US EPA PAHs was used for the calculation of particulate-bound riverine fluxes. The sum of dissolved phase PAH concentrations (from LDPE samplers) do not include naphthalene (not reported). Limits of detection were used to calculate sum of concentrations for compounds whose concentration was below LOD.

Table 50.
Concentrations and flux estimates of PAHs in the Alna River.

		Sum 16 PAHs
$C_{SumPAH,SPM}$ (ng/g)	SPM1 SPM2 SPM3	6121 4051 3551
$C_{SumPAH,POC}$ (ng/g OC)	SPM1 SPM2 SPM3	88072 67515 45998
$C_{SumPAH, w}$ (ng/L)		73.5
Particle-bound flux (kg/year)	STS-based TOC-based	19.8 15.4
Dissolved PAH flux (kg/year)		2.5

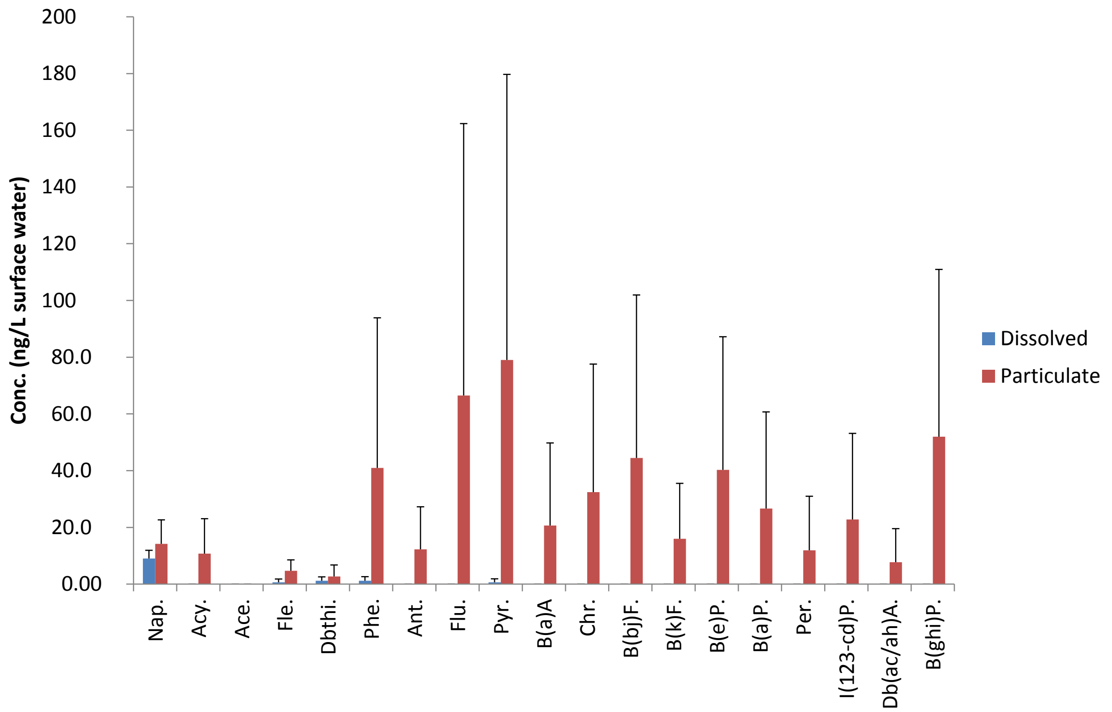
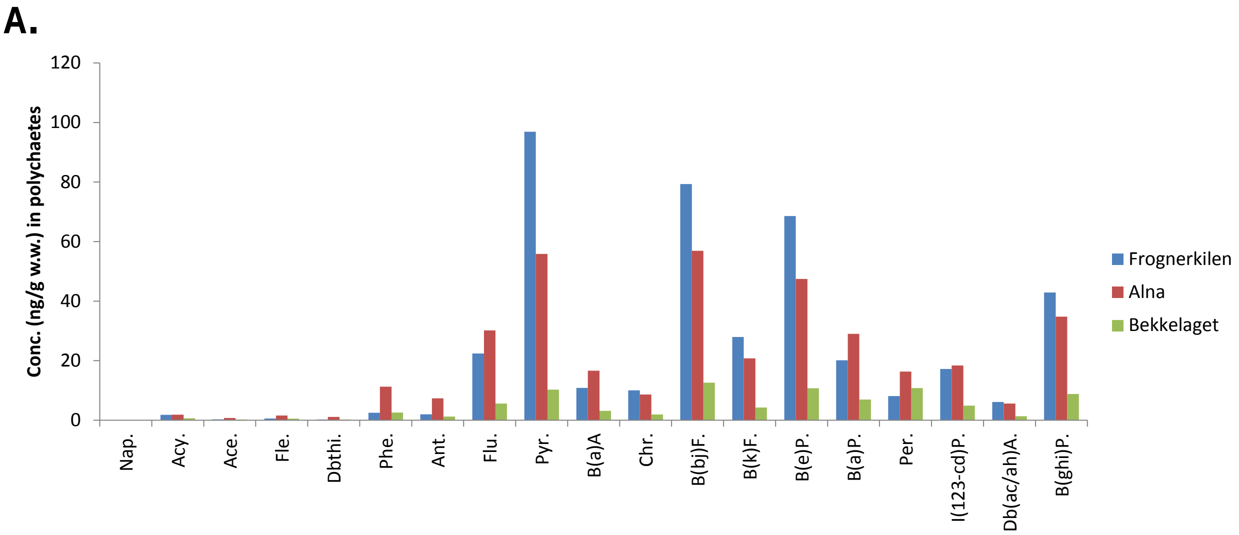


Figure 40. Concentrations of PAHs (ng/L of water) in storm water/surface water (mean and standard deviation; n=4; non-detects are assigned values of zero).

Geographical aspects

There were differences in concentrations (statistical evaluation not applicable due to limited number of samples) of PAHs in polychaetes and mussels from Frognerkilen, the mouth of Alna River and Bekkelaget (Figure 41). Concentrations in both polychaetes and blue mussel were generally lowest at Bekkelaget. PAH concentrations in sediments were apparently also lowest at Bekkelaget, but variability was high (no statistics performed; Figure 42).



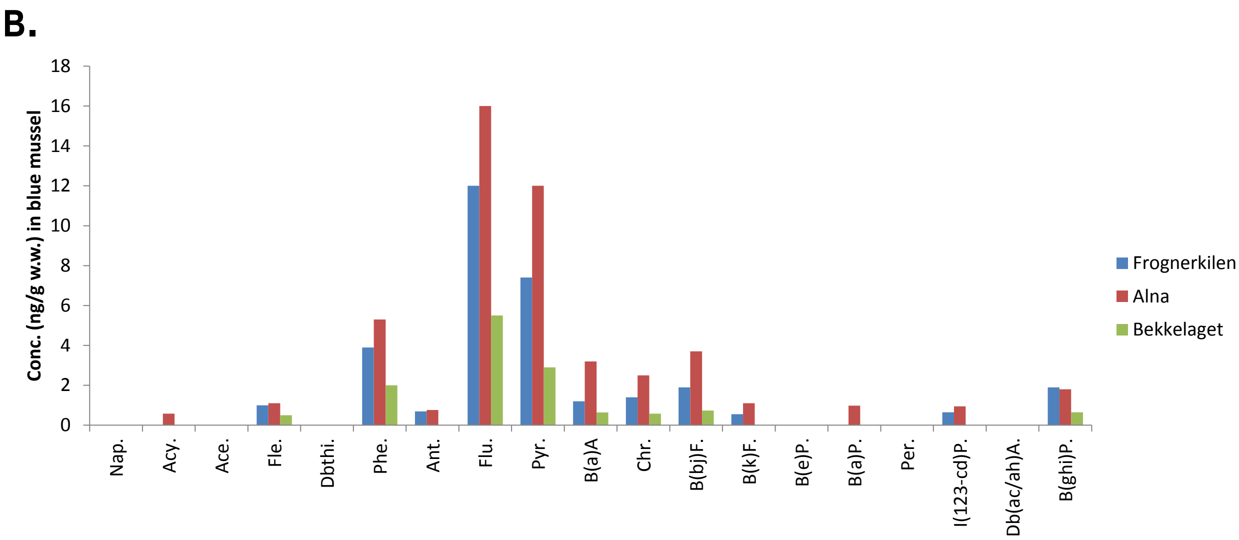


Figure 41. Concentrations of PAHs (ng/g wet wt.) in polychaetes (A.) and blue mussel (B.) from Frognerkilen, the mouth of Alna River and at Bekkelaget. One composite sample per station.

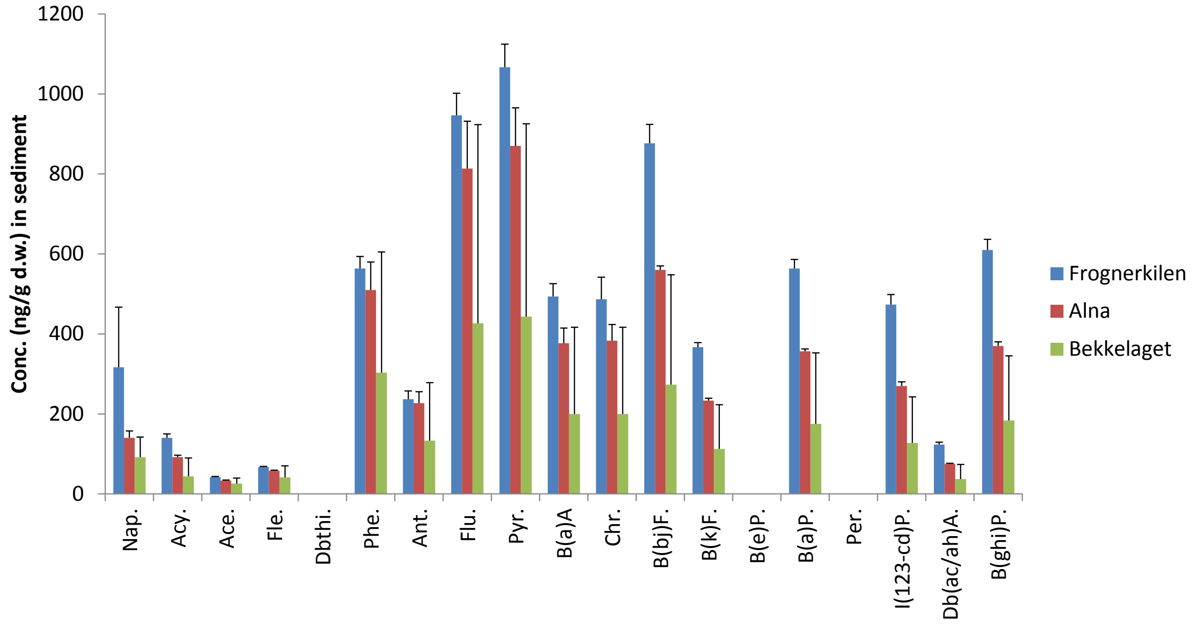


Figure 42. Concentrations of PAHs (ng/g dry wt.) in sediments from Frognerkilen, the mouth of Alna River and at Bekkelaget (mean and standard deviation; n=3).

3.12 Metals

The results of the metal analyses are given in Appendix.

Relation to quality standards

According to “Vannforskriften” (Norwegian Law) the quality stardards for metals in question in water are presented in Table 51. “Vannforskriften” also gives an EQS for mercury (and compounds) in organisms (fish, molluscs, crustaceans and other organisms in freshwater and coastal water): 20 ng/g wet wt. Quality standards for some of the other metals (not handled by “Vannforskriften” are given in the Norwegian guidelines on classification of environmental quality in fjords and coastal waters – a revision of the classification of waters and sediments with respect to metals and organic contaminants (Table 52; Bakke et al. 2007; Bakke et al. 2010).

According to the Norwegian guidelines on classification of environmental quality in fjords and coastal waters – a revision of the classification of waters and sediments with respect to metals and organic contaminants (Bakke et al. 2007; Bakke et al. 2010), quality standards for the relevant metals in sediment are as presented in Table 53. According to the Norwegian classification of environmental quality in fjords and coastal waters (Molvær et al. 1997), quality standards for the relevant metals (except Hg, since EQS is given in “Vannforskriften”) in mussel are as presented in Table 54.

Table 51.
Environmental Quality Standards for metals according to "Vannforskriften" (Norwegian law; µg/L).

Metal	CAS.no.	AA-EQS fresh water	AA-EQS coastal water	MAC-EQS fresh water	MAC-EQS coastal water
Cadmium (and compounds)	7440-43-9	≤0.08 (class 1) 0.08 (class 2) 0.09 (class 3) 0.15 (class 4) 0.25 (class 5)	0.2	≤0.45 (class 1) 0.45 (class 2) 0.6 (class 3) 0.9 (class 4) 1.5 (class 5)	≤0.45 (class 1) 0.45 (class 2) 0.6 (class 3) 0.9 (class 4) 1.5 (class 5)
Lead (and compounds)	7439-92-1	7.2	7.2	Na	Na
Mercury (and compounds)	7439-97-6	0.05	0.05	0.07	0.07
Nickel(and compounds)	7440-02-0	20	20	Na	Na

Table 52.
Quality standards (µg/L) for metals in water according to the Norwegian guidelines on classification of environmental quality in fjords and coastal waters – a revision of the classification of waters and sediments with respect to metals and organic contaminants (Bakke et al. 2007; Bakke et al. 2010).

PAH compound	Class I (Background)	Class II (Good)	Class III (Moderate)	Class IV (Poor)	Class V (Very Poor)
Arsenic (As)	<2	2 - 4.8	4.8 – 8.5	8.5 - 85	>85
Copper (Cu)	<0.3	0.3 -0.64	0.64 -0.8	0.8 -7.7	>7.7
Chrome (Cr)	<0.2	0.2 - 3.4	3.4 - 36	36 - 360	>360
Zinc (Zn)	<1.5	1.5 - 2.9	2.9 - 6	6 - 60	>60

Table 53.
Quality standards (µg/g dry wt.) for metals in sediment according to the Norwegian guidelines on classification of environmental quality in fjords and coastal waters – a revision of the classification of waters and sediments with respect to metals and organic contaminants (Bakke et al. 2007; Bakke et al. 2010).

PAH compound	Class I (Background)	Class II (Good)	Class III (Moderate)	Class IV (Poor)	Class V (Very Poor)
Arsenic (As)	<20	20 - 52	52 - 76	76 - 580	>580
Lead (Pb)	<30	30 - 83	83 - 100	100 - 720	>720
Cadmium (Cd)	<0.25	0.25 - 2.6	2.6 - 15	15 - 140	>140
Copper (Cu)	<35	35 - 51	51 - 55	55 - 220	>220
Chrome (Cr)	<70	70 - 560	560 - 5900	5900 - 59000	>59000
Mercury (Hg)	<0.15	0.15 - 0.63	0.63 - 0.86	0.86 - 1,6	>1.6
Nickel (Ni)	<30	30 - 46	46 - 120	120 - 840	>840
Zinc (Zn)	<150	150 - 360	360 - 590	590 - 4500	>4500

Table 54.
Quality standards (µg/g dry wt.) for metals in mussel according to the Norwegian classification of environmental quality in fjords and coastal waters (Molvær et al. 1997).

Metal	Class I Insignificantly polluted	Class II Moderately polluted	Class III Markedly polluted	Class IV Strongly polluted	Class V Very strongly polluted
Arsenic (As)	<50	50 - 150	15 - 350	350 - 700	>700
Lead (Pb)	<1	1 - 3	3 - 10	10 - 30	>30
Cadmium (Cd)	<1.5	1.5 - 5	5 - 20	20 - 40	>40
Copper (Cu)	<5	5 - 15	15 - 50	50 - 150	>150
Chrome (Cr)	<1	1 - 5	5 - 15	15 - 50	>50
Nickel (Ni)	<5	5 - 25	25 - 50	50 - 100	>100
Zinc (Zn)	<150	150 - 400	400 - 1000	1000 - 2500	>2500
Silver (Ag)	<0.5	0.5 – 1.5	1.5 - 5	5 - 10	>10

The mean concentrations of metals measured in surface water (dissolved phase) did not exceed the AA-EQS (for Cd, Pb, Hg or Ni), according to "Vannforskriften". According to the Norwegian guidelines on classification of environmental quality in fjords and coastal waters – a revision of the classification of waters and sediments with respect to metals and organic contaminants (Bakke et al. 2007; Bakke et al. 2010), the concentrations of metals corresponded to background concentration (class I; As) to poor environmental condition (class IV; Cu and Zn).

In sediments, the metal concentrations corresponded to background concentrations (class I; Cr and Ni), background concentrations to good environmental condition (class I – II; As, Pb, Cd and Zn), dependent on station, and background concentrations to poor environmental condition (class I – IV; Cu and Hg), dependent on station. For both Cu and Hg, concentrations were lowest at Bekkelaget (see below).

Concentrations of mercury (Hg) in mussel did not exceed the EQS given by "Vannforskriften" at any of the three stations.The quality standards for the other metals in mussel (Table 54) are expressed as µg/g dry wt. Total dry matter was not measured in blue mussel within the programme. However, environmental monitoring along the Norwegian coast (Green et al. 2013) has shown that the total dry matter in blue mussel is on average 16.7% (±0.2%; based on analysis of >2000 samples). Thus, the concentration of metals in blue mussel corresponded to background concentrations (class I; AS, Cd, Cu, Ni, Zn, Ag), background concentrations to moderately polluted (class I –II; Cr), and moderately polluted (class II; Pb).

Diffuse inputs

The concentrations of metals measured in surface water (dissolved phase and particulate phase, respectively) are presented in Table 55. Apparently, higher concentrations were generally found in the particulate fraction, than the dissolved fraction (no statistics performed).

Table 55..
Concentrations (µg/L; ng/L for Hg) of metals in surface water (dissolved phase and particulate phase, respectively; Mean and standard deviation; n=4).

Metal	Dissolved	Particulate
Hg (ng/L)	1.66 (0.70)	22.50 (35.73)
Cr (µg/L)	2.45 (1.98)	8.57 (6.80)
Fe (µg/L)	427.32 (347)	2938.66 (2734)
Ni (µg/L)	1.50 (0.65)	4.80 (4.04)
Cu (µg/L)	8.91 (5.36)	17.25 (15.68)
Zn (µg/L)	35.25 (26.74)	84.06 (85.25)
As (µg/L)	0.63 (0.42)	0.79 (0.77)
Ag (µg/L)	0.01 (0.003)	0.06 (0.08)
Cd (µg/L)	0.04 (0.03)	0.11 (0.09)
Pb (µg/L)	0.70 (0.48)	7.30 (9.06)

Geographical aspects

The concentrations of metals in polychaetes and blue mussel, respectively, from Frognerkilen, the mouth of Alna River, and Bekkelaget are presented in Tables 56 and 57. The concentrations in sediment from the same stations are presented in Table 58. There were no notable differences between stations.

Table 56.
Concentrations (µg/g wet wt.) of metals in polychaetes from Frognerkilen, the mouth of Alna River, and Bekkelaget (Inner Oslofjord).

Metal	Frognerkilen	Alna	Bekkelaget
Hg	0.04	0.02	0.01
Cr	1.26	0.64	0.22
Fe	184.19	293.79	208.15
Ni	0.86	0.52	0.36
Cu	11.80	9.78	10.20
Zn	28.89	11.02	5.04
As	4.06	2.03	1.82
Ag	0.93	0.20	0.70
Cd	0.16	0.07	0.21
Pb	0.69	0.84	0.17

Table 57.
Concentrations (µg/g wet wt.) of metals in blue mussel from Frognerkilen, the mouth of Alna River, and Bekkelaget (Inner Oslofjord).

Metal	Frognerkilen	Alna	Bekkelaget
Hg	0.01	0.01	0.01
Cr	0.20	0.21	0.16
Fe	33.95	39.17	21.13
Ni	0.19	0.16	0.16
Cu	1.85	1.63	1.35
Zn	22.93	20.25	22.06
As	1.04	0.95	1.00
Ag	0.005	0.005	0.004
Cd	0.17	0.20	0.14
Pb	0.33	0.38	0.35

Table 58.
Concentrations (µg/g dry wt.) of metals in sediments from Frognerkilen, the mouth of Alna River, and Bekkelaget (inner Oslofjord; mean and standard deviation; n=3).

Metal	Frognerkilen	Alna	Bekkelaget
Hg	1.33 (0.48)	0.38 (0.10)	0.14 (0.03)
Cr	57.74 (9.15)	49.51 (5.44)	40.65 (3.42)
Fe	22675.12 (2593)	20606.48 (2602)	22586.95 (802)
Ni	21.63 (0.82)	21.32 (1.79)	18.95 (1.74)
Cu	74.63 (1.92)	75.65 (10.51)	26.18 (2.63)
Zn	150.91 (8.24)	188.92 (10.05)	78.30 (5.05)
As	14.57 (3.41)	8.20 (2.95)	20.06 (4.21)
Ag	3.03 (1.74)	1.35 (0.27)	0.56 (0.03)
Cd	0.23 (0.09)	0.61 (0.04)	0.05 (0.01)
Pb	61.65 (3.38)	49.35 (7.63)	22.69 (3.08)

Herring gull

Metals were detected in eggs and blood of herring gull (Table 59). High concentrations of iron in blood are obviously related to the function of iron in the haemoglobin oxygen-transport metalloprotein.

Table 59.
Concentrations (µg/g wet wt.) of metals in herring gull (eggs and blood, respectively; mean and standard deviation; n=15; non-detects are assigned values of zero (only relevant for blood)).

Metal	Eggs	Blood
Hg	0.1185 (0,0776)	0.0558 (0.0378)
Cr *	0.0239 (0,0401)	0.0036 (0.0032)
Fe	27.3797 (4.5594)	474.7929 (64.8204)
Ni *	0.0281 (0,0412)	0.0014 (0.0019)
Cu	0.6442 (0.0945)	0.5156 (0.0928)
Zn	12.9187 (1.7786)	5.9787 (1.1144)
As	0.0440 (0.0405)	0.0728 (0.1097)
Ag *	0.0007 (0.0005)	0.0003 (0.0003)
Cd *	0.0003 (0.0001)	0.0009 (0.0011)
Pb	0.0114 (0.0067)	0.1408 (0.0915)

* For Cr, Ni, Ag and Cd concentrations were below limit of detection (here assigned a value of zero) in ≥3 blood samples.

Food chain of the Inner Oslofjord

Evaluations of the concentrations of metals in the Inner Oslofjord food web were done on a wet weight basis.

Initially, it should be noted that mercury (for logistical reasons) were measured in the liver of flounder, while it is known that this metal is more associated with proteins and thus the muscle tissue.

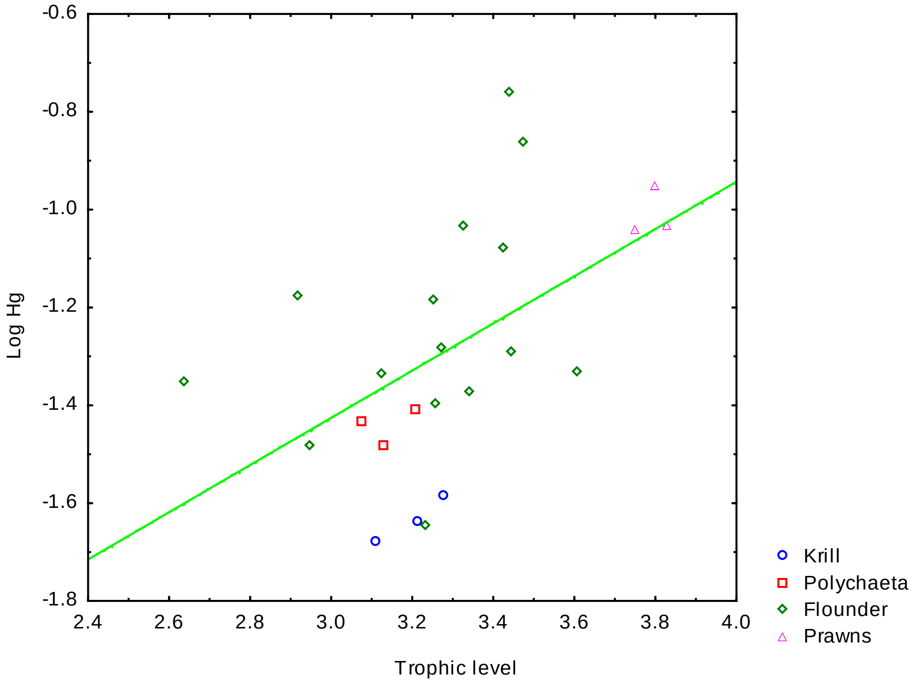
There were significant linear relationships between trophic level and (log) concentrations of Hg and As in the studied Inner Oslofjord food web (herring gull excluded; Figure 43). The biomagnifying properties of mercury are well known (e.g. Jaeger et al. 2009). Regarding arsenic, it is known that marine animals naturally contain considerable levels, and in higher concentrations compared to freshwater and terrestrial animals (Amlund, 2005 and references therein). The toxicity of As is strongly dependent on the chemical form, and a wide range of arsenicals are found in marine organisms (Amlund, 2005 and references therein). In general, inorganic arsenic is more toxic than organic arsenicals and in marine organisms organic arsenic compounds, mainly arsenobetaine, are the dominating forms (Amlund, 2005 and references therein).

For most metals, concentrations were highest in the invertebrates (see Appendix; herring gull not evaluated). This was particularly evident for the essential metals Cu and Zn, as well as for Ag.

Looking at flounder, isolated, there was a significant linear decrease in the (log) concentration of Zn with trophic level (not shown; R^2 = 0.62; p = 0.0005). Furthermore, the concentration of Hg increased linearly with the age (not shown; R^2 = 0.38; p = 0.01) and the length (not shown; R^2 = 0.32; p = 0.03) of the fish. The concentration of arsenic also increased linearly with the age (not shown; R^2 = 0.62; p = 0.0004) and the length (not shown; R^2 = 0.47; p = 0.004), as well as the body mass (not shown; R^2 = 0.41; p = 0.01) of the fish. Additionally, the concentration of cadmium increased linearly with the age (not shown; R^2 = 0.47; p = 0.004) and the length (not shown; R^2 = 0.44; p = 0.007), as well as the body mass (not shown; R^2 = 0.35; p = 0.02) of the flounder.

For herring gull eggs in isolation, the (log) concentration of As displayed a significant positive linear relationship with trophic level (not shown; R^2 = 0.70; p = 0.0001), while the (log) concentration of Cd showed a significant negative linear relationship with trophic level (not shown; R^2 = 0.33; p = 0.02). For Herring gull blood, the (log) concentration of Hg displayed a significant positive linear relationship with trophic level (not shown; R^2 = 0.58; p = 0.0009). Furthermore, the concentration of Cu showed a negative linear relationship with wing length (not shown; R^2 = 0.38; p = 0.01), while Pb showed a negative linear relationship with body mass (not shown; R^2 = 0.53; p = 0.002).

A.



B.

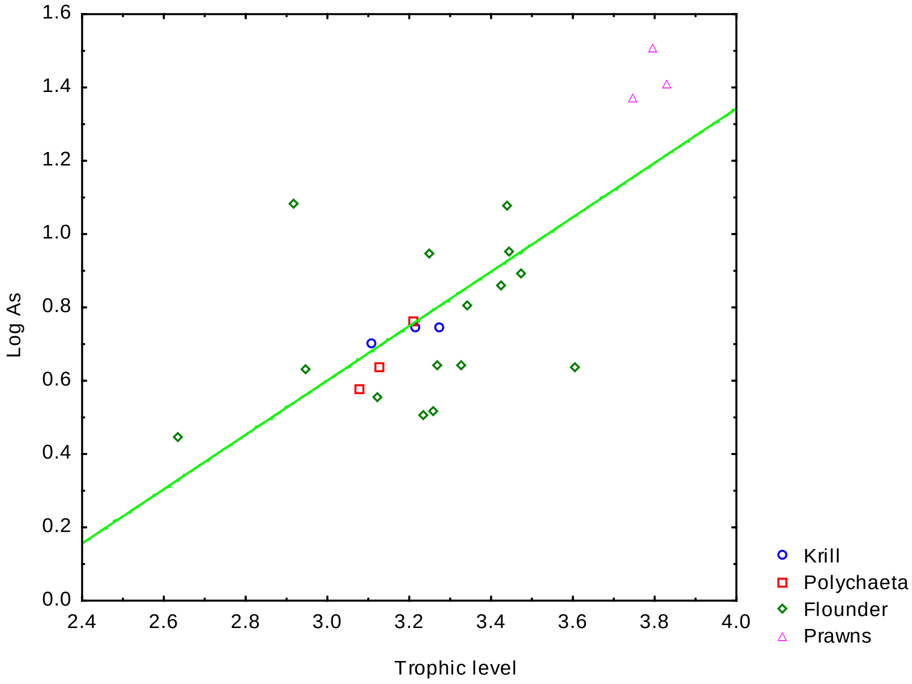


Figure 43. Trophic level against concentrations (µg/g wet wt.; log-transformed) of mercury (A.) and arsenic (B.) in organisms of the Inner Oslofjord food web (herring gull excluded; R^2 = 0.28 and 0.50, respectively, p = 0.007 and 0.0001, respectively).

Cod from the Inner Oslofjord

Metals have also been analysed in cod liver annually since 1990, through the "Contaminants in coastal areas" (MILKYS) monitoring programme (Green et al. 2013). In 2012, metals were analysed in cod liver (Hg in cod muscle) from 14 stations (including the Inner Oslofjord). The median concentrations of the metals were in general somewhat higher than in flounder of the present study (no statistics performed).

3.13 Support Parameters

Miscellaneous support parameters were measured for the different matrixes/samples/organisms. Some of these were included in different statistical analyses referred to above. The measurements of these support parameters are presented in Tables 60-65. The lipid content of all biological samples is given in Appendix.

An overview of the stomach content of the flounder from the Inner Oslofjord is presented in Table 66. It is shown that worms (including polychaetes) are important food items. *Polyphysia crassa*, which is an important species in the polychaete samples analysed within this study (see chapter 2.1), is conformed in flounder stomachs.

Table 60.
Support parameters measured for sediments from Forgnerkilen, the mouth of Alna River, and Bekkelaget.

Area	Sample sub no.	TDM (%)	<63 µm (% dry wt.)	TOC (µg/mg dry wt.)
Frognerkilen	1	36.4	49	34.6
Frognerkilen	2	35.6	52	34.1
Frognerkilen	3	36.2	54	35
Alna	1	38.7	72	32.8
Alna	2	41	77	35
Alna	3	37.2	81	37.4
Bekkelaget	1	33.1	75	21.5
Bekkelaget	2	35.8	72	17.4
Bekkelaget	3	37.7	72	37.6

Table 61.
Support parameters measured for storm water samples (dissolved phase).

Sample sub no.	Sample area details	SDM (mg/L)	NPOC/DC (mg C/L)
1	Bryn Ring3/E6	25.3	7.4
2	Breivoll/Alnabru Teminal	26.5	5.6
3	Breivoll E6, Downstream Term.	173	28.4
4	Hasle, Snow disposal site	145	6.3

Table 62.
Support parameters measured for Herring gull eggs from the Inner Oslofjord.

Sample no.	$\delta^{13}C$	$\delta^{15}N$	W% C:N	Trophic level	Eggshell thickness (mm)
1	-26.16	9.49	6.04	2.92	0.47
2	-27.25	10.47	6.16	3.18	0.43
3	-26.47	10.82	6.62	3.27	0.38
4	-23.35	14.79	6.89	4.32	0.43
5	-27.01	8.77	6.53	2.73	0.45
6	-25.63	10.79	6.55	3.27	0.44
7	-26.06	10.47	7.49	3.18	0.41
8	-26.79	8.71	5.20	2.72	0.45
9	-25.46	11.26	6.22	3.39	0.47
10	-26.72	9.71	5.82	2.98	0.46
11	-26.75	9.37	5.93	2.89	0.41
12	-24.89	10.89	5.85	3.29	0.50
13	-23.49	14.57	6.28	4.26	0.46
14	-26.85	8.92	7.05	2.77	0.42
15	-27.37	7.91	5.56	2.14	0.42

Table 63.
Support parameters measured for Herring gull blood from the Inner Oslofjord.

Sample no.	$\delta^{13}C$	$\delta^{15}N$	W% C:N	Trophic level	Wing (mm)	Head (mm)	Bill (mm)	Billh (mm)	Weight (g)
1	-24.69	8.09	3.21	2.55	436	131.8	56	18.1	1150
2	-23.38	9.80	3.37	3.00	427	125.8	55.4	19	1010
3	-24.48	8.78	3.20	2.74	442	118.9	51.2	18.6	920
4	-23.92	8.98	3.14	2.79	441	129.1	58.7	20.5	1080
5	-25.12	8.26	3.41	2.60	439	128.7	58.6	18.6	980
6	-24.42	8.74	3.20	2.73	412	118.2	52	17.2	900
7	-24.61	8.75	3.10	2.73	447	126.4	56.8	18.7	1020
8	-23.69	8.85	3.04	2.75	409	118.8	52.7	17.2	1020
9	-24.66	9.16	3.29	2.84	418	117.5	52.2	17.2	800
10	-24.44	8.11	2.97	2.56	443	127.6			1020
11	-23.98	9.49	3.27	2.92	420	116.2	50.5	18.4	860
12	-24.14	8.59	3.10	2.69	413	113.2	51.8	18.9	890
13	-23.96	9.45	3.05	2.91	432	130.6	58.4	18.9	1010
14	-23.62	9.04	3.09	2.80	416	119.7	52.6	18.4	870
15	-21.86	10.57	3.14	3.21	408	111.5	51.7	17.9	840

Table 64.
Support parameters measured for Flounder from the Inner Oslofjord.

Sample no.	$\delta^{13}C$	$\delta^{15}N$	W% C:N	Trophic level	Age (yr)	Length (cm)	Weight (g)	Sex
1	-17.70	12.84	2.70	3.44	9	43.5	821	F
2	-19.19	10.88	2.73	2.92	8	41.5	838	F
3	-15.79	12.16	2.69	3.26	6	39	763	F
4	-16.58	12.43	2.63	3.33	6	39	639	F
5	-17.38	12.47	2.75	3.34	6	38	718	F
6	-17.71	13.48	2.98	3.60	5	37	630	F
7	-18.20	12.87	2.67	3.44	5	37	646	F
8	-16.62	12.07	2.73	3.23	4	34.5	514	F
9	-17.53	12.80	2.72	3.43	5	38	655	F
10	-20.16	12.98	2.68	3.47	5	35.5	536	F
11	-17.58	10.97	2.75	2.94	4	35	520	F
12	-17.98	12.14	2.83	3.25	6	36	566	F
13	-16.47	12.21	2.68	3.27	4	35	543	F
14	-18.29	9.80	2.72	2.64	3	34	463	F
15	-16.16	11.66	2.86	3.12	4	33.5	441	M

Table 65.
Support parameters measured for Krill, polychaeta, prawns and blue mussel.

Species	Area	Sample sub no.	$\delta^{13}C$	$\delta^{15}N$	W% C:N	Trophic level
Krill	Oslofjord	1	-24.12	11.59	4.65	3.11
Krill	Oslofjord	2	-22.09	12.00	3.73	3.21
Krill	Oslofjord	3	-21.56	12.23	3.48	3.27
Polychaeta	Frognerkilen		-20.28	11.55	3.68	3.10
Polychaeta	Alna		-21.41	9.08	3.49	2.45
Polychaeta	Bekkelaget		-20.50	11.04	3.41	2.96
Polychaeta	Oslofjord	1	-19.00	11.47	3.39	3.08
Polychaeta	Oslofjord	2	-19.04	11.67	3.40	3.13
Polychaeta	Oslofjord	3	-19.18	11.98	3.40	3.21
Prawns	Oslofjord	1	-17.88	14.03	2.81	3.75
Prawns	Oslofjord	2	-17.84	14.33	2.79	3.83
Prawns	Oslofjord	3	-17.83	14.21	2.76	3.80
Blue mussel	Frognerkilen		-20.62	7.49	4.34	2.03
Blue mussel	Alna		-21.36	7.16	4.34	1.94
Blue mussel	Bekkelaget		-20.59	7.50	4.07	2.03

Table 66.
Overview of stomach content in Flounder from the inner Oslofjord.

			Stomach content:				
Fish no.	**Degree of fullness (%)**	**Degree of digestion (%)**	**Polychaeta**	**Bivalvia**	**Nematoda**	**Priapulidae**	**Undetermined pulp/lumps**
1	60	60	2 (*Polyphysia crassa*)				pulp
2	0						
3	20	90	1		6		pulp
4	10	10		1			
5	80	70	5				pulp
6	40	30		1		2 (*Priapulus caudatus*)	
7	30	60		1			some pulp
8	100	50	10 (*Polyphysia crassa*)				
9	0				6		
10	10	90			12		pulp
11	70	10				1 (*Priapulus caudatus*)	
12	20	80	2		1		some pulp
13	30	60	2		6		some pulp
14	10	100					some pulp
15	80	70				2	

3.14 Eggshell thickness

Separate linear regressions were run between contaminant concentration and eggshell thickness for all compounds analysed in eggs of Herring gull from the Inner Oslofjord (there were too many variables relative to the number of samples for more complex regression models). It should be noted that co-variation among several chemical parameters is expected.

Significant negative relationships were found between the concentration of bisphenol A (BPA) and eggshell thickness, and between β-HCH and eggshell thickness (Figure 44). The reason for this is unknown. It is known that DDT-compounds induce a decrease in eggshell calcium (Bitman et al. 1969), thus affecting reproductive success in certain predatory birds (Ratcliffe, 1967), However, to our knowledge this is not shown for HCH, which is also an organochlorine compound. A negative relationship between concentrations of DDT compounds and thickness of herring gull eggs has been shown in times when concentrations were higher (Hickey and Anderson, 1968), however apparently it has been difficult to relate this to decreased reproductive success (Hickey and Anderson, 1968; Weseloh et al. 1994).

BPA is known for its oestrogen-like effects (Chapin et al. 2008). However, it is difficult to relate oestrogenic effects to the decrease of avian eggshell thickness. On the other hand, it is shown that post-hatch oral oestrogen exposure reduces oviduct and egg mass in adult zebra finches (*Taeniopygia guttata*; Rochester et al. 2008). Additionally, oestrogens are potential regulators of genes associated with calcium regulation, and there is some evidence of effects of BPA on the expression of calcium transport genes in mammals (Kim et al. 2013). Anyhow, it is not possible to determine any causal relationships between the concentrations observed here in herring gull eggs and the eggshell thickness, and future studies will be valuable for indicating if this correlation was a “random” observation, or if such a relationship may be expected.

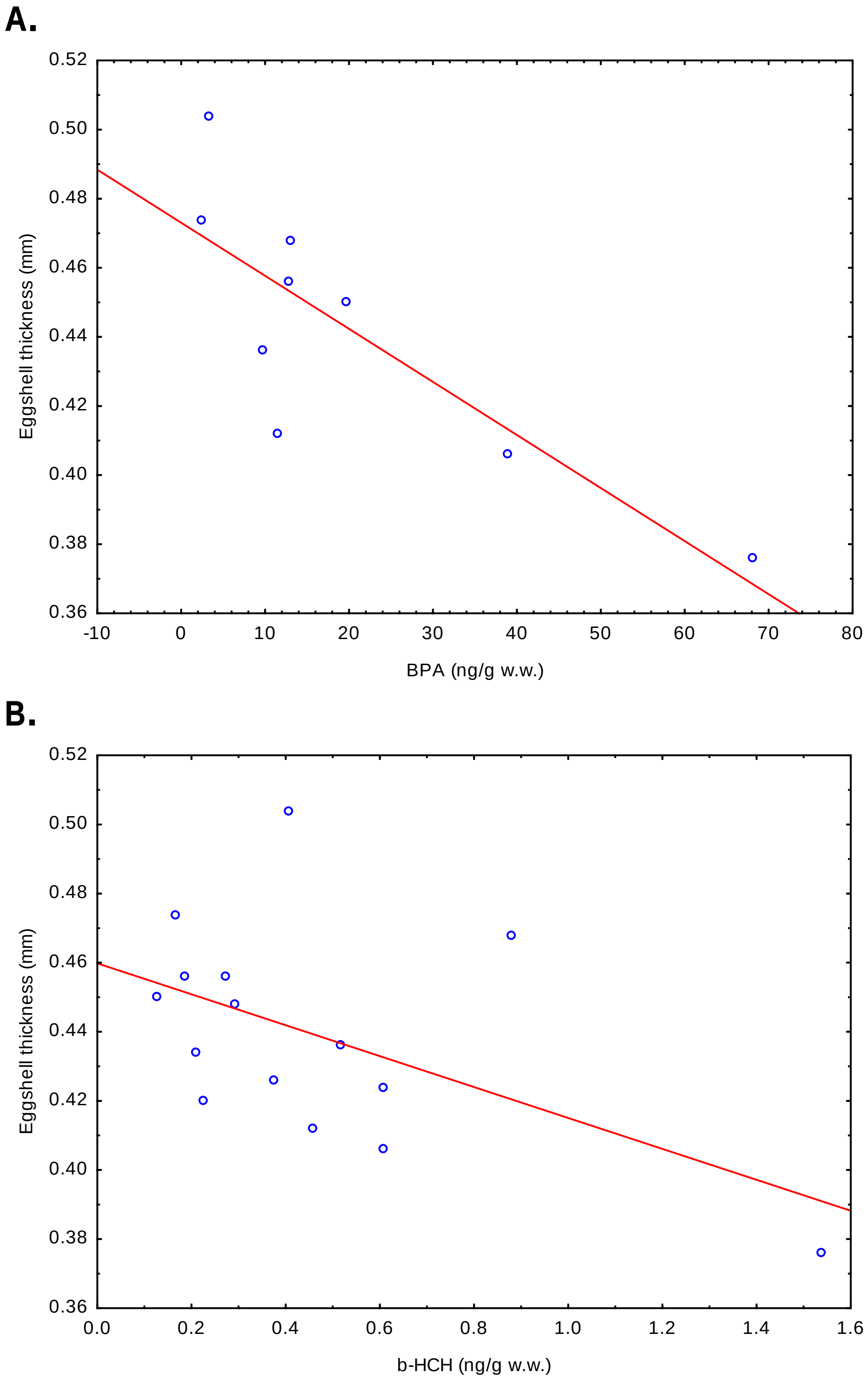


Figure 44. Concentration (ng/g wet wt.) of bisphenol A (BPA; A.) and β-HCH (B.) against eggshell thickness (mm) of herring gull eggs from the Inner Oslofjord (R^2 = 0.67 and 0.27, respectively, p = 0.007 and 0.047, respectively).

3.15 Concluding remarks and recommendations for future screening and monitoring

"Environmental contaminants in an urban fjord" is a programme designed to monitor the discharges of chemicals present in a densely populated area and to study how this affects a fjord system. The programme has included sampling and analysis of organisms in a marine food web of the Inner Oslofjord in addition to samples of sediment, blue mussel and polychaetes at selected locations in the fjord. A large number of chemical parameters have been quantified (see chapter 2.2), and the report serves as valuable documentation of the concentrations of these chemicals in different compartments of the Inner Oslofjord marine ecosystem. Furthermore, this report presents relationships between the contaminant concentrations and various biological variables. Of these relationships, two are worth mentioning here:

1. A significant negative relationship was found between the concentration of bisphenol A (BPA) and eggshell thickness of herring gull eggs. (see chapter 3.14). BPA is known for its oestrogen-like effects (Chapin et al. 2008) and oestrogens are potential regulators of genes associated with calcium regulation. There is some evidence of effects of BPA on the expression of calcium transport genes in mammals (Kim et al. 2013). Nevertheless, it is not possible to determine any causal relationships between the BPA concentrations observed in herring gull eggs and the eggshell thickness, and future studies will be valuable for indicating if this correlation was a “random” observation, or if such a relationship may be expected.

2. For herring gull eggs, a significant positive relationship was observed between trophic level and the (log) concentration of the cyclic volatile methylsiloxane ‘D5’. There have previously been some divergences in reports of the bioaccumulative/ biomagnifying properties of siloxanes (Borgå et al. 2012 and references therein), and future studies will again be valuable to indicate if this correlation was a “random” observation, or if such a relationship may be expected. In addition, (as for all other compounds in this report), it will be valuable to study the disposition of D5 in the Inner Oslofjord food web, when the sampled species represent more accurate predator-prey relationships (see discussion regarding the sampled food web, below).

For comparison of the contamination levels of gulls in the present study, the following can be noted: It has previously been shown that the liver concentration of e.g. PCB-153 in herring gulls caught in the Outer Oslofjord (in 1998) ranged from 560 to 6603 ng/g lipid wt. (Ruus et al. 2002). This was approximately the same range as found in eggs and blood in the present study from the Inner Oslofjord (468 – 4201 ng/g lipid wt. and 199 – 10226 ng/g lipid wt., respectively). Furthermore, it has been shown that liver concentrations of PBDEs (sum of BDE-28, -47, -99, -100, -153, -154, -183 and -209) in the same herring gulls caught in the Outer Oslofjord (in 1998) ranged from 135 to 985 ng/g lipid wt. (Sørmo et al. 2011). This was also approximately the same range as found in eggs and blood in the present study from the Inner Oslofjord (44 – 309 ng/g lipid wt. and 104 – 1703 ng/g lipid wt., respectively).

Furthermore, Sørmo et al. (2011) concluded that high range in $\delta^{13}C$ indicated that gulls were subject to a diversity of carbon sources, likely reflecting their mixed feeding on terrestrial and marine organisms, or diversity of autochthonous and allochthonous (watershed) energy sources at the bases of their marine/estuarial food chains. Inverse relationships of BDE-99, BDE-183 and BDE-209 with $\delta^{15}N$ suggest that trophic relationships affect bioaccumulation of these compounds in the herring gulls, with greater bioaccumulation from lower trophic level prey species. This may be because these PBDE congeners are subjected to debromination in higher trophic levels prey species of the gulls (e.g. teleost fish).

It is known that the gulls of the present study display different feeding behavior and migration patterns, which obviously influence on the results. The Herring gulls are partial migrants, a strategy were some individuals stay in the breeding region in the whole annual cycle were other migrate (Bakken et al. 2003). The proportion of migrants in the sampled population is unknown, and only one bird was observed outside Norway the winter following the blood sampling. This individual was observed both in Denmark (august) and in Rotterdam, The Netherlands (January). On the other end of the migration scale there was one bird reported in Oslo in September and all months from January to May. However, color rings only give data for some periods, and in theory most of the herring Gulls may be migrants. The feeding ecology in this region are poorly known, however, it is observed that food search in the sea is common. One of the sampled birds had eaten a starfish. However, the herring gulls are highly generalistic, and many of the birds in this study are observed regularly in urban areas in central parts of Oslo. This may indicate scavenging on man-made waste. Also, in periods of wet weather searching for earthworm in fields and lawns is known.

The generalistic feeding behavior of herring gulls was also reflected in the isotopic signatures. Herring gull displayed low $\delta^{15}N$ (and thus inhabit a low trophic position) and $\delta^{13}C$ compared the other species, indicating important food items not related to the selected food web. Herring gull was therefore omitted from the food web in terms of evaluations of biomagnification in the food web (except in specific comparative exercises). However, since the individual herring gulls (or eggs) display a range of $\delta^{15}N$ values (implicating different feeding behavior placing individuals in different trophic positions) the bioaccumulative properties of the contaminants in question was evaluated by analyzing relationships between trophic level and contaminant concentrations in herring gull (in isolation), as well as relationships between contaminant concentrations and other biometrics. This approach unveiled very interesting results/relationships, which deserve further scrutiny (see above).

Hence, the results of the stable isotopes also suggested that the species collected in the present study do not constitute a representative food web (species analyzed may not represent important predator-prey relationships). Furthermore, cod have been monitored through the "Contaminants in coastal areas" (MILKYS) monitoring programme (Green et al. 2013), and isotopic signatures suggests the Oslofjord cod as a favourable species to include in the sampled food web in similar future evaluations of the biomagnifying properties of ("emerging") contaminants in the inner Oslofjord, where for instance PCBs can serve as "benchmark" in the evaluations of biomagnifying properties (see chapter 3.2).

Krill also displayed a higher isotopic N-signature (and thus trophic level) than anticipated (and compared with e.g. blue mussel and polychaetes; see chapter 3.1). It might be worthwhile exploring other representatives of the zoo plankton community in future programmes. However, it is very laborious to sort smaller planktonic crustaceans to species, and simultaneously provide enough material for all chemical parameters. One possibility is to e.g. sort to subclass Copepoda. If this also is proven difficult, one can e.g. sort to subphylum crustaceans with body size less than a defined mesh size of the plankton net.

If the resources are available, it could be beneficial to include a more comprehensive storm water/surface water campaign in future programmes, where one can utilize passive samplers (for compounds where it is possible), for more time integrated measurements. Furthermore, it would be beneficial to attempt to acquire good flow estimates at the storm water sampling sites for the purpose of calculating total yearly contribution from this source of inputs to the fjord.

4. References

Allan IJ, Harman C, Ranneklev SB, Thomas KV, Grung M. Passive sampling for target and nontarget analyses of moderately polar and nonpolar substances in water. Environmental Toxicology and Chemistry 2013; 32: 1718-1726.

Amlund H. The disposition of arsenobetaine in Atlantic salmon, Salmo salar L., and Atlantic cod, Gadus morhua L. Doctor Scientiarum thesis, University of Bergen. 2005.

Andersen S, Gudbrandsen M, Haugstad K, Hartnik T. Some environmentally harmful substances in sewage sludge – occurrence and environmental risk, Report TA-3005/2012 from the Norwegian Climate and Pollution Agency, 37 pp. 2012.

Bakke T, Breedveld G, Källqvist T, Oen A, Eek E, Ruus A, et al. Guidelines on classification of environmental quality in fjords and coastal waters – a revision of the classification of waters and sediments with respect to metals and organic contaminants, Report TA-2229/2007 from the Norwegian Pollution Control Authority, 12 pp. 2007.

Bakke T, Kallqvist T, Ruus A, Breedveld GD, Hylland K. Development of sediment quality criteria in Norway. Journal of Soils and Sediments 2010; 10: 172-178.

Bakken V, Runde O, Tjørve E. Norsk Ringmerkingsatlas. Volum 1. Stavanger. 2003.

Berge J, Amundsen R, Fredriksen L, Bjerkeng B, Gitmark J, Holt T, et al. Overvåking av Indre Oslofjord i 2012 - Vedlaggsrapport, NIVA-rapport nr. 6534. 142 s. 2013.

Berge JA, Ranneklev S, Selvik JR, Steen AO. Indre Oslofjord – Sammenstilling av data om miljøgifttilførsler og forekomst av miljøgifter i sedimenter, NIVA-rapport nr. 6565. 122 s. 2013.

BEVAS. Årsrapport Bekkelaget RA 2012. 2013.

Bitman J, Cecil HC, Harris SJ, Fries GF. DDT INDUCES A DECREASE IN EGGSHELL CALCIUM. Nature 1969; 224: 44-&.

Borga K, Fjeld E, Kierkegaard A, McLachlan MS. Food Web Accumulation of Cyclic Siloxanes in Lake Mjosa, Norway. Environmental Science & Technology 2012; 46: 6347-6354.

Chapin RE, Adams J, Boekelheide K, Gray LE, Jr., Hayward SW, Lees PSJ, et al. NTP-CERHR expert panel report on the reproductive and developmental toxicity of bisphenol A. Birth Defects Research Part B-Developmental and Reproductive Toxicology 2008; 83: 157-395.

Green N, Schøyen M, Øxnevad S, Ruus A, Allan I, Høgåsen T, et al. Contaminants in coastal waters of Norway 2012. Norwegian State Pollution Monitoring Programme Report no. 1154/2013. M-69/2013. 130 pp. 2013.

Hallanger IG, Warner NA, Ruus A, Evenset A, Christensen G, Herzke D, et al. SEASONALITY IN CONTAMINANT ACCUMULATION IN ARCTIC MARINE PELAGIC FOOD WEBS USING TROPHIC MAGNIFICATION FACTOR AS A MEASURE OF BIOACCUMULATION. Environmental Toxicology and Chemistry 2011; 30: 1026-1035.

Haukås M. Fate and dynamics of hexabromocyclododecane (HBCD) in marine ecosystems. Dissertation for the degree of Doctor of Philosophy, University of Oslo. 2009.

Helland A, Aberg G, Skei J. Source dependent behaviour of lead and organic matter in the Glomma estuary, SE Norway: evidence from isotope ratios. Marine Chemistry 2002; 78: 149-169.

Hickey JJ, Anderson DW. CHLORINATED HYDROCARBONS AND EGGSHELL CHANGES IN RAPTORIAL AND FISH-EATING BIRDS. Science 1968; 162: 271-&.

Hobson KA, Welch HE. DETERMINATION OF TROPHIC RELATIONSHIPS WITHIN A HIGH ARCTIC MARINE FOOD WEB USING DELTA-C-13 AND DELTA-N-15 ANALYSIS. Marine Ecology Progress Series 1992; 84: 9-18.

Jaeger I, Hop H, Gabrielsen GW. Biomagnification of mercury in selected species from an Arctic marine food web in Svalbard. Science of the Total Environment 2009; 407: 4744-4751.

Kim S, An B-S, Yang H, Jeung E-B. Effects of octylphenol and bisphenol A on the expression of calcium transport genes in the mouse duodenum and kidney during pregnancy. Toxicology 2013; 303: 99-106.

Krogseth IS, Kierkegaard A, McLachlan MS, Breivik K, Hansen KM, Schlabach M. Occurrence and Seasonality of Cyclic Volatile Methyl Siloxanes in Arctic Air. Environmental Science & Technology 2013; 47: 502-509.

Krumbein WC, Pettijohn FC. Manual of sedimentary petrography. Appelton-Century-Crofts, New York, 1938.

Langford K, Beylich B, Bæk K, Fjeld E, Kringstad A, Høgfeldt A, et al. Screening of selected alkylphenolic compounds, biocides, rat poisons and current use pesticides. Klif-report ISBN: 978-82-577-6078-6. 2012.

Layman CA, Araujo MS, Boucek R, Hammerschlag-Peyer CM, Harrison E, Jud ZR, et al. Applying stable isotopes to examine food-web structure: an overview of analytical tools. Biological Reviews 2012; 87: 545-562.

McGoldrick DJ, Durham J, Leknes H, Kierkegaard A, Gerhards R, Powell DE, et al. Assessing inter-laboratory comparability and limits of determination for the analysis of cyclic volatile methyl siloxanes in whole Rainbow Trout (Oncorhynchus mykiss). Chemosphere 2011; 85: 1241-1247.

Mizutani H, Kabaya Y, Wada E. NITROGEN AND CARBON ISOTOPE COMPOSITIONS RELATE LINEARLY IN CORMORANT TISSUES AND ITS DIET. Isotopenpraxis 1991; 27: 166-168.

Molvær J, Knutzen J, Magnusson J, Rygg B, Skei J, Sørensen J. Classification of environmental quality in fjords and coastal waters. A guide. Report TA-1467/1997 from the Norwegian Pollution Control Authority (SFT). 36 pp. . 1997.

Mueller CE, De Silva AO, Small J, Williamson M, Wang X, Morris A, et al. Biomagnification of Perfluorinated Compounds in a Remote Terrestrial Food Chain: Lichen-Caribou-Wolf. Environmental Science & Technology 2011; 45: 8665-8673.

Nygard T. PESTICIDE-RESIDUES AND SHELL THINNING IN EGGS OF PEREGRINES IN NORWAY. Ornis Scandinavica 1983; 14: 161-166.

Post DM. Using stable isotopes to estimate trophic position: Models, methods, and assumptions. Ecology 2002; 83: 703-718.

Ratcliff.Da. DECREASE IN EGGSHELL WEIGHT IN CERTAIN BIRDS OF PREY. Nature 1967; 215: 208-&.

Rochester JR, Heiblum R, Rozenboim I, Millam JR. Post-hatch oral estrogen exposure reduces oviduct and egg mass and alters nest-building behavior in adult zebra finches (Taeniopygia guttata). Physiology & Behavior 2008; 95: 370-380.

Ruus A, Ugland KI, Espeland O, Skaare JU. Organochlorine contaminants in a local marine food chain from Jarfjord, Northern Norway. Marine Environmental Research 1999; 48: 131-146.

Ruus A, Ugland KI, Skaare JU. Influence of trophic position on organochlorine concentrations and compositional patterns in a marine food web. Environmental Toxicology and Chemistry 2002; 21: 2356-2364.

Sormo EG, Lie E, Ruus A, Gaustad H, Skaare JU, Jenssen BM. Trophic level determines levels of brominated flame-retardants in coastal herring gulls. Ecotoxicology and Environmental Safety 2011; 74: 2091-2098.

Sparham C, Van Egmond R, O'Connor S, Hastie C, Whelan M, Kanda R, et al. Determination of decamethylcyclopentasiloxane in river water and final effluent by headspace gas chromatography/mass spectrometry. Journal of Chromatography A 2008; 1212: 124-129.

Thomas KV, McHugh M, Waldock M. Antifouling paint booster biocides in UK coastal waters: inputs, occurrence and environmental fate. Science of the Total Environment 2002; 293: 117-127.

Villeneuve DL, Kannan K, Priest BT, Giesy JP. In vitro assessment of potential mechanism-specific effects of polybrominated diphenyl ethers. Environmental Toxicology and Chemistry 2002; 21: 2431-2433.

Wan Y, Zhang K, Dong Z, Hu J. Distribution is a Major Factor Affecting Bioaccumulation of Decabrominated Diphenyl Ether: Chinese Sturgeon (Acipenser sinensis) as an Example. Environmental Science & Technology 2013; 47: 2279-2286.

Warner NA, Evenset A, Christensen G, Gabrielsen GW, Borga K, Leknes H. Volatile Siloxanes in the European Arctic: Assessment of Sources and Spatial Distribution. Environmental Science & Technology 2010; 44: 7705-7710.

Warner NA, Kozerski G, Durham J, Koerner M, Gerhards R, Campbell R, et al. Positive vs. false detection: A comparison of analytical methods and performance for analysis of cyclic volatile methylsiloxanes (cVMS) in environmental samples from remote regions. Chemosphere 2013; 93: 749-756.

Weseloh DVC, Ewins PJ, Struger J, Mineau P, Norstrom RJ. GEOGRAPHICAL-DISTRIBUTION OF ORGANOCHLORINE CONTAMINANTS AND REPRODUCTIVE PARAMETERS IN HERRING-GULLS ON LAKE-SUPERIOR IN 1983. Environmental Monitoring and Assessment 1994; 29: 229-251.

Appendix

NILU-no.	NIVA-no.	Compartment	Compartment spec.	Area	Species	Tissue
13/1870	13-2116-1	Organism	Plankton	Oslofjord	Krill	Pooled wb
13/1871	13-2116-2	Organism	Plankton	Oslofjord	Krill	Pooled wb
13/1872	13-2116-3	Organism	Plankton	Oslofjord	Krill	Pooled wb
13/1909	2118-1	Organism	Bird egg	Oslofjord	Herring gull	Egg
13/1910	2118-2	Organism	Bird egg	Oslofjord	Herring gull	Egg
13/1911	2118-3	Organism	Bird egg	Oslofjord	Herring gull	Egg
13/1912	2118-4	Organism	Bird egg	Oslofjord	Herring gull	Egg
13/1913	2118-5	Organism	Bird egg	Oslofjord	Herring gull	Egg
13/1914	2118-6	Organism	Bird egg	Oslofjord	Herring gull	Egg
13/1915	2118-7	Organism	Bird egg	Oslofjord	Herring gull	Egg
13/1916	2118-8	Organism	Bird egg	Oslofjord	Herring gull	Egg
13/1917	2118-9	Organism	Bird egg	Oslofjord	Herring gull	Egg
13/1918	2118-10	Organism	Bird egg	Oslofjord	Herring gull	Egg
13/1919	2118-11	Organism	Bird egg	Oslofjord	Herring gull	Egg
13/1920	2118-12	Organism	Bird egg	Oslofjord	Herring gull	Egg
13/1921	2118-13	Organism	Bird egg	Oslofjord	Herring gull	Egg
13/1922	2118-14	Organism	Bird egg	Oslofjord	Herring gull	Egg
13/1923	2118-15	Organism	Bird egg	Oslofjord	Herring gull	Egg
13/1876	13-2176-4	Organism	Polychaets	Oslofjord	Polychaeta	Pooled wb
13/1877	13-2176-5	Organism	Polychaets	Oslofjord	Polychaeta	Pooled wb
13/1878	13-2176-6	Organism	Polychaets	Oslofjord	Polychaeta	Pooled wb
13/1879	13-2467-1	Organism	Fish	Oslofjord	Flounder	Liver
13/1880	13-2467-2	Organism	Fish	Oslofjord	Flounder	Liver
13/1881	13-2467-3	Organism	Fish	Oslofjord	Flounder	Liver
13/1882	13-2467-4	Organism	Fish	Oslofjord	Flounder	Liver
13/1883	13-2467-5	Organism	Fish	Oslofjord	Flounder	Liver
13/1884	13-2467-6	Organism	Fish	Oslofjord	Flounder	Liver
13/1885	13-2467-7	Organism	Fish	Oslofjord	Flounder	Liver
13/1886	13-2467-8	Organism	Fish	Oslofjord	Flounder	Liver
13/1887	13-2467-9	Organism	Fish	Oslofjord	Flounder	Liver
13/1888	13-2467-10	Organism	Fish	Oslofjord	Flounder	Liver
13/1889	13-2467-11	Organism	Fish	Oslofjord	Flounder	Liver
13/1890	13-2467-12	Organism	Fish	Oslofjord	Flounder	Liver
13/1891	13-2467-13	Organism	Fish	Oslofjord	Flounder	Liver
13/1892	13-2467-14	Organism	Fish	Oslofjord	Flounder	Liver
13/1893	13-2467-15	Organism	Fish	Oslofjord	Flounder	Liver
13/1873	13-2468-1	Organism	Prawns	Oslofjord	Prawns	Pooled tail soft tissue
13/1874	13-2468-2	Organism	Prawns	Oslofjord	Prawns	Pooled tail soft tissue
13/1875	13-2468-3	Organism	Prawns	Oslofjord	Prawns	Pooled tail soft tissue
13/1946	13-2176-1	Organism	Polychaets	Frognerkilen	Frognerkilen	Pooled wb
13/1936	13-2176-2	Organism	Polychaets	Alna	Alna	Pooled wb
13/1941	13-2176-3	Organism	Polychaets	Bekkelaget	Bekkelaget	Pooled wb
13/1932	2469-1	Organism	Mussel	Frognerkilen	Frognerkilen	Pooled soft tissue
13/1937	2469-2	Organism	Mussel	Alna	Alna	Pooled soft tissue
13/3061	2469-3	Organism	Mussel	Bekkelaget	Bekkelaget	Pooled soft tissue

Compartment spec.	Area	Lipid%	PeCB	HCB	PCB-18	PCB-28	PCB-31
		1.5	ng/g (w.w.)	ng/g (w.w.)	ng/g (w.w.)	ng/g (w.w.)	ng/g (w.w.)
Plankton	Oslofjord	1.41	0.01	0.18	0.04	0.14	0.13
Plankton	Oslofjord	1.45	0.01	0.17	0.04	0.13	0.13
Plankton	Oslofjord	7.64	0.02	0.18	0.04	0.14	0.13
Bird egg	Oslofjord	8.51	0.07	0.84	<0.01	0.40	0.02
Bird egg	Oslofjord	8.71	0.10	3.32	<0.01	1.90	<0.01
Bird egg	Oslofjord	8.93	0.22	1.41	<0.01	0.66	0.02
Bird egg	Oslofjord	8.63	0.28	4.86	0.05	2.67	0.20
Bird egg	Oslofjord	9.88	0.21	5.02	<0.01	0.67	0.01
Bird egg	Oslofjord	10.36	0.22	1.23	<0.01	2.83	0.04
Bird egg	Oslofjord	6.4	0.35	7.54	<0.01	1.36	0.01
Bird egg	Oslofjord	7.77	0.07	1.38	<0.01	0.35	<0.01
Bird egg	Oslofjord	7.6	1.08	17.4	<0.01	3.36	0.01
Bird egg	Oslofjord	8.26	0.23	4.95	<0.01	0.49	0.02
Bird egg	Oslofjord	7.8	0.36	8.50	<0.01	1.85	<0.01
Bird egg	Oslofjord	9.25	0.23	2.74	0.02	3.71	0.15
Bird egg	Oslofjord	10.2	0.13	2.40	0.09	1.11	0.14
Bird egg	Oslofjord	9.23	0.09	1.33	<0.01	0.98	0.02
Bird egg	Oslofjord	0.67	0.30	5.04	<0.01	0.58	<0.01
Polychaets	Oslofjord	0.79	0.01	0.10	0.02	0.11	0.05
Polychaets	Oslofjord	0.87	0.01	0.08	0.02	0.11	0.04
Polychaets	Oslofjord	5.71	0.01	0.09	0.02	0.13	0.04
Fish	Oslofjord	11.8	0.16	1.47	0.61	8.83	2.17
Fish	Oslofjord	21.36	0.59	5.52	0.48	6.98	2.80
Fish	Oslofjord	10	0.67	5.92	0.93	16.7	5.02
Fish	Oslofjord	18.75	0.34	3.76	0.30	4.74	1.06
Fish	Oslofjord	7.12	0.38	4.13	0.61	15.2	3.31
Fish	Oslofjord	21.2	0.21	2.74	0.69	6.83	2.48
Fish	Oslofjord	18.6	0.57	5.86	0.77	19.6	4.22
Fish	Oslofjord	17.2	0.64	5.42	1.73	17.1	6.27
Fish	Oslofjord	2.52	0.67	6.18	1.96	21.9	8.48
Fish	Oslofjord	10.2	0.18	1.41	0.58	6.13	2.35
Fish	Oslofjord	17.3	0.36	3.73	1.06	8.85	4.29
Fish	Oslofjord	14.88	0.57	4.63	1.77	14.8	6.08
Fish	Oslofjord	14.92	0.42	3.62	0.89	15.2	3.38
Fish	Oslofjord	4.62	2.01	13.1	3.86	27.4	17.7
Fish	Oslofjord	0.59	0.30	2.31	0.69	6.88	3.50
Prawns	Oslofjord	0.59	<0.01	0.03	<0.01	0.02	0.01
Prawns	Oslofjord	0.64	<0.01	0.03	<0.01	0.02	<0.01
Prawns	Oslofjord		<0.01	0.04	<0.01	0.02	0.01
Polychaets	Frognerkilen	1.31	0.04	0.21	0.40	1.12	0.92
Polychaets	Alna	0.9	0.04	0.25	0.09	0.29	0.22
Polychaets	Bekkelaget	0.5	<0.01	0.08	0.02	0.07	0.05
Mussel	Frognerkilen	1.22	0.01	0.05	0.08	0.26	0.16
Mussel	Alna	1.27	0.01	0.05	0.08	0.27	0.17
Mussel	Bekkelaget	1.24	<0.01	0.03	0.07	0.22	0.14

Compartment spec.	Area	PCB-33 ng/g (w.w.)	PCB-37 ng/g (w.w.)	PCB-47 ng/g (w.w.)	PCB-52 ng/g (w.w.)	PCB-66 ng/g (w.w.)	PCB-74 ng/g (w.w.)
Plankton	Oslofjord	0.03	0.02	0.40	0.70	0.64	0.33
Plankton	Oslofjord	0.03	0.02	0.39	0.68	0.63	0.32
Plankton	Oslofjord	0.03	0.02	0.40	0.69	0.64	0.33
Bird egg	Oslofjord	<0.01	<0.01	1.64	0.13	4.06	1.70
Bird egg	Oslofjord	<0.01	<0.01	13.7	1.81	27.4	13.8
Bird egg	Oslofjord	<0.01	<0.01	2.23	0.90	4.69	2.25
Bird egg	Oslofjord	<0.01	<0.01	12.3	14.4	25.9	14.1
Bird egg	Oslofjord	<0.01	<0.01	2.17	1.41	3.65	2.08
Bird egg	Oslofjord	<0.01	<0.01	12.1	2.97	27.3	12.3
Bird egg	Oslofjord	<0.01	<0.01	4.19	0.47	7.37	4.29
Bird egg	Oslofjord	<0.01	<0.01	1.61	0.50	2.62	1.14
Bird egg	Oslofjord	<0.01	<0.01	4.32	1.31	8.90	5.13
Bird egg	Oslofjord	<0.01	<0.01	1.17	0.43	1.57	0.88
Bird egg	Oslofjord	<0.01	<0.01	6.86	0.23	9.52	4.18
Bird egg	Oslofjord	<0.01	<0.01	21.1	9.21	37.5	20.4
Bird egg	Oslofjord	0.02	<0.01	5.27	2.31	11.4	4.84
Bird egg	Oslofjord	<0.01	<0.01	5.65	0.42	10.7	4.49
Bird egg	Oslofjord	<0.01	<0.01	3.18	1.03	3.68	2.23
Polychaets	Oslofjord	0.02	0.01	0.30	0.45	0.35	0.18
Polychaets	Oslofjord	0.02	0.01	0.28	0.37	0.35	0.16
Polychaets	Oslofjord	0.01	0.01	0.32	0.43	0.43	0.19
Fish	Oslofjord	0.27	0.10	14.0	9.85	42.9	23.5
Fish	Oslofjord	0.25	0.16	12.2	18.1	29.9	16.9
Fish	Oslofjord	0.50	0.27	26.6	23.4	70.1	40.1
Fish	Oslofjord	0.17	0.07	7.76	6.71	21.9	11.5
Fish	Oslofjord	0.32	0.23	21.1	17.5	80.9	44.0
Fish	Oslofjord	0.38	0.15	14.4	18.1	26.3	12.2
Fish	Oslofjord	0.33	0.25	27.3	20.4	99.6	54.1
Fish	Oslofjord	1.31	0.29	26.9	33.5	74.2	37.6
Fish	Oslofjord	1.68	0.40	32.0	37.7	96.6	51.2
Fish	Oslofjord	0.42	0.13	10.7	13.2	29.4	15.2
Fish	Oslofjord	0.84	0.34	14.4	22.8	34.1	17.2
Fish	Oslofjord	1.19	0.37	25.0	33.7	60.6	30.7
Fish	Oslofjord	0.50	0.25	21.5	16.4	69.8	39.7
Fish	Oslofjord	1.33	0.77	34.7	59.3	85.0	44.0
Fish	Oslofjord	0.59	0.15	14.2	17.2	29.9	15.6
Prawns	Oslofjord	<0.01	<0.01	0.05	0.06	0.14	0.08
Prawns	Oslofjord	<0.01	<0.01	0.04	0.05	0.07	0.04
Prawns	Oslofjord	<0.01	<0.01	0.05	0.06	0.09	0.05
Polychaets	Frognerkilen	0.30	0.12	2.40	4.23	4.88	2.35
Polychaets	Alna	0.08	0.05	0.44	1.10	1.05	0.53
Polychaets	Bekkelaget	0.01	0.01	0.21	0.29	0.36	0.18
Mussel	Frognerkilen	0.07	0.04	0.48	0.94	1.03	0.45
Mussel	Alna	0.08	0.06	0.53	1.11	1.37	0.58
Mussel	Bekkelaget	0.06	0.04	0.52	0.93	1.18	0.49

Compartment spec.	Area	PCB-99 ng/g (w.w.)	PCB-101 ng/g (w.w.)	PCB-105 ng/g (w.w.)	PCB-114 ng/g (w.w.)	PCB-118 ng/g (w.w.)	PCB-122 ng/g (w.w.)
Plankton	Oslofjord	0.90	1.41	0.44	0.03	1.13	0.01
Plankton	Oslofjord	0.87	1.34	0.42	0.03	1.07	0.01
Plankton	Oslofjord	0.88	1.34	0.43	0.03	1.10	0.01
Bird egg	Oslofjord	7.88	0.21	3.63	0.38	12.2	<0.01
Bird egg	Oslofjord	58.0	1.33	25.3	1.95	74.7	2.25
Bird egg	Oslofjord	13.4	1.61	5.15	0.51	18.4	<0.01
Bird egg	Oslofjord	52.9	30.1	25.4	1.82	63.1	<0.01
Bird egg	Oslofjord	17.7	4.07	7.05	1.17	30.3	<0.01
Bird egg	Oslofjord	49.9	2.84	24.4	1.76	66.6	<0.01
Bird egg	Oslofjord	30.5	0.55	11.7	1.12	40.7	<0.01
Bird egg	Oslofjord	8.04	1.17	3.98	0.35	11.9	<0.01
Bird egg	Oslofjord	29.6	0.82	11.2	1.31	39.1	<0.01
Bird egg	Oslofjord	6.51	1.26	2.57	0.39	9.05	<0.01
Bird egg	Oslofjord	63.2	0.64	14.2	2.54	73.7	<0.01
Bird egg	Oslofjord	116	13.8	48.0	3.72	139	<0.01
Bird egg	Oslofjord	24.5	3.24	15.2	1.10	34.1	<0.01
Bird egg	Oslofjord	24.9	0.53	10.7	0.79	32.2	<0.01
Bird egg	Oslofjord	21.9	1.45	8.10	1.05	29.4	<0.01
Polychaets	Oslofjord	0.98	1.11	0.38	0.02	1.10	0.01
Polychaets	Oslofjord	0.95	1.05	0.40	0.03	1.04	0.01
Polychaets	Oslofjord	1.08	1.10	0.46	0.03	1.17	0.01
Fish	Oslofjord	73.0	18.6	34.1	2.19	111	0.05
Fish	Oslofjord	47.1	39.1	24.0	1.58	79.6	0.18
Fish	Oslofjord	77.4	51.7	38.3	2.35	117	0.21
Fish	Oslofjord	32.0	17.2	19.4	1.11	57.1	0.05
Fish	Oslofjord	83.7	36.7	52.0	2.94	160	0.07
Fish	Oslofjord	34.5	36.2	17.8	0.75	46.7	0.19
Fish	Oslofjord	106	46.2	60.4	3.47	190	0.13
Fish	Oslofjord	72.4	62.9	43.7	2.82	129	0.23
Fish	Oslofjord	97.0	74.8	57.2	3.77	175	0.25
Fish	Oslofjord	33.2	24.1	18.9	1.10	56.2	0.08
Fish	Oslofjord	35.4	42.9	20.2	1.43	61.6	0.19
Fish	Oslofjord	58.2	57.4	35.1	2.37	102	0.30
Fish	Oslofjord	81.1	31.1	43.0	2.44	122	0.14
Fish	Oslofjord	60.6	60.2	38.2	2.89	85.3	0.35
Fish	Oslofjord	34.6	32.4	15.5	0.73	42.9	0.11
Prawns	Oslofjord	0.20	0.16	0.11	<0.01	0.33	<0.01
Prawns	Oslofjord	0.12	0.13	0.07	<0.01	0.19	<0.01
Prawns	Oslofjord	0.18	0.18	0.10	<0.01	0.28	<0.01
Polychaets	Frognerkilen	4.31	8.01	2.69	0.18	6.96	0.08
Polychaets	Alna	1.06	2.51	0.71	0.05	1.95	0.02
Polychaets	Bekkelaget	0.62	0.80	0.37	0.03	1.12	<0.01
Mussel	Frognerkilen	0.85	1.50	0.53	0.03	1.31	0.01
Mussel	Alna	1.00	1.89	0.75	0.05	1.68	0.02
Mussel	Bekkelaget	0.85	1.26	0.60	0.03	1.31	0.01

Compartment spec.	Area	PCB-123 ng/g (w.w.)	PCB-128 ng/g (w.w.)	PCB-138 ng/g (w.w.)	PCB-141 ng/g (w.w.)	PCB-149 ng/g (w.w.)	PCB-153 ng/g (w.w.)
Plankton	Oslofjord	0.03	0.27	1.38	0.13	1.58	1.96
Plankton	Oslofjord	0.03	0.27	1.30	0.13	1.58	1.90
Plankton	Oslofjord	0.03	0.26	1.32	0.13	1.50	1.92
Bird egg	Oslofjord	0.24	2.82	20.0	0.03	0.73	35.8
Bird egg	Oslofjord	1.29	14.4	105	0.12	3.79	161
Bird egg	Oslofjord	0.28	4.30	32.7	0.13	2.18	50.4
Bird egg	Oslofjord	0.88	12.6	87.5	4.30	22.4	122
Bird egg	Oslofjord	0.37	10.2	88.8	1.59	5.62	173
Bird egg	Oslofjord	1.19	15.0	100	0.26	9.48	140
Bird egg	Oslofjord	0.53	10.9	76.2	0.17	2.60	118
Bird egg	Oslofjord	0.20	2.89	19.8	0.15	1.10	30.5
Bird egg	Oslofjord	0.48	14.4	99.7	0.32	6.63	144
Bird egg	Oslofjord	0.11	3.22	23.6	0.38	2.39	44.6
Bird egg	Oslofjord	0.64	22.5	164	0.17	6.50	344
Bird egg	Oslofjord	2.16	28.8	210	2.97	24.6	328
Bird egg	Oslofjord	0.62	6.37	42.4	0.34	5.92	59.0
Bird egg	Oslofjord	0.64	6.86	48.2	0.15	3.62	67.9
Bird egg	Oslofjord	0.34	7.87	69.2	0.32	2.00	128
Polychaets	Oslofjord	0.03	0.38	1.99	0.12	1.37	2.82
Polychaets	Oslofjord	0.03	0.45	2.34	0.12	1.44	3.14
Polychaets	Oslofjord	0.03	0.51	2.53	0.13	1.50	3.38
Fish	Oslofjord	2.61	10.3	94.9	2.63	5.16	138
Fish	Oslofjord	1.74	9.53	75.8	6.02	10.4	106
Fish	Oslofjord	2.43	14.4	104	8.74	9.52	153
Fish	Oslofjord	1.28	8.52	54.2	2.95	3.86	72.0
Fish	Oslofjord	3.58	18.4	136	6.85	8.28	177
Fish	Oslofjord	1.08	9.24	50.7	1.85	14.9	66.6
Fish	Oslofjord	4.27	22.1	165	8.20	9.28	227
Fish	Oslofjord	2.74	19.9	117	10.6	17.3	154
Fish	Oslofjord	3.80	21.3	156	12.7	17.9	210
Fish	Oslofjord	1.19	8.75	56.5	3.91	6.66	73.3
Fish	Oslofjord	1.26	8.33	53.7	6.46	14.0	69.8
Fish	Oslofjord	2.12	14.7	89.0	9.08	13.8	118
Fish	Oslofjord	3.11	16.7	109	5.68	7.89	135
Fish	Oslofjord	2.34	10.1	60.8	7.05	20.5	81.5
Fish	Oslofjord	0.96	7.75	44.2	2.73	6.83	62.4
Prawns	Oslofjord	<0.01	0.06	0.34	0.02	0.10	0.54
Prawns	Oslofjord	<0.01	0.04	0.21	0.02	0.09	0.36
Prawns	Oslofjord	<0.01	0.06	0.29	0.02	0.13	0.53
Polychaets	Frognerkilen	0.15	1.50	8.01	1.10	6.82	10.8
Polychaets	Alna	0.04	0.41	2.20	0.50	1.94	2.94
Polychaets	Bekkelaget	0.02	0.31	1.64	0.21	1.17	2.17
Mussel	Frognerkilen	0.03	0.26	1.52	0.02	1.10	1.90
Mussel	Alna	0.04	0.33	1.62	0.03	1.32	1.99
Mussel	Bekkelaget	0.03	0.19	0.99	0.01	0.64	1.23

Compartment spec.	Area	PCB-156 ng/g (w.w.)	PCB-157 ng/g (w.w.)	PCB-167 ng/g (w.w.)	PCB-170 ng/g (w.w.)	PCB-180 ng/g (w.w.)	PCB-183 ng/g (w.w.)
Plankton	Oslofjord	0.08	0.02	0.06	0.09	0.44	0.16
Plankton	Oslofjord	0.07	0.02	0.06	0.08	0.42	0.14
Plankton	Oslofjord	0.08	0.02	0.06	0.09	0.43	0.14
Bird egg	Oslofjord	1.33	0.33	0.87	1.52	5.94	2.08
Bird egg	Oslofjord	5.93	1.50	3.57	7.97	29.8	8.97
Bird egg	Oslofjord	1.67	0.45	1.13	2.44	8.73	2.64
Bird egg	Oslofjord	4.64	1.31	2.68	7.84	32.4	8.86
Bird egg	Oslofjord	5.19	1.15	3.56	20.2	81.4	16.9
Bird egg	Oslofjord	5.21	1.38	3.52	4.60	18.6	8.38
Bird egg	Oslofjord	4.24	1.16	2.60	7.39	28.9	8.30
Bird egg	Oslofjord	1.30	0.31	0.74	1.83	9.42	3.59
Bird egg	Oslofjord	4.45	1.27	3.00	8.30	30.1	9.52
Bird egg	Oslofjord	1.38	0.32	0.97	4.18	17.4	4.12
Bird egg	Oslofjord	10.7	2.43	8.06	28.5	126	27.1
Bird egg	Oslofjord	13.6	3.34	7.41	25.1	97.5	27.8
Bird egg	Oslofjord	2.70	0.73	1.38	2.85	11.8	5.17
Bird egg	Oslofjord	2.65	0.68	1.91	4.60	15.9	4.71
Bird egg	Oslofjord	4.22	1.01	2.67	11.3	45.6	10.5
Polychaets	Oslofjord	0.12	0.03	0.10	0.25	0.62	0.24
Polychaets	Oslofjord	0.13	0.04	0.10	0.29	0.60	0.27
Polychaets	Oslofjord	0.14	0.04	0.10	0.32	0.62	0.30
Fish	Oslofjord	9.14	1.64	6.30	12.6	45.3	15.0
Fish	Oslofjord	7.19	1.27	5.17	9.43	42.0	13.6
Fish	Oslofjord	8.84	1.67	6.08	12.8	52.1	15.6
Fish	Oslofjord	4.63	0.89	3.14	5.43	22.7	7.82
Fish	Oslofjord	12.1	2.11	8.01	15.8	57.4	17.8
Fish	Oslofjord	2.62	0.73	1.82	3.72	8.83	6.38
Fish	Oslofjord	14.7	2.63	10.0	19.5	71.5	22.1
Fish	Oslofjord	10.2	1.87	6.87	13.3	51.0	16.3
Fish	Oslofjord	14.4	2.53	9.23	17.4	69.2	21.0
Fish	Oslofjord	4.93	0.89	3.12	7.02	23.8	6.44
Fish	Oslofjord	4.59	0.84	2.98	6.27	23.9	7.11
Fish	Oslofjord	7.79	1.41	5.02	10.8	40.7	11.6
Fish	Oslofjord	9.30	1.81	6.32	12.8	43.2	12.7
Fish	Oslofjord	4.93	0.83	2.84	7.25	27.5	8.43
Fish	Oslofjord	2.70	0.57	1.80	4.77	15.3	5.49
Prawns	Oslofjord	0.03	<0.01	0.02	0.05	0.14	0.04
Prawns	Oslofjord	0.02	<0.01	0.01	0.03	0.08	0.02
Prawns	Oslofjord	0.03	<0.01	0.02	0.04	0.11	0.03
Polychaets	Frognerkilen	0.78	0.13	0.42	1.03	2.68	0.65
Polychaets	Alna	0.24	0.04	0.12	0.30	0.96	0.20
Polychaets	Bekkelaget	0.14	0.03	0.09	0.28	0.73	0.17
Mussel	Frognerkilen	0.09	0.02	0.07	0.03	0.22	0.17
Mussel	Alna	0.11	0.03	0.08	0.05	0.28	0.18
Mussel	Bekkelaget	0.06	0.01	0.04	0.02	0.09	0.09

Compartment spec.	Area	PCB-187 ng/g (w.w.)	PCB-189 ng/g (w.w.)	PCB-194 ng/g (w.w.)	PCB-206 ng/g (w.w.)	PCB-209 ng/g (w.w.)	TBA pg/g (w.w.)
Plankton	Oslofjord	1.02	<0.01	0.05	0.02	0.01	8.23
Plankton	Oslofjord	0.92	<0.01	0.05	0.02	0.02	<1.08
Plankton	Oslofjord	0.90	<0.01	0.04	0.02	0.01	<1.07
Bird egg	Oslofjord	7.29	0.13	0.96	0.13	0.11	4.47
Bird egg	Oslofjord	22.8	0.52	4.99	0.66	0.11	3.43
Bird egg	Oslofjord	16.5	0.18	1.64	0.20	0.09	4.46
Bird egg	Oslofjord	25.3	0.53	4.94	1.08	0.68	32.6
Bird egg	Oslofjord	35.3	0.96	12.5	1.53	0.64	3.29
Bird egg	Oslofjord	25.7	0.39	2.48	0.30	0.08	8.03
Bird egg	Oslofjord	18.4	0.56	5.39	1.14	1.31	11.8
Bird egg	Oslofjord	8.96	0.14	1.47	0.29	0.12	7.57
Bird egg	Oslofjord	35.5	0.69	4.58	1.23	1.88	2.97
Bird egg	Oslofjord	21.3	0.25	3.29	0.56	0.67	5.09
Bird egg	Oslofjord	63.3	1.93	19.8	2.36	1.75	2.38
Bird egg	Oslofjord	35.9	1.52	15.6	3.13	0.84	48.6
Bird egg	Oslofjord	20.6	0.24	1.93	0.41	0.17	42.4
Bird egg	Oslofjord	23.3	0.29	2.88	0.67	0.23	31.6
Bird egg	Oslofjord	22.0	0.64	6.18	0.75	0.44	1.75
Polychaets	Oslofjord	0.99	0.02	0.17	0.11	0.04	4.79
Polychaets	Oslofjord	1.32	0.02	0.23	0.15	0.05	4.15
Polychaets	Oslofjord	1.51	0.02	0.25	0.18	0.06	4.06
Fish	Oslofjord	1.76	0.65	10.8	4.04	1.33	235
Fish	Oslofjord	6.05	0.57	11.1	4.48	1.80	600
Fish	Oslofjord	10.2	0.72	10.8	5.48	2.05	472
Fish	Oslofjord	2.22	0.33	3.70	2.58	1.52	464
Fish	Oslofjord	4.54	0.76	9.32	4.61	1.64	641
Fish	Oslofjord	13.7	0.28	3.83	3.11	1.66	551
Fish	Oslofjord	6.03	1.02	12.3	6.65	2.39	550
Fish	Oslofjord	12.2	0.84	11.4	6.06	2.22	1 056
Fish	Oslofjord	10.8	1.02	12.5	5.88	2.13	748
Fish	Oslofjord	2.61	0.33	4.12	1.96	0.81	341
Fish	Oslofjord	10.5	0.34	4.41	2.06	1.20	1 212
Fish	Oslofjord	8.80	0.59	8.52	4.04	2.26	925
Fish	Oslofjord	3.49	0.68	7.64	3.65	1.60	802
Fish	Oslofjord	12.8	0.30	5.16	2.85	1.28	1 246
Fish	Oslofjord	6.81	0.28	3.56	2.99	1.54	608
Prawns	Oslofjord	0.05	<0.01	0.02	0.01	<0.01	2.16
Prawns	Oslofjord	0.04	<0.01	0.01	<0.01	<0.01	<2.13
Prawns	Oslofjord	0.05	<0.01	0.02	<0.01	<0.01	1.53
Polychaets	Frognerkilen	2.54	0.05	0.37	0.25	0.03	22.7
Polychaets	Alna	0.57	0.02	0.10	0.05	<0.01	8.61
Polychaets	Bekkelaget	0.54	0.01	0.10	0.04	<0.01	5.20
Mussel	Frognerkilen	0.45	<0.01	0.01	<0.01	<0.01	134
Mussel	Alna	0.47	<0.01	0.01	<0.01	<0.01	130
Mussel	Bekkelaget	0.26	<0.01	<0.01	<0.01	<0.01	105

Compartment spec.	Area	BDE-28 pg/g (w.w.)	BDE-47 pg/g (w.w.)	BDE-49 pg/g (w.w.)	BDE-66 pg/g (w.w.)	BDE-71 pg/g (w.w.)	BDE-77 pg/g (w.w.)
Plankton	Oslofjord	5.52	199	20.8	4.64	<0.9	<0.87
Plankton	Oslofjord	5.11	188	20.4	6.24	<0.72	<0.7
Plankton	Oslofjord	5.68	188	18.5	6.11	<0.95	<0.92
Bird egg	Oslofjord	1.93	1 024	5.68	1.63	<0.84	<0.64
Bird egg	Oslofjord	3.74	3 323	10.9	3.51	<1.69	<1.28
Bird egg	Oslofjord	4.00	1 352	12.5	3.11	<1.34	<1.01
Bird egg	Oslofjord	75.8	9 405	223	76.7	<1.73	14.3
Bird egg	Oslofjord	41.6	5 505	103	158	<1.85	9.35
Bird egg	Oslofjord	15.6	9 371	22.1	22.5	<2.19	3.49
Bird egg	Oslofjord	19.9	7 714	133	118	<2.01	7.85
Bird egg	Oslofjord	3.77	1 601	7.77	38.6	<1.31	<1
Bird egg	Oslofjord	103	13 526	440	286	<3.02	21.4
Bird egg	Oslofjord	14.5	3 962	61.3	63.2	<0.96	3.91
Bird egg	Oslofjord	30.4	5 931	157	58.9	<2.25	2.70
Bird egg	Oslofjord	45.0	10 941	89.7	21.3	<2.57	6.51
Bird egg	Oslofjord	14.9	3 438	28.4	22.4	<1.01	<0.79
Bird egg	Oslofjord	8.28	2 561	14.4	<2.42	<1.86	<1.45
Bird egg	Oslofjord	4.08	2 596	67.8	43.3	<1.24	9.53
Polychaets	Oslofjord	1.51	44.0	11.4	1.06	<0.52	<0.48
Polychaets	Oslofjord	1.47	41.8	12.0	1.14	<0.55	<0.5
Polychaets	Oslofjord	1.40	49.6	12.2	<0.68	<0.47	<0.43
Fish	Oslofjord	20.6	831	25.8	<14.39	<11.06	<8.76
Fish	Oslofjord	58.7	2 584	68.6	28.2	<13.38	<10.59
Fish	Oslofjord	26.8	1 181	31.3	12.8	<5.46	<4.13
Fish	Oslofjord	21.5	641	26.6	<8.78	<7.01	<5.31
Fish	Oslofjord	28.9	708	25.5	<9.85	<7.86	<5.95
Fish	Oslofjord	36.0	1 346	63.8	16.9	<4.08	<3.22
Fish	Oslofjord	45.1	1 319	39.8	12.9	<8.19	<6.2
Fish	Oslofjord	51.8	1 552	70.2	14.8	<11.74	<8.88
Fish	Oslofjord	46.5	1 755	40.6	18.5	<8.62	<6.52
Fish	Oslofjord	27.1	938	31.0	<14.37	<11.05	<8.75
Fish	Oslofjord	24.9	694	31.5	9.44	<6.23	<4.93
Fish	Oslofjord	35.6	1 128	47.1	17.6	<3.98	<3.15
Fish	Oslofjord	21.1	610	10.4	9.83	<4.05	<3.21
Fish	Oslofjord	61.6	2 189	203	20.4	2 708	<2.19
Fish	Oslofjord	27.6	916	49.1	17.2	<9.82	<7.77
Prawns	Oslofjord	1.00	25.4	3.08	<0.94	0.85	<0.59
Prawns	Oslofjord	<1.28	20.3	3.70	<1.13	<0.78	<0.71
Prawns	Oslofjord	0.45	28.4	5.77	<0.78	<0.54	<0.49
Polychaets	Frognerkilen	2.48	100	26.9	<1.18	<0.81	<0.74
Polychaets	Alna	4.08	94.3	30.6	2.98	<0.68	<0.62
Polychaets	Bekkelaget	2.43	125	23.8	2.97	<0.75	<0.68
Mussel	Frognerkilen	4.34	176	12.7	6.05	<0.81	<0.74
Mussel	Alna	4.27	241	13.2	7.83	<1.28	<1.17
Mussel	Bekkelaget	4.69	147	11.0	5.29	<0.78	<0.71

Compartment spec.	Area	BDE-85 pg/g (w.w.)	BDE-99 pg/g (w.w.)	BDE-100 pg/g (w.w.)	BDE-119 pg/g (w.w.)	BDE-126 pg/g (w.w.)	BDE-138 pg/g (w.w.)
Plankton	Oslofjord	<2.44	169	35.6	<1.67	<6	<2.92
Plankton	Oslofjord	<2.49	155	31.5	<1.71	<4.9	<3
Plankton	Oslofjord	<1.58	160	35.1	<1.08	<3.7	<3.23
Bird egg	Oslofjord	12.9	690	312	<2.73	<3	9.62
Bird egg	Oslofjord	25.3	1 452	965	<2.06	<7.3	15.3
Bird egg	Oslofjord	5.30	610	404	<4.3	<2.76	16.2
Bird egg	Oslofjord	11.9	1 644	1 944	<6.78	<5.14	9.62
Bird egg	Oslofjord	26.6	2 802	1 771	101	86.4	51.4
Bird egg	Oslofjord	52.5	3 980	2 414	<4.65	<9.79	43.3
Bird egg	Oslofjord	82.1	3 337	1 947	37.9	<11.1	33.1
Bird egg	Oslofjord	<78.28	3 987	621	<61.35	<22.7	66.0
Bird egg	Oslofjord	7.27	2 544	4 159	300	486	8.45
Bird egg	Oslofjord	32.0	3 601	1 030	<6.55	<6.04	33.6
Bird egg	Oslofjord	<5.07	1 044	1 769	69.4	136	6.47
Bird egg	Oslofjord	18.9	1 720	2 601	<3.17	<8.74	6.27
Bird egg	Oslofjord	<14.89	3 112	965	<13.19	2 020	49.9
Bird egg	Oslofjord	<17.63	1 520	786	<15.61	<21.4	40.0
Bird egg	Oslofjord	5.27	846	826	17.3	1.37	5.13
Polychaets	Oslofjord	<1.33	20.2	12.3	<0.91	<1.7	<2.49
Polychaets	Oslofjord	<1.59	17.5	11.8	<1.09	<1.46	<1.95
Polychaets	Oslofjord	<1.34	17.1	13.7	<0.92	<1.7	<1.65
Fish	Oslofjord	<114.8	<83.11	<68.22	<94.39	<70	<119.62
Fish	Oslofjord	<79.81	388	155	<65.63	<31.5	<75.71
Fish	Oslofjord	<11.72	81.5	111	<16.99	<13.9	<32.48
Fish	Oslofjord	<40.42	46.1	22.4	<19.75	294	<33.32
Fish	Oslofjord	<59.07	53.8	28.2	<45.28	<12.3	<25.16
Fish	Oslofjord	<21.53	60.3	106	<16.19	<6	<5.77
Fish	Oslofjord	<31.75	59.2	32.6	<24.34	<8.64	<24.79
Fish	Oslofjord	29.8	169	146	<77.56	<28.7	<96.83
Fish	Oslofjord	<64.14	151	107	<49.16	16.7	<52.24
Fish	Oslofjord	<95.65	56.1	30.4	<78.65	<68	<55.76
Fish	Oslofjord	<27.91	81.6	57.9	<22.95	99.5	<32.06
Fish	Oslofjord	<35.43	98.3	78.1	<29.13	<21.9	<15.75
Fish	Oslofjord	<34.14	78.4	36.1	<28.07	<20.1	<17.87
Fish	Oslofjord	<86.09	287	262	<70.79	<81	<24.93
Fish	Oslofjord	<21.39	75.1	104	<17.59	32.9	<48.04
Prawns	Oslofjord	<1.7	3.90	5.17	<1.17	23.7	<5.3
Prawns	Oslofjord	<1.62	2.75	4.03	<1.11	<1.7	<6.74
Prawns	Oslofjord	<2.01	1.39	5.30	<1.38	<1	<3.61
Polychaets	Frognerkilen	<1.8	34.0	17.9	<1.24	<1	<4.66
Polychaets	Alna	<2.33	64.2	15.7	<1.61	<1.12	<3.59
Polychaets	Bekkelaget	1.50	97.7	31.0	<1.09	<1	<5.13
Mussel	Frognerkilen	5.36	104	44.2	2.04	<1	<4.89
Mussel	Alna	11.3	209	68.6	<1.49	29.7	<3.92
Mussel	Bekkelaget	2.42	68.3	36.0	<1.01	<1	<4.46

Compartment spec.	Area	BDE-153 pg/g (w.w.)	BDE-154 pg/g (w.w.)	BDE-183 pg/g (w.w.)	BDE-196 pg/g (w.w.)	BDE-206 pg/g (w.w.)	BDE-209 pg/g (w.w.)
Plankton	Oslofjord	20.5	14.2	<1.35	<5.26	<5.21	<17.82
Plankton	Oslofjord	15.7	13.2	<1.44	<5.38	<4.15	<18.13
Plankton	Oslofjord	17.3	12.5	<1.27	<5.35	<4.68	<21.32
Bird egg	Oslofjord	179	40.7	66.0	46.3	38.0	1 393
Bird egg	Oslofjord	339	81.0	61.5	44.8	14.8	540
Bird egg	Oslofjord	169	90.1	68.9	92.9	47.2	1 175
Bird egg	Oslofjord	481	376	76.4	26.5	11.8	311
Bird egg	Oslofjord	1 224	720	118	67.3	37.1	1 187
Bird egg	Oslofjord	513	168	165	177	80.8	948
Bird egg	Oslofjord	794	561	200	85.7	119	6 142
Bird egg	Oslofjord	1 015	203	124	59.0	18.9	904
Bird egg	Oslofjord	825	1 724	81.6	28.5	22.6	325
Bird egg	Oslofjord	1 031	239	109	84.7	21.7	765
Bird egg	Oslofjord	703	589	63.0	29.6	11.6	271
Bird egg	Oslofjord	297	361	28.3	16.8	10.5	463
Bird egg	Oslofjord	918	207	244	213	531	19 634
Bird egg	Oslofjord	659	117	162	243	126	2 141
Bird egg	Oslofjord	342	224	42.7	29.9	95.2	3 542
Polychaets	Oslofjord	3.15	6.67	1.10	<4.64	<4.42	62.8
Polychaets	Oslofjord	3.52	8.12	<1.05	<4.62	<4.45	52.6
Polychaets	Oslofjord	3.55	9.90	<1.38	<4.2	<3.34	38.8
Fish	Oslofjord	<95.47	<64.16	<18.85	<37.13	<31.86	161
Fish	Oslofjord	150	<40.61	<34.48	<72.01	<49.28	<135.06
Fish	Oslofjord	24.2	5.27	<5.43	<51.8	<51.35	<248.64
Fish	Oslofjord	11.2	<17.54	<7.6	<26.7	<28.02	<109.49
Fish	Oslofjord	<20.45	<13.24	<8.37	<16.76	<18.75	<85.18
Fish	Oslofjord	27.6	20.3	<7.09	<12.98	<14.68	256
Fish	Oslofjord	27.6	5.88	<7.47	<24.72	<26.54	<102.7
Fish	Oslofjord	51.6	<50.97	<27.6	<127.4	<99.37	<453.12
Fish	Oslofjord	48.0	12.9	<14.4	<32.09	<29.97	106
Fish	Oslofjord	<44.5	<29.91	<12.66	<29.29	<20.32	199
Fish	Oslofjord	25.8	<17.2	<6.99	<23.55	18.3	509
Fish	Oslofjord	32.9	66.3	<5.49	<18.51	18.5	152
Fish	Oslofjord	13.8	<9.58	<7.49	<18.03	10.5	322
Fish	Oslofjord	93.8	43.7	<9.38	<18.98	<14.77	260
Fish	Oslofjord	32.7	11.6	<15.69	<34.37	<25.45	825
Prawns	Oslofjord	<3.98	<2.33	<2.41	<6.93	<6.14	20.1
Prawns	Oslofjord	<5.06	<2.97	<2.79	<7.54	<6.63	<27.97
Prawns	Oslofjord	<2.71	<1.59	<1.57	<5.32	<4.35	<14.79
Polychaets	Frognerkilen	5.01	5.98	<0.66	<5.35	<4.35	26.0
Polychaets	Alna	8.92	8.18	4.02	<6.35	8.67	266
Polychaets	Bekkelaget	11.5	10.1	2.77	<7.61	<6.66	61.8
Mussel	Frognerkilen	7.77	4.41	2.68	<5.26	7.10	164
Mussel	Alna	9.35	7.38	4.45	<5.13	5.43	63.8
Mussel	Bekkelaget	2.67	1.42	<2.24	<4.48	<4.44	20.4

Compartment spec.	Area	EHTeBB pg/g (w.w.)	BEHTBP pg/g (w.w.)	a-HBCD ng/g (w.w.)	b-HBCD ng/g (w.w.)	g-HBCD ng/g (w.w.)	a-HCH ng/g (w.w.)
Plankton	Oslofjord	<2.7	<7.63	0.20	<0.03	<0.01	
Plankton	Oslofjord	<11.9	38.8	0.19	<0.03	<0.01	
Plankton	Oslofjord	<14.4	<44.6	0.15	<0.02	<0.01	
Bird egg	Oslofjord	<25	<60	1.40	<0.04	<0.01	0.02
Bird egg	Oslofjord	<25	<60	3.55	<0.05	<0.01	0.01
Bird egg	Oslofjord	<25	<60	1.07	<0.05	<0.01	<0.01
Bird egg	Oslofjord	<25	<60	6.46	<0.06	<0.01	0.03
Bird egg	Oslofjord	<25	<60	0.70	<0.06	<0.01	0.03
Bird egg	Oslofjord	<25	<60	9.31	<0.04	<0.01	0.03
Bird egg	Oslofjord	<25	<60	4.49	<0.09	0.05	0.01
Bird egg	Oslofjord	<25	<60	1.01	<0.05	<0.01	<0.01
Bird egg	Oslofjord	<25	<60	3.38	<0.05	<0.01	<0.01
Bird egg	Oslofjord	<25	<60	0.84	<0.04	<0.01	0.03
Bird egg	Oslofjord	<25	<60	1.07	<0.06	<0.01	0.01
Bird egg	Oslofjord	<25	<60	3.32	<0.06	<0.01	0.03
Bird egg	Oslofjord	<25	<60	5.34	0.11	0.07	<0.01
Bird egg	Oslofjord	<25	<60	1.52	<0.08	<0.02	0.01
Bird egg	Oslofjord	<25	<60	2.65	<0.07	<0.01	0.01
Polychaets	Oslofjord	<14.17	<36.65	0.02	<0.02	<0.01	
Polychaets	Oslofjord	<20.74	<48.6	0.02	<0.02	<0.01	
Polychaets	Oslofjord	<16.06	119	0.02	<0.02	<0.01	
Fish	Oslofjord	<500	<600	<0.04	<0.18	<0.04	
Fish	Oslofjord	<500	<600	1.27	<0.28	<0.06	
Fish	Oslofjord	<500	<600	0.19	<0.17	<0.03	
Fish	Oslofjord	<500	<600	0.06	<0.16	<0.03	
Fish	Oslofjord	<500	<600	0.15	<0.16	<0.03	
Fish	Oslofjord	<500	<600	0.21	<0.21	<0.05	
Fish	Oslofjord	<500	<600	0.19	<0.18	<0.04	
Fish	Oslofjord	<500	<600	0.17	<0.19	<0.04	
Fish	Oslofjord	<500	<600	0.45	<0.29	<0.05	
Fish	Oslofjord	<500	<600	<0.12	<0.25	<0.08	
Fish	Oslofjord	<500	<600	0.20	<0.38	<0.1	
Fish	Oslofjord	<500	<600	0.50	<0.45	<0.12	
Fish	Oslofjord	<500	<600	0.19	<0.11	<0.03	
Fish	Oslofjord	<500	<600	0.23	<0.17	<0.04	
Fish	Oslofjord	<500	<600	0.27	<0.3	<0.08	
Prawns	Oslofjord	<6.25	<18.2	<0.01	<0.01	<0.01	
Prawns	Oslofjord	<3.71	<10.26	<0.01	<0.01	<0.01	
Prawns	Oslofjord	<11.75	<15.42	<0.01	<0.01	<0.01	
Polychaets	Frognerkilen	<9.07	<20.29	0.15	<0.02	<0.01	
Polychaets	Alna	<16.02	<39.75	0.12	<0.02	<0.01	
Polychaets	Bekkelaget	<9.91	<19.81	0.03	<0.02	<0.01	
Mussel	Frognerkilen	<6.43	45.0	0.15	<0.01	<0.01	
Mussel	Alna	<5.84	175	0.24	<0.01	0.03	
Mussel	Bekkelaget	<5.6	21.7	0.06	<0.01	<0.01	

Compartment spec.	Area	b-HCH ng/g (w.w.)	g-HCH ng/g (w.w.)	o,p'-DDE ng/g (w.w.)	p,p'-DDE ng/g (w.w.)	o,p'-DDD ng/g (w.w.)	p,p'-DDD ng/g (w.w.)
Plankton	Oslofjord						
Plankton	Oslofjord						
Plankton	Oslofjord						
Bird egg	Oslofjord	0.17	0.02	<0.01	10.0	<0.01	0.05
Bird egg	Oslofjord	0.21	0.01	<0.01	36.7	<0.01	0.06
Bird egg	Oslofjord	1.54	<0.01	<0.01	16.2	<0.01	0.05
Bird egg	Oslofjord	0.37	<0.01	0.01	61.1	0.07	3.38
Bird egg	Oslofjord	0.29	0.02	0.04	128	0.02	0.19
Bird egg	Oslofjord	0.52	0.02	0.01	34.7	0.02	0.09
Bird egg	Oslofjord	0.61	<0.01	<0.01	61.9	<0.01	0.21
Bird egg	Oslofjord	0.12	<0.01	<0.01	11.8	<0.01	0.04
Bird egg	Oslofjord	0.88	<0.01	<0.01	126	<0.01	0.08
Bird egg	Oslofjord	0.27	0.03	0.02	44.2	0.01	0.15
Bird egg	Oslofjord	0.46	0.02	0.01	133	0.03	0.07
Bird egg	Oslofjord	0.41	0.02	0.01	88.0	0.05	1.38
Bird egg	Oslofjord	0.19	0.01	<0.01	15.2	0.02	0.32
Bird egg	Oslofjord	0.22	<0.01	<0.01	23.9	0.01	0.17
Bird egg	Oslofjord	0.61	<0.01	0.03	40.9	<0.01	0.07
Polychaets	Oslofjord						
Polychaets	Oslofjord						
Polychaets	Oslofjord						
Fish	Oslofjord						
Fish	Oslofjord						
Fish	Oslofjord						
Fish	Oslofjord						
Fish	Oslofjord						
Fish	Oslofjord						
Fish	Oslofjord						
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Fish	Oslofjord						
Fish	Oslofjord						
Fish	Oslofjord						
Fish	Oslofjord						
Fish	Oslofjord						
Fish	Oslofjord						
Prawns	Oslofjord						
Prawns	Oslofjord						
Prawns	Oslofjord						
Polychaets	Frognerkilen						
Polychaets	Alna						
Polychaets	Bekkelaget						
Mussel	Frognerkilen						
Mussel	Alna						
Mussel	Bekkelaget						

Compartment spec.	Area	o,p'-DDT ng/g (w.w.)	p,p'-DDT ng/g (w.w.)	TiBP ng/g (w.w.)	TBP ng/g (w.w.)	TCEP ng/g (w.w.)	TCPP ng/g (w.w.)
Plankton	Oslofjord			62.3	<14.7	644	137
Plankton	Oslofjord			<52.1	<14.7	63.3	16.3
Plankton	Oslofjord			<52.1	<14.7	<51.4	<13.7
Bird egg	Oslofjord	0.01	0.04	<52.1	<14.7	<51.4	<13.7
Bird egg	Oslofjord	0.01	0.15	<52.1	<14.7	<51.4	<13.7
Bird egg	Oslofjord	0.01	0.05	<52.1	<14.7	<51.4	<13.7
Bird egg	Oslofjord	0.09	2.56	<52.1	<14.7	<51.4	<13.7
Bird egg	Oslofjord	0.08	2.71	233	36.9	<51.4	<13.7
Bird egg	Oslofjord	0.02	0.18	<52.1	<14.7	<51.4	<13.7
Bird egg	Oslofjord	0.05	0.54	133	17.4	<51.4	<13.7
Bird egg	Oslofjord	<0.01	0.11	65.2	<14.7	<51.4	<13.7
Bird egg	Oslofjord	<0.02	0.24	<52.1	<14.7	<51.4	<13.7
Bird egg	Oslofjord	0.02	0.38	<52.1	<14.7	<51.4	<13.7
Bird egg	Oslofjord	0.02	0.16	<52.1	<14.7	<51.4	<13.7
Bird egg	Oslofjord	0.06	1.15	<52.1	<14.7	<51.4	<13.7
Bird egg	Oslofjord	0.03	0.42	<52.1	<14.7	<51.4	<13.7
Bird egg	Oslofjord	0.03	0.27	<52.1	<14.7	<51.4	<13.7
Bird egg	Oslofjord	0.04	1.28	<52.1	<14.7	<51.4	<13.7
Polychaets	Oslofjord			<52.1	<14.7	160	85.3
Polychaets	Oslofjord			<52.1	<14.7	55.6	32.3
Polychaets	Oslofjord			<52.1	<14.7	<51.4	<13.7
Fish	Oslofjord			<52.1	<14.7	<51.4	22.3
Fish	Oslofjord			<52.1	<14.7	<51.4	17.0
Fish	Oslofjord			<52.1	<14.7	<51.4	<13.7
Fish	Oslofjord			<52.1	<14.7	<51.4	<13.7
Fish	Oslofjord			<52.1	18.3	94.3	35.5
Fish	Oslofjord			<52.1	<14.7	<51.4	20.6
Fish	Oslofjord			<52.1	<14.7	<51.4	<13.7
Fish	Oslofjord			<52.1	<14.7	<51.4	<13.7
Fish	Oslofjord			61.3	23.6	<51.4	21.1
Fish	Oslofjord			<52.1	<14.7	<51.4	<13.7
Fish	Oslofjord			<52.1	<14.7	<51.4	<13.7
Fish	Oslofjord			<52.1	<14.7	<51.4	15.1
Fish	Oslofjord			<52.1	<14.7	<51.4	16.3
Fish	Oslofjord			<52.1	<14.7	<51.4	<13.7
Fish	Oslofjord			<52.1	<14.7	<51.4	16.6
Prawns	Oslofjord			58.1	<14.7	<51.4	19.0
Prawns	Oslofjord			<52.1	<14.7	<51.4	<13.7
Prawns	Oslofjord			<52.1	<14.7	<51.4	<13.7
Polychaets	Frognerkilen			<52.1	<14.7	<51.4	<13.7
Polychaets	Alna			<52.1	<14.7	<51.4	<13.7
Polychaets	Bekkelaget			<52.1	<14.7	<51.4	<13.7
Mussel	Frognerkilen			<52.1	<14.7	<51.4	19.2
Mussel	Alna			<52.1	<14.7	<51.4	<13.7
Mussel	Bekkelaget			<52.1	<14.7	73.3	20.2

Compartment spec.	Area	DBPhP ng/g (w.w.)	BdPhP ng/g (w.w.)	TDCPP ng/g (w.w.)	TBEP ng/g (w.w.)	TPP ng/g (w.w.)	EHDP ng/g (w.w.)
Plankton	Oslofjord	<0.2	<0.7	31.6	358	<7.9	<0.9
Plankton	Oslofjord	<0.2	<0.7	6.35	55.3	<7.9	<0.9
Plankton	Oslofjord	<0.2	<0.7	5.25	<20	<7.9	<0.9
Bird egg	Oslofjord	<0.2	<0.7	<1.3	<20	<7.9	<0.9
Bird egg	Oslofjord	<0.2	<0.7	<1.3	<20	<7.9	<0.9
Bird egg	Oslofjord	<0.2	<0.7	<1.3	<20	<7.9	<0.9
Bird egg	Oslofjord	<0.2	<0.7	<1.3	<20	<7.9	<0.9
Bird egg	Oslofjord	<0.2	<0.7	<1.3	<20	<7.9	<0.9
Bird egg	Oslofjord	<0.2	<0.7	<1.3	<20	<7.9	1.70
Bird egg	Oslofjord	<0.2	<0.7	<1.3	<20	<7.9	<0.9
Bird egg	Oslofjord	<0.2	<0.7	<1.3	<20	<7.9	<0.9
Bird egg	Oslofjord	<0.2	<0.7	<1.3	<20	<7.9	<0.9
Bird egg	Oslofjord	<0.2	<0.7	<1.3	<20	<7.9	<0.9
Bird egg	Oslofjord	<0.2	<0.7	<1.3	23.0	<7.9	<0.9
Bird egg	Oslofjord	<0.2	<0.7	<1.3	<20	<7.9	<0.9
Bird egg	Oslofjord	<0.2	<0.7	<1.3	<20	<7.9	<0.9
Bird egg	Oslofjord	<0.2	<0.7	<1.3	<20	<7.9	<0.9
Bird egg	Oslofjord	<0.2	<0.7	<1.3	<20	<7.9	<0.9
Polychaets	Oslofjord	<0.2	<0.7	14.9	73.0	<7.9	<0.9
Polychaets	Oslofjord	<0.2	<0.7	5.00	22.1	<7.9	<0.9
Polychaets	Oslofjord	<0.2	<0.7	<1.3	<20	<7.9	<0.9
Fish	Oslofjord	<0.2	<0.7	<1.3	23.3	35.2	<0.9
Fish	Oslofjord	<0.2	<0.7	<1.3	<20	<7.9	<0.9
Fish	Oslofjord	<0.2	<0.7	<1.3	<20	<7.9	<0.9
Fish	Oslofjord	<0.2	<0.7	<1.3	<20	<7.9	1.00
Fish	Oslofjord	<0.2	<0.7	<1.3	33.9	<7.9	<0.9
Fish	Oslofjord	<0.2	<0.7	<1.3	22.4	<7.9	<0.9
Fish	Oslofjord	<0.2	<0.7	<1.3	<20	<7.9	1.00
Fish	Oslofjord	<0.2	<0.7	<1.3	24.6	<7.9	<0.9
Fish	Oslofjord	<0.2	<0.7	<1.3	<20	<7.9	<0.9
Fish	Oslofjord	<0.2	<0.7	<1.3	30.0	<7.9	1.40
Fish	Oslofjord	<0.2	<0.7	<1.3	<20	<7.9	<0.9
Fish	Oslofjord	<0.2	<0.7	<1.3	<20	<7.9	<0.9
Fish	Oslofjord	<0.2	<0.7	1.50	44.3	<7.9	1.70
Fish	Oslofjord	<0.2	<0.7	<1.3	<20	<7.9	<0.9
Fish	Oslofjord	<0.2	<0.7	1.40	31.4	<7.9	1.80
Prawns	Oslofjord	<0.2	<0.7	<1.3	<20	<7.9	<0.9
Prawns	Oslofjord	<0.2	<0.7	<1.3	<20	<7.9	<0.9
Prawns	Oslofjord	<0.2	<0.7	<1.3	<20	<7.9	<0.9
Polychaets	Frognerkilen	<0.2	<0.7	<1.3	<20	<7.9	<0.9
Polychaets	Alna	<0.2	<0.7	1.40	<20	<7.9	<0.9
Polychaets	Bekkelaget	<0.2	<0.7	<1.3	<20	<7.9	<0.9
Mussel	Frognerkilen	<0.2	<0.7	1.40	<20	<7.9	2.10
Mussel	Alna	<0.2	<0.7	<1.3	<20	<7.9	<0.9
Mussel	Bekkelaget	<0.2	<0.7	1.30	21.3	<7.9	<0.9

Compartment spec.	Area	TEHP ng/g (w.w.)	ooo-TCP ng/g (w.w.)	Sum-TCP ng/g (w.w.)	Hg µg/g (w.w.)	Cr µg/g (w.w.)	Fe µg/g (w.w.)
Plankton	Oslofjord	<0.6	<0.2	<0.2	0.02	0.99	11.2
Plankton	Oslofjord	<0.6	<0.2	<0.2	0.02	0.75	11.7
Plankton	Oslofjord	<0.6	<0.2	<0.2	0.03	0.39	9.08
Bird egg	Oslofjord	<0.6	<0.2	<0.2	0.04	0.01	17.0
Bird egg	Oslofjord	<0.6	<0.2	<0.2	0.03	0.02	26.4
Bird egg	Oslofjord	<0.6	<0.2	<0.2	0.06	0.02	27.6
Bird egg	Oslofjord	<0.6	<0.2	<0.2	0.18	0.01	25.2
Bird egg	Oslofjord	<0.6	<0.2	<0.2	0.19	0.06	30.9
Bird egg	Oslofjord	<0.6	<0.2	<0.2	0.08	0.01	31.5
Bird egg	Oslofjord	<0.6	<0.2	<0.2	0.13	0.01	25.5
Bird egg	Oslofjord	<0.6	<0.2	<0.2	0.02	0.16	33.7
Bird egg	Oslofjord	<0.6	<0.2	<0.2	0.22	0.02	23.7
Bird egg	Oslofjord	<0.6	<0.2	<0.2	0.16	0.01	23.7
Bird egg	Oslofjord	<0.6	<0.2	<0.2	0.23	0.01	24.0
Bird egg	Oslofjord	<0.6	<0.2	<0.2	0.08	0.01	30.3
Bird egg	Oslofjord	<0.6	<0.2	<0.2	0.16	0.00	34.9
Bird egg	Oslofjord	<0.6	<0.2	<0.2	0.02	0.01	27.3
Bird egg	Oslofjord	<0.6	<0.2	<0.2	0.21	0.00	29.0
Polychaets	Oslofjord	<0.6	<0.2	<0.2	0.04	1.05	571
Polychaets	Oslofjord	<0.6	<0.2	<0.2	0.03	1.16	480
Polychaets	Oslofjord	<0.6	<0.2	<0.2	0.04	1.08	536
Fish	Oslofjord	<0.6	<0.2	<0.2	0.17	<0	1.58
Fish	Oslofjord	<0.6	<0.2	<0.2	0.07	0.01	1.62
Fish	Oslofjord	<0.6	<0.2	<0.2	0.04	0.03	1.61
Fish	Oslofjord	<0.6	<0.2	<0.2	0.09	0.01	1.43
Fish	Oslofjord	<0.6	<0.2	<0.2	0.04	0.01	1.69
Fish	Oslofjord	<0.6	<0.2	<0.2	0.05	0.00	1.45
Fish	Oslofjord	<0.6	<0.2	<0.2	0.05	0.00	2.60
Fish	Oslofjord	<0.6	<0.2	<0.2	0.02	0.02	1.73
Fish	Oslofjord	<0.6	<0.2	<0.2	0.08	0.00	2.83
Fish	Oslofjord	<0.6	<0.2	<0.2	0.14	0.08	2.56
Fish	Oslofjord	<0.6	<0.2	<0.2	0.03	<0	3.01
Fish	Oslofjord	<0.6	<0.2	<0.2	0.07	<0	3.12
Fish	Oslofjord	<0.6	<0.2	<0.2	0.05	0.02	1.23
Fish	Oslofjord	<0.6	<0.2	<0.2	0.04	0.01	1.33
Fish	Oslofjord	<0.6	<0.2	<0.2	0.05	0.00	3.02
Prawns	Oslofjord	<0.6	<0.2	<0.2	0.09	0.08	5.33
Prawns	Oslofjord	<0.6	<0.2	<0.2	0.09	0.04	4.24
Prawns	Oslofjord	<0.6	<0.2	<0.2	0.11	0.04	3.88
Polychaets	Frognerkilen	<0.6	<0.2	<0.2	0.04	1.26	184
Polychaets	Alna	<0.6	<0.2	<0.2	0.02	0.64	294
Polychaets	Bekkelaget	<0.6	<0.2	<0.2	0.01	0.22	208
Mussel	Frognerkilen	<0.6	<0.2	<0.2	0.01	0.20	33.9
Mussel	Alna	<0.6	<0.2	<0.2	0.01	0.21	39.2
Mussel	Bekkelaget	<0.6	<0.2	<0.2	0.01	0.16	21.1

Compartment spec.	Area	Ni µg/g (w.w.)	Cu µg/g (w.w.)	Zn µg/g (w.w.)	As µg/g (w.w.)	Ag µg/g (w.w.)	Cd µg/g (w.w.)
Plankton	Oslofjord	0.57	15.7	14.3	5.02	0.12	0.01
Plankton	Oslofjord	0.36	17.7	15.0	5.58	0.13	0.02
Plankton	Oslofjord	0.29	16.5	15.8	5.55	0.13	0.02
Bird egg	Oslofjord	0.02	0.57	11.5	0.03	0.00	0.00
Bird egg	Oslofjord	0.03	0.59	12.0	0.02	0.00	0.00
Bird egg	Oslofjord	0.02	0.51	12.1	0.04	0.00	0.00
Bird egg	Oslofjord	0.02	0.62	11.0	0.14	0.00	0.00
Bird egg	Oslofjord	0.05	0.73	13.4	0.01	0.00	0.00
Bird egg	Oslofjord	0.02	0.69	13.1	0.07	0.00	0.00
Bird egg	Oslofjord	0.01	0.63	12.7	0.01	0.00	0.00
Bird egg	Oslofjord	0.17	0.89	18.3	0.01	0.00	0.00
Bird egg	Oslofjord	0.02	0.54	10.8	0.03	0.00	0.00
Bird egg	Oslofjord	0.01	0.55	12.8	0.04	0.00	0.00
Bird egg	Oslofjord	0.01	0.60	12.5	0.01	0.00	0.00
Bird egg	Oslofjord	0.01	0.67	12.9	0.06	0.00	0.00
Bird egg	Oslofjord	0.01	0.66	12.5	0.12	0.00	0.00
Bird egg	Oslofjord	0.01	0.74	14.4	0.05	0.00	0.00
Bird egg	Oslofjord	0.01	0.65	13.6	0.01	0.00	0.00
Polychaets	Oslofjord	0.80	27.9	10.3	3.76	1.35	0.27
Polychaets	Oslofjord	0.88	23.6	11.2	4.35	1.27	0.27
Polychaets	Oslofjord	0.78	25.4	14.2	5.81	1.41	0.26
Fish	Oslofjord	0.02	0.29	4.84	12.0	0.00	0.00
Fish	Oslofjord	0.02	0.25	5.58	12.1	0.00	0.00
Fish	Oslofjord	0.01	0.21	4.93	3.28	0.00	0.00
Fish	Oslofjord	0.01	0.34	4.40	4.41	0.00	0.00
Fish	Oslofjord	0.01	0.29	4.65	6.39	0.00	0.00
Fish	Oslofjord	0.01	0.22	4.35	4.35	0.00	0.00
Fish	Oslofjord	0.02	0.33	4.89	8.97	0.00	0.00
Fish	Oslofjord	0.01	0.64	4.96	3.22	0.00	0.00
Fish	Oslofjord	0.01	0.43	5.65	7.27	0.00	0.00
Fish	Oslofjord	0.04	0.47	4.24	7.79	0.00	0.00
Fish	Oslofjord	0.01	0.38	6.31	4.26	0.00	0.00
Fish	Oslofjord	0.02	0.26	5.79	8.87	0.00	0.00
Fish	Oslofjord	0.03	0.29	5.57	4.37	0.00	0.00
Fish	Oslofjord	0.00	0.28	6.84	2.81	<0	0.00
Fish	Oslofjord	0.01	0.39	6.54	3.61	0.00	0.00
Prawns	Oslofjord	0.08	5.24	13.4	23.7	0.28	0.01
Prawns	Oslofjord	0.05	5.37	13.8	25.8	0.30	0.01
Prawns	Oslofjord	0.04	5.47	13.4	32.3	0.31	0.01
Polychaets	Frognerkilen	0.86	11.8	28.9	4.06	0.93	0.16
Polychaets	Alna	0.52	9.78	11.0	2.03	0.20	0.07
Polychaets	Bekkelaget	0.36	10.2	5.04	1.82	0.70	0.21
Mussel	Frognerkilen	0.19	1.85	22.9	1.04	0.00	0.17
Mussel	Alna	0.16	1.63	20.3	0.95	0.00	0.20
Mussel	Bekkelaget	0.16	1.35	22.1	1.00	0.00	0.14

Compartment spec.	Area	Pb	SCCP	MCCP	D4	D5	D6
		µg/g (w.w.)	ng/g (w.w.)	ng/g (w.w.)	ng/g (w.w.)	ng/g (w.w.)	ng/g (w.w.)
Plankton	Oslofjord	0.02	57.0	3.10	5.08	184	3.58
Plankton	Oslofjord	0.02	49.0	3.00	4.61	161	<2.5
Plankton	Oslofjord	0.02	60.0	3.00	17.8	627	13.0
Bird egg	Oslofjord	0.01	6.10	0.60	2.86	16.7	17.4
Bird egg	Oslofjord	0.03	4.40	<0.2	3.46	17.0	22.9
Bird egg	Oslofjord	0.01	16.0	1.00	3.65	12.1	12.1
Bird egg	Oslofjord	0.01	11.0	0.60	3.20	265	20.1
Bird egg	Oslofjord	0.01	31.0	<0.5	3.87	24.2	14.6
Bird egg	Oslofjord	0.01	8.50	0.80	7.44	41.5	12.1
Bird egg	Oslofjord	0.01	19.0	0.70	4.62	7.34	9.32
Bird egg	Oslofjord	0.01	3.60	1.40	31.8	63.9	25.6
Bird egg	Oslofjord	0.00	1.80	<0.5	4.21	18.4	11.6
Bird egg	Oslofjord	0.00	0.30	<0.2	21.8	43.3	55.8
Bird egg	Oslofjord	0.02	<0.2	<0.4	2.07	4.70	7.53
Bird egg	Oslofjord	0.02	8.00	<0.2	1.18	71.9	9.36
Bird egg	Oslofjord	0.01	58.0	1.30	3.78	164	20.7
Bird egg	Oslofjord	0.01	1.10	<0.2	4.77	18.4	19.5
Bird egg	Oslofjord	0.01	3.60	<0.3	4.09	5.39	14.9
Polychaets	Oslofjord	1.06	6.70	1.60	1.28	48.8	3.47
Polychaets	Oslofjord	0.91	7.10	0.80	2.20	85.9	4.04
Polychaets	Oslofjord	1.04	6.70	2.30	2.81	80.4	5.06
Fish	Oslofjord	0.01	7.40	4.40	3.12	64.9	6.86
Fish	Oslofjord	0.00	27.0	15.0	27.4	321	13.2
Fish	Oslofjord	0.00	8.70	6.70	3.90	119	9.56
Fish	Oslofjord	0.00	15.0	11.0	10.3	179	35.1
Fish	Oslofjord	0.01	2.30	4.10	18.4	721	17.5
Fish	Oslofjord	0.02	17.0	5.80	3.78	129	<2.5
Fish	Oslofjord	0.01	17.0	3.90	5.09	121	22.9
Fish	Oslofjord	0.00	9.00	5.20	6.33	238	12.7
Fish	Oslofjord	0.01	15.0	9.80	5.08	147	14.1
Fish	Oslofjord	0.01	109	<1.2	10.3	269	28.5
Fish	Oslofjord	0.00	12.0	<1	15.9	358	15.3
Fish	Oslofjord	0.00	14.0	<1.2	8.46	190	22.6
Fish	Oslofjord	0.02	8.10	<0.6	4.16	133	22.5
Fish	Oslofjord	0.00	22.0	<1.2	28.5	501	21.2
Fish	Oslofjord	0.01	<3	<1.8	10.9	333	<2.5
Prawns	Oslofjord	0.01	1.00	0.20	<0.65	0.95	4.18
Prawns	Oslofjord	0.01	0.90	0.10	0.66	1.00	<2.5
Prawns	Oslofjord	0.01	1.40	<0.1	<0.65	0.87	2.60
Polychaets	Frognerkilen	0.69	24.0	1.00	3.12	57.2	3.19
Polychaets	Alna	0.84	26.0	2.40	8.17	173	7.87
Polychaets	Bekkelaget	0.17	6.50	0.50	15.9	955	34.8
Mussel	Frognerkilen	0.33	39.0	1.10	1.94	57.3	5.34
Mussel	Alna	0.38	95.0	5.20	4.01	156	15.8
Mussel	Bekkelaget	0.35	8.90	0.40	5.94	52.7	17.1

Compartment spec.	Area	BPA ng/g (w.w.)	TBBPA ng/g (w.w.)	44-BPF ng/g (w.w.)	22-BPF ng/g (w.w.)	BPAF ng/g (w.w.)	BPBP ng/g (w.w.)
Plankton	Oslofjord	<0.6	143	79.9	3.55	0.97	7.58
Plankton	Oslofjord	<0.5	141	7.61	<0.7	1.52	<0.4
Plankton	Oslofjord	0.00	8.61	8.82	0.19	0.13	0.25
Bird egg	Oslofjord	2.34	0.73	9.35	0.69	0.35	0.78
Bird egg	Oslofjord	0.00	0.80	16.4	1.03	0.30	0.59
Bird egg	Oslofjord	68.0	2.81	98.6	6.20	1.56	<0.1
Bird egg	Oslofjord	<0.8	1.13	116	14.2	7.99	8.56
Bird egg	Oslofjord	<0.1	0.59	13.6	1.89	1.03	1.53
Bird egg	Oslofjord	9.74	0.90	8.39	1.28	0.56	0.44
Bird egg	Oslofjord	38.9	0.42	4.19	1.11	0.66	0.23
Bird egg	Oslofjord	19.6	1.46	90.9	7.13	1.76	3.16
Bird egg	Oslofjord	13.0	0.92	16.1	1.28	0.37	0.08
Bird egg	Oslofjord	12.8	1.02	9.00	1.63	0.40	0.13
Bird egg	Oslofjord	11.5	0.48	14.0	0.83	0.21	0.00
Bird egg	Oslofjord	3.36	0.63	22.2	2.10	0.39	1.91
Bird egg	Oslofjord	0.00	0.78	45.1	2.37	0.33	0.32
Bird egg	Oslofjord	<0.3	2.79	108	10.2	3.97	4.37
Bird egg	Oslofjord	<0.1	4.56	109	4.88	2.07	4.30
Polychaets	Oslofjord	<0.2	58.0	<0.5	<0.3	0.57	<0.2
Polychaets	Oslofjord	4.71	25.4	<0.5	2.43	0.09	<0.2
Polychaets	Oslofjord						
Fish	Oslofjord	<1	<0.5	22.7	<3.5	0.52	<0.8
Fish	Oslofjord	<1.5	<0.4	<3	<5.3	0.36	<1.2
Fish	Oslofjord	<1.4	<0.5	<2.9	<5.2	0.89	<1.1
Fish	Oslofjord	49.4	<0.3	<2.4	3.46	1.19	<1.3
Fish	Oslofjord	<4.7	<0.5	<9.5	<17.1	1.20	<3.7
Fish	Oslofjord	7 014	<0.7	37.0	<14.3	0.72	8.27
Fish	Oslofjord	<1.3	<0.6	<2.7	<4.9	0.78	2.82
Fish	Oslofjord	<4.8	<0.6	138	<17.5	0.83	<3.8
Fish	Oslofjord	<2.3	<0.5	365	19.0	0.46	<1.9
Fish	Oslofjord	<2.8	<0.9	105	11.9	4.57	3.32
Fish	Oslofjord	<1.4	<0.8	781	<4.9	0.98	<1.1
Fish	Oslofjord	<3.4	1.93	254	12.5	3.63	<2.7
Fish	Oslofjord	<1.2	<0.6	82.6	<4.5	2.21	<1
Fish	Oslofjord	<2.7	2.06	153	<9.8	0.88	<2.1
Fish	Oslofjord						
Prawns	Oslofjord	63.3	92.6	58.5	<0.6	1.10	3.52
Prawns	Oslofjord	<0.1	62.8	10.3	0.45	0.20	0.98
Prawns	Oslofjord	21.2	66.6	34.1	1.48	0.66	1.97
Polychaets	Frognerkilen	4.07	9.03	4.02	0.34	0.10	0.49
Polychaets	Alna	1.91	7.86	7.66	0.15	0.20	0.00
Polychaets	Bekkelaget	1.62	8.90	1.47	0.08	0.03	0.02
Mussel	Frognerkilen	<1	212	<2.8	<1.6	0.95	<0.8
Mussel	Alna	<0.4	80.7	77.1	2.27	1.52	6.31
Mussel	Bekkelaget	0.32	14.7	7.12	0.60	<0.1	0.92

Compartment spec.	Area	BPS ng/g (w.w.)	4-NP ng/g (w.w.)	4-OP ng/g (w.w.)	PFBA ng/g (w.w.)	PFPA ng/g (w.w.)	PFHxA ng/g (w.w.)
Plankton	Oslofjord	4.83	1.68	43.2	<4	<1	<0.5
Plankton	Oslofjord	3.38	0.13	<0.1	<4	<1	<0.5
Plankton	Oslofjord	0.24	0.00	0.02	<4	<1	<0.5
Bird egg	Oslofjord	2.10	0.32	3.74	<4	<1	<0.5
Bird egg	Oslofjord	2.20	0.31	72.6	<4	<1	<0.5
Bird egg	Oslofjord	0.78	0.92	29.6	<4	<1	<0.5
Bird egg	Oslofjord	44.2	21.9	4 468	<4	<1	<0.5
Bird egg	Oslofjord	4.22	0.42	26.3	<4	<1	<0.5
Bird egg	Oslofjord	1.94	0.34	85.3	<4	<1	<0.5
Bird egg	Oslofjord	2.02	1.29	553	<4	<1	<0.5
Bird egg	Oslofjord	0.26	0.46	8.09	<4	<1	<0.5
Bird egg	Oslofjord	0.00	1.40	152	<4	<1	<0.5
Bird egg	Oslofjord	1.70	0.48	180	<4	<1	<0.5
Bird egg	Oslofjord	0.00	<0.1	157	<4	<1	<0.5
Bird egg	Oslofjord	2.42	0.41	208	<4	<1	<0.5
Bird egg	Oslofjord	1.22	1.14	4.43	<4	<1	<0.5
Bird egg	Oslofjord	14.3	5.08	23.4	<4	<1	<0.5
Bird egg	Oslofjord	5.41	1.68	8.82	<4	<1	<0.5
Polychaets	Oslofjord	2.35	0.00	25.0	<4	<1	<0.5
Polychaets	Oslofjord	0.06	6.72	<0.5	<4	<1	<0.5
Polychaets	Oslofjord				<4	<1	<0.5
Fish	Oslofjord	4.12	173	<11.7	<2	<2	<0.4
Fish	Oslofjord	7.65	13.7	0.83	<2	<2	<0.4
Fish	Oslofjord	9.37	2.24	2.53	<2	<2	<0.4
Fish	Oslofjord	8.98	0.01	0.04	<2	<2	<0.4
Fish	Oslofjord	20.5	0.05	0.09	<2	<2	<0.4
Fish	Oslofjord	19.4	0.12	0.14	<2	<2	<0.4
Fish	Oslofjord	6.69	7.38	3.75	<2	<2	<0.4
Fish	Oslofjord	17.4			<2	<2	<0.4
Fish	Oslofjord	13.1	2.21	1.05	<2	<2	<0.4
Fish	Oslofjord	15.1			<2	<2	<0.4
Fish	Oslofjord	1.93	165	38.5	<2	<2	<0.4
Fish	Oslofjord	12.4			<2	<2	<0.4
Fish	Oslofjord	0.62	53 992	26 449	<2	<2	<0.4
Fish	Oslofjord	<0.5	0.21	0.31	<2	<2	<0.4
Fish	Oslofjord				<2	<2	<0.4
Prawns	Oslofjord	2.87	0.08	1.68	<4	<1	<0.5
Prawns	Oslofjord	1.74	18.2	25.2	<4	<1	<0.5
Prawns	Oslofjord	1.34	28.7	321	<4	<1	<0.5
Polychaets	Frognerkilen	0.29	0.06	1.07	<4	<1	<0.5
Polychaets	Alna	0.31	0.04	0.79	<4	<1	<0.5
Polychaets	Bekkelaget	0.12	0.00	0.78	<4	<1	<0.5
Mussel	Frognerkilen	<0.3	2.25	34.6	<2	<3	<1
Mussel	Alna	1.89	0.00	20.3	<2	<3	<1
Mussel	Bekkelaget	0.00	0.10	0.00	<2	<3	<1

Compartment spec.	Area	PFHpA ng/g (w.w.)	PFOA ng/g (w.w.)	PFNA ng/g (w.w.)	PFDA ng/g (w.w.)	PFUdA ng/g (w.w.)	PFDoA ng/g (w.w.)
Plankton	Oslofjord	<0.3	<0.4	<0.5	<0.5	<0.3	<0.3
Plankton	Oslofjord	<0.3	<0.4	<0.5	<0.5	<0.3	<0.3
Plankton	Oslofjord	<0.3	<0.4	<0.5	<0.5	<0.3	<0.3
Bird egg	Oslofjord	<0.3	<0.4	<0.5	0.91	0.53	0.37
Bird egg	Oslofjord	<0.3	<0.4	<0.5	<0.5	0.42	0.51
Bird egg	Oslofjord	<0.3	0.58	<0.5	<0.5	0.39	1.1
Bird egg	Oslofjord	<0.3	<0.4	<0.5	0.67	1.3	0.46
Bird egg	Oslofjord	<0.3	<0.4	<0.5	<0.5	<0.3	0.4
Bird egg	Oslofjord	<0.3	<0.4	0.64	1.7	1.1	2.2
Bird egg	Oslofjord	<0.3	<0.4	<0.5	<0.5	0.58	0.51
Bird egg	Oslofjord	<0.3	<0.4	<0.5	<0.5	<0.3	<0.3
Bird egg	Oslofjord	<0.3	<0.4	<0.5	<0.5	0.9	0.5
Bird egg	Oslofjord	<0.3	<0.4	<0.5	<0.5	<0.3	<0.3
Bird egg	Oslofjord	<0.3	<0.4	<0.5	<0.5	0.45	0.44
Bird egg	Oslofjord	<0.3	<0.4	<0.5	0.54	0.52	0.78
Bird egg	Oslofjord	<0.3	<0.4	<0.5	0.61	1.2	0.92
Bird egg	Oslofjord	<0.3	<0.4	<0.5	<0.5	0.36	<0.3
Bird egg	Oslofjord	<0.3	0.57	<0.5	<0.5	<0.3	0.99
Polychaets	Oslofjord	<0.3	<0.4	<0.5	<0.5	0.39	0.38
Polychaets	Oslofjord	<0.3	<0.4	0.64	<0.5	0.43	0.56
Polychaets	Oslofjord	<0.3	<0.4	<0.5	<0.5	0.32	0.5
Fish	Oslofjord	<0.4	<0.4	<0.5	0.54	0.79	2.67
Fish	Oslofjord	<0.4	<0.4	<0.5	<0.5	<0.4	0.82
Fish	Oslofjord	<0.4	<0.4	<0.5	<0.5	4.8	1.23
Fish	Oslofjord	<0.4	<0.4	<0.5	<0.5	0.49	1.38
Fish	Oslofjord	<0.4	<0.4	<0.5	<0.5	0.62	0.82
Fish	Oslofjord	<0.4	<0.4	<0.5	<0.5	0.8	0.57
Fish	Oslofjord	<0.4	<0.4	<0.5	<0.5	<0.4	1.18
Fish	Oslofjord	<0.4	<0.4	<0.5	<0.5	<0.4	0.57
Fish	Oslofjord	<0.4	<0.4	<0.5	<0.5	<0.4	0.79
Fish	Oslofjord	<0.4	<0.4	<0.5	0.51	<0.4	1.69
Fish	Oslofjord	<0.4	<0.4	<0.5	<0.5	<0.4	<0.4
Fish	Oslofjord	<0.4	<0.4	<0.5	<0.5	<0.4	0.77
Fish	Oslofjord	<0.4	<0.4	<0.5	<0.5	0.45	1.55
Fish	Oslofjord	<0.4	<0.4	<0.5	<0.5	0.47	0.79
Fish	Oslofjord	<0.4	<0.4	<0.5	0.61	0.8	0.83
Prawns	Oslofjord	<0.3	<0.4	<0.5	0.55	1.5	1.8
Prawns	Oslofjord	<0.3	<0.4	<0.5	0.9	1.5	2.1
Prawns	Oslofjord	<0.3	<0.4	<0.5	0.78	1.5	1.7
Polychaets	Frognerkilen	<0.3	<0.4	<0.5	<0.5	<0.3	<0.3
Polychaets	Alna	<0.3	<0.4	<0.5	<0.5	<0.3	<0.3
Polychaets	Bekkelaget	<0.3	<0.4	<0.5	<0.5	<0.3	0.64
Mussel	Frognerkilen	<0.5	<0.4	<0.5	<0.8	<0.4	<0.5
Mussel	Alna	<0.5	<0.4	<0.5	<0.8	<0.4	<0.5
Mussel	Bekkelaget	<0.5	<0.4	<0.5	<0.8	<0.4	<0.5

Compartment spec.	Area	PFTrA ng/g (w.w.)	PFTeA ng/g (w.w.)	PFBS ng/g (w.w.)	PFHxS ng/g (w.w.)	PFOS ng/g (w.w.)	ip-PFNS ng/g (w.w.)
Plankton	Oslofjord	<0.3	<0.3	<0.05	<0.05	0.07	<0.03
Plankton	Oslofjord	<0.3	<0.3	<0.05	<0.05	0.09	<0.03
Plankton	Oslofjord	<0.3	<0.3	<0.05	<0.05	0.08	<0.03
Bird egg	Oslofjord	<0.3	0.37	<0.05	0.04	3.0	<0.03
Bird egg	Oslofjord	0.42	0.44	<0.05	1.2	4.8	<0.03
Bird egg	Oslofjord	0.36	0.41	<0.05	0.03	1.2	<0.03
Bird egg	Oslofjord	0.68	<0.3	<0.05	0.19	14	<0.03
Bird egg	Oslofjord	<0.3	<0.3	<0.05	0.08	11	<0.03
Bird egg	Oslofjord	0.8	1.4	<0.05	0.09	5.2	<0.03
Bird egg	Oslofjord	0.51	<0.3	<0.05	0.15	6.5	<0.03
Bird egg	Oslofjord	<0.3	<0.3	<0.05	0.07	1.2	<0.03
Bird egg	Oslofjord	1.1	0.31	<0.05	0.1	8.9	<0.03
Bird egg	Oslofjord	<0.3	<0.3	<0.05	0.16	5.4	<0.03
Bird egg	Oslofjord	0.66	<0.3	<0.05	0.12	8.5	<0.03
Bird egg	Oslofjord	0.37	0.69	<0.05	0.09	6.0	<0.03
Bird egg	Oslofjord	0.79	0.46	<0.05	0.41	13	<0.03
Bird egg	Oslofjord	<0.3	<0.3	<0.05	0.05	3.8	<0.03
Bird egg	Oslofjord	0.48	0.56	<0.05	0.08	6.9	<0.03
Polychaets	Oslofjord	0.3	<0.3	0.72	0.08	0.35	<0.03
Polychaets	Oslofjord	0.62	<0.3	0.54	0.09	0.48	<0.03
Polychaets	Oslofjord	0.53	<0.3	0.42	0.15	0.39	<0.03
Fish	Oslofjord	3.48	<0.4	0.41	0.11	40.6	<0.2
Fish	Oslofjord	0.46	<0.4	0.29	<0.1	15.2	<0.2
Fish	Oslofjord	4.28	<0.4	0.54	0.12	18.9	<0.2
Fish	Oslofjord	1.32	<0.4	0.19	0.12	25.6	<0.2
Fish	Oslofjord	0.89	<0.4	0.6	<0.1	13.1	<0.2
Fish	Oslofjord	0.47	<0.4	<0.1	<0.1	5.9	<0.2
Fish	Oslofjord	1.15	<0.4	0.33	0.11	21.3	<0.2
Fish	Oslofjord	0.75	<0.4	0.21	<0.1	15.3	<0.2
Fish	Oslofjord	1.21	<0.4	0.56	0.11	18.9	<0.2
Fish	Oslofjord	2.04	<0.4	<0.1	<0.1	41.3	<0.2
Fish	Oslofjord	0.44	<0.4	0.3	<0.1	14.3	<0.2
Fish	Oslofjord	1.04	<0.4	0.29	<0.1	17.8	<0.2
Fish	Oslofjord	1.75	<0.4	0.6	0.18	33.2	<0.2
Fish	Oslofjord	0.46	<0.4	<0.1	<0.1	8.3	<0.2
Fish	Oslofjord	0.48	<0.4	<0.1	<0.1	12.9	<0.2
Prawns	Oslofjord	2.0	0.97	<0.05	<0.05	1.2	<0.05
Prawns	Oslofjord	2.4	1.3	<0.05	<0.05	1.4	<0.05
Prawns	Oslofjord	2.3	0.37	<0.05	<0.05	1.4	<0.05
Polychaets	Frognerkilen	<0.3	<0.3	<0.05	1.2	0.1	<0.03
Polychaets	Alna	<0.3	0.33	0.51	0.03	0.07	<0.03
Polychaets	Bekkelaget	0.67	<0.3	0.92	0.19	1.55	<0.03
Mussel	Frognerkilen	<0.5	<1	<0.1	<0.2	<0.1	<0.2
Mussel	Alna	<0.5	<1	<0.1	<0.2	<0.1	<0.2
Mussel	Bekkelaget	<0.5	<1	<0.1	<0.2	<0.1	<0.2

Compartment spec.	Area	PFDS ng/g (w.w.)	PFDoS ng/g (w.w.)	PFOSA ng/g (w.w.)	me-PFOSA ng/g (w.w.)	et-PFOSA ng/g (w.w.)	me-PFOSE ng/g (w.w.)
Plankton	Oslofjord	<0.03	<0.05	1.3	<0.1	<0.2	<2
Plankton	Oslofjord	<0.03	<0.05	1.1	<0.1	<0.2	<2
Plankton	Oslofjord	<0.03	<0.05	1.3	<0.1	<0.2	<2
Bird egg	Oslofjord	0.12	<0.05	<0.02	<0.1	<0.2	<2
Bird egg	Oslofjord	0.2	<0.05	<0.02	<0.1	<0.2	<2
Bird egg	Oslofjord	0.2	<0.05	0.05	<0.1	<0.2	<2
Bird egg	Oslofjord	0.29	<0.05	0.33	<0.1	<0.2	<2
Bird egg	Oslofjord	0.12	<0.05	<0.02	<0.1	<0.2	<2
Bird egg	Oslofjord	0.34	<0.05	0.05	<0.1	<0.2	<2
Bird egg	Oslofjord	0.18	<0.05	<0.02	<0.1	<0.2	<2
Bird egg	Oslofjord	<0.05	<0.05	<0.02	<0.1	<0.2	<2
Bird egg	Oslofjord	0.09	<0.05	<0.02	<0.1	<0.2	<2
Bird egg	Oslofjord	0.09	<0.05	<0.02	<0.1	<0.2	<2
Bird egg	Oslofjord	0.11	<0.05	<0.02	<0.1	<0.2	<2
Bird egg	Oslofjord	0.23	<0.05	0.09	<0.1	<0.2	<2
Bird egg	Oslofjord	0.73	<0.05	0.15	<0.1	<0.2	<2
Bird egg	Oslofjord	0.32	<0.05	<0.02	<0.1	<0.2	<2
Bird egg	Oslofjord	0.7	<0.05	<0.02	<0.1	<0.2	<2
Polychaets	Oslofjord	0.32	<0.05	0.54	<0.1	<0.2	<2
Polychaets	Oslofjord	0.43	<0.05	0.46	<0.1	<0.2	<2
Polychaets	Oslofjord	0.33	<0.05	0.39	<0.1	<0.2	<2
Fish	Oslofjord	6.56	<0.2	2.7	<0.2	<0.2	<3
Fish	Oslofjord	1.33	<0.2	0.34	<0.2	<0.2	<3
Fish	Oslofjord	2.4	<0.2	1.81	<0.2	<0.2	<3
Fish	Oslofjord	8.4	<0.2	11.3	<0.2	<0.2	<3
Fish	Oslofjord	1.59	<0.2	25.2	<0.2	<0.2	<3
Fish	Oslofjord	0.6	<0.2	1.28	<0.2	<0.2	<3
Fish	Oslofjord	2.57	<0.2	0.41	<0.2	<0.2	<3
Fish	Oslofjord	2.48	<0.2	9.11	<0.2	<0.2	<3
Fish	Oslofjord	3.27	<0.2	0.42	<0.2	<0.2	<3
Fish	Oslofjord	4.58	<0.2	32.8	<0.2	<0.2	<3
Fish	Oslofjord	2.27	<0.2	3.46	<0.2	<0.2	<3
Fish	Oslofjord	2.95	<0.2	13.4	<0.2	<0.2	<3
Fish	Oslofjord	4.63	<0.2	3.54	<0.2	<0.2	<3
Fish	Oslofjord	0.66	<0.2	2.13	<0.2	<0.2	<3
Fish	Oslofjord	1.06	<0.2	16.2	<0.2	<0.2	<3
Prawns	Oslofjord	0.13	<0.05	0.77	<0.1	<0.2	<2
Prawns	Oslofjord	0.14	<0.05	0.69	<0.1	<0.2	<2
Prawns	Oslofjord	0.14	<0.05	0.65	<0.1	<0.2	<2
Polychaets	Frognerkilen	<0.03	<0.05	0.15	<0.1	<0.2	<2
Polychaets	Alna	0.07	<0.05	0.24	<0.1	<0.2	<2
Polychaets	Bekkelaget	0.76	<0.05	1.07	<0.1	<0.2	<2
Mussel	Frognerkilen	<0.2	<0.2	0.47	<0.4	<0.5	<5
Mussel	Alna	<0.2	<0.2	0.51	<0.4	<0.5	<5
Mussel	Bekkelaget	<0.2	<0.2	0.35	<0.4	<0.5	<5

Compartment spec.	Area	et-PFOSE ng/g (w.w.)	6:2 FTS ng/g (w.w.)	4:2 F53B ng/g (w.w.)	6:2 F53B ng/g (w.w.)	Nap. ng/g (w.w.)	Acy. ng/g (w.w.)
Plankton	Oslofjord	<2	<0.3				
Plankton	Oslofjord	<2	<0.3				
Plankton	Oslofjord	<2	<0.3				
Bird egg	Oslofjord	<2	<0.3				
Bird egg	Oslofjord	<2	<0.3				
Bird egg	Oslofjord	<2	<0.3				
Bird egg	Oslofjord	<2	<0.3				
Bird egg	Oslofjord	<2	<0.3				
Bird egg	Oslofjord	<2	<0.3				
Bird egg	Oslofjord	<2	<0.3				
Bird egg	Oslofjord	<2	<0.3				
Bird egg	Oslofjord	<2	<0.3				
Bird egg	Oslofjord	<2	<0.3				
Bird egg	Oslofjord	<2	<0.3				
Bird egg	Oslofjord	<2	<0.3				
Bird egg	Oslofjord	<2	<0.3				
Bird egg	Oslofjord	<2	<0.3				
Bird egg	Oslofjord	<2	<0.3				
Polychaets	Oslofjord	<2	<0.3				
Polychaets	Oslofjord	<2	<0.3				
Polychaets	Oslofjord	<2	<0.3				
Fish	Oslofjord	<3	<0.3				
Fish	Oslofjord	<3	<0.3				
Fish	Oslofjord	<3	<0.3				
Fish	Oslofjord	<3	<0.3				
Fish	Oslofjord	<3	<0.3				
Fish	Oslofjord	<3	<0.3				
Fish	Oslofjord	<3	<0.3				
Fish	Oslofjord	<3	<0.3				
Fish	Oslofjord	<3	<0.3				
Fish	Oslofjord	<3	<0.3				
Fish	Oslofjord	<3	<0.3				
Fish	Oslofjord	<3	<0.3				
Fish	Oslofjord	<3	<0.3				
Fish	Oslofjord	<3	<0.3				
Fish	Oslofjord	<3	<0.3				
Prawns	Oslofjord	<2	<0.3				
Prawns	Oslofjord	<2	<0.3				
Prawns	Oslofjord	<2	<0.3				
Polychaets	Frognerkilen	<2	<0.3			<1	1.79
Polychaets	Alna	<2	<0.3			<1	1.90
Polychaets	Bekkelaget	<2	<0.3			<1	0.68
Mussel	Frognerkilen	<5	<0.4	<0.2	<0.2	<1	<0.5
Mussel	Alna	<5	<0.4	<0.2	<0.2	<1	0.58
Mussel	Bekkelaget	<5	<0.4	<0.2	<0.2	<1	<0.5

Compartment spec.	Area	Ace. ng/g (w.w.)	Fle. ng/g (w.w.)	Dbthi. ng/g (w.w.)	Phe. ng/g (w.w.)	Ant. ng/g (w.w.)	Flu. ng/g (w.w.)
Plankton	Oslofjord						
Plankton	Oslofjord						
Plankton	Oslofjord						
Bird egg	Oslofjord						
Bird egg	Oslofjord						
Bird egg	Oslofjord						
Bird egg	Oslofjord						
Bird egg	Oslofjord						
Bird egg	Oslofjord						
Bird egg	Oslofjord						
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Bird egg	Oslofjord						
Bird egg	Oslofjord						
Bird egg	Oslofjord						
Bird egg	Oslofjord						
Bird egg	Oslofjord						
Polychaets	Oslofjord						
Polychaets	Oslofjord						
Polychaets	Oslofjord						
Fish	Oslofjord						
Fish	Oslofjord						
Fish	Oslofjord						
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Fish	Oslofjord						
Fish	Oslofjord						
Fish	Oslofjord						
Fish	Oslofjord						
Fish	Oslofjord						
Prawns	Oslofjord						
Prawns	Oslofjord						
Prawns	Oslofjord						
Polychaets	Frognerkilen	0.30	0.60	0.27	2.55	2.01	22.42
Polychaets	Alna	0.80	1.57	1.10	11.27	7.37	30.18
Polychaets	Bekkelaget	0.22	0.52	0.26	2.56	1.22	5.58
Mussel	Frognerkilen	<0.5	1		3.9	0.69	12
Mussel	Alna	<0.5	1.1		5.3	0.76	16
Mussel	Bekkelaget	<0.5	0.5		2	<0.5	5.5

Compartment spec.	Area	Pyr. ng/g (w.w.)	B(a)A ng/g (w.w.)	Chr. ng/g (w.w.)	B(bj)F. ng/g (w.w.)	B(k)F. ng/g (w.w.)	B(e)P. ng/g (w.w.)
Plankton	Oslofjord						
Plankton	Oslofjord						
Plankton	Oslofjord						
Bird egg	Oslofjord						
Bird egg	Oslofjord						
Bird egg	Oslofjord						
Bird egg	Oslofjord						
Bird egg	Oslofjord						
Bird egg	Oslofjord						
Bird egg	Oslofjord						
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Bird egg	Oslofjord						
Bird egg	Oslofjord						
Bird egg	Oslofjord						
Bird egg	Oslofjord						
Bird egg	Oslofjord						
Polychaets	Oslofjord						
Polychaets	Oslofjord						
Polychaets	Oslofjord						
Fish	Oslofjord						
Fish	Oslofjord						
Fish	Oslofjord						
Fish	Oslofjord						
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Fish	Oslofjord						
Fish	Oslofjord						
Fish	Oslofjord						
Fish	Oslofjord						
Fish	Oslofjord						
Fish	Oslofjord						
Prawns	Oslofjord						
Prawns	Oslofjord						
Prawns	Oslofjord						
Polychaets	Frognerkilen	96.87	10.85	10.04	79.32	27.97	68.58
Polychaets	Alna	55.85	16.66	8.62	56.91	20.76	47.46
Polychaets	Bekkelaget	10.27	3.15	1.95	12.64	4.30	10.72
Mussel	Frognerkilen	7.4	1.2	1.4	1.9	0.55	
Mussel	Alna	12	3.2	2.5	3.7	1.1	
Mussel	Bekkelaget	2.9	0.64	0.58	0.74	<0.5	

Compartment spec.	Area	B(a)P. ng/g (w.w.)	Per. ng/g (w.w.)	I(123-cd)P. ng/g (w.w.)	Db(ac/ah)A. ng/g (w.w.)	B(ghi)P. ng/g (w.w.)	DBT ng/g (w.w.)
Plankton	Oslofjord						
Plankton	Oslofjord						
Plankton	Oslofjord						
Bird egg	Oslofjord						
Bird egg	Oslofjord						
Bird egg	Oslofjord						
Bird egg	Oslofjord						
Bird egg	Oslofjord						
Bird egg	Oslofjord						
Bird egg	Oslofjord						
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Bird egg	Oslofjord						
Bird egg	Oslofjord						
Bird egg	Oslofjord						
Bird egg	Oslofjord						
Bird egg	Oslofjord						
Polychaets	Oslofjord						
Polychaets	Oslofjord						
Polychaets	Oslofjord						
Fish	Oslofjord						
Fish	Oslofjord						
Fish	Oslofjord						
Fish	Oslofjord						
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Fish	Oslofjord						
Fish	Oslofjord						
Fish	Oslofjord						
Fish	Oslofjord						
Fish	Oslofjord						
Fish	Oslofjord						
Prawns	Oslofjord						
Prawns	Oslofjord						
Prawns	Oslofjord						
Polychaets	Frognerkilen	20.13	8.13	17.22	6.16	42.89	33.8
Polychaets	Alna	29.02	16.35	18.39	5.62	34.77	
Polychaets	Bekkelaget	6.95	10.78	4.90	1.34	8.85	
Mussel	Frognerkilen	<0.5		0.65	<0.5	1.9	8.31
Mussel	Alna	0.98		0.95	<0.5	1.8	
Mussel	Bekkelaget	<0.5		<0.5	<0.5	0.65	

Compartment spec.	Area	DOT ng/g (w.w.)	MBT ng/g (w.w.)	MOT ng/g (w.w.)	TetraBT ng/g (w.w.)	TBT ng/g (w.w.)	TPhT ng/g (w.w.)
Plankton	Oslofjord						
Plankton	Oslofjord						
Plankton	Oslofjord						
Bird egg	Oslofjord						
Bird egg	Oslofjord						
Bird egg	Oslofjord						
Bird egg	Oslofjord						
Bird egg	Oslofjord						
Bird egg	Oslofjord						
Bird egg	Oslofjord						
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Bird egg	Oslofjord						
Bird egg	Oslofjord						
Bird egg	Oslofjord						
Bird egg	Oslofjord						
Bird egg	Oslofjord						
Polychaets	Oslofjord						
Polychaets	Oslofjord						
Polychaets	Oslofjord						
Fish	Oslofjord						
Fish	Oslofjord						
Fish	Oslofjord						
Fish	Oslofjord						
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Fish	Oslofjord						
Fish	Oslofjord						
Fish	Oslofjord						
Fish	Oslofjord						
Fish	Oslofjord						
Fish	Oslofjord						
Prawns	Oslofjord						
Prawns	Oslofjord						
Prawns	Oslofjord						
Polychaets	Frognerkilen	< 0.999	19.1	< 0.999	< 0.999	124	4.22
Polychaets	Alna						
Polychaets	Bekkelaget						
Mussel	Frognerkilen	< 0.730	3.18	< 0.730	< 0.730	42	5.63
Mussel	Alna						
Mussel	Bekkelaget						

Compartment spec.	Area	TCHT ng/g (w.w.)
Plankton	Oslofjord	
Plankton	Oslofjord	
Plankton	Oslofjord	
Bird egg	Oslofjord	
Bird egg	Oslofjord	
Bird egg	Oslofjord	
Bird egg	Oslofjord	
Bird egg	Oslofjord	
Bird egg	Oslofjord	
Bird egg	Oslofjord	
Bird egg	Oslofjord	
Bird egg	Oslofjord	
Bird egg	Oslofjord	
Bird egg	Oslofjord	
Bird egg	Oslofjord	
Bird egg	Oslofjord	
Bird egg	Oslofjord	
Bird egg	Oslofjord	
Polychaets	Oslofjord	
Polychaets	Oslofjord	
Polychaets	Oslofjord	
Fish	Oslofjord	
Fish	Oslofjord	
Fish	Oslofjord	
Fish	Oslofjord	
Fish	Oslofjord	
Fish	Oslofjord	
Fish	Oslofjord	
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Fish	Oslofjord	
Fish	Oslofjord	
Fish	Oslofjord	
Fish	Oslofjord	
Fish	Oslofjord	
Fish	Oslofjord	
Prawns	Oslofjord	
Prawns	Oslofjord	
Prawns	Oslofjord	
Polychaets	Frognerkilen	< 2
Polychaets	Alna	
Polychaets	Bekkelaget	
Mussel	Frognerkilen	< 1.46
Mussel	Alna	
Mussel	Bekkelaget	

NILU-no.	NIVA-no.	Compartment	Compartment spec.	Area	Species	Tissue
13/1894	2119-1	Organism	Bird blood	Oslofjord	Herring gull	Blood
13/1895	2119-2	Organism	Bird blood	Oslofjord	Herring gull	Blood
13/1896	2119-3	Organism	Bird blood	Oslofjord	Herring gull	Blood
13/1897	2119-4	Organism	Bird blood	Oslofjord	Herring gull	Blood
13/1898	2119-5	Organism	Bird blood	Oslofjord	Herring gull	Blood
13/1899	2119-6	Organism	Bird blood	Oslofjord	Herring gull	Blood
13/1900	2119-7	Organism	Bird blood	Oslofjord	Herring gull	Blood
13/1901	2119-8	Organism	Bird blood	Oslofjord	Herring gull	Blood
13/1902	2119-9	Organism	Bird blood	Oslofjord	Herring gull	Blood
13/1903	2119-10	Organism	Bird blood	Oslofjord	Herring gull	Blood
13/1904	2119-11	Organism	Bird blood	Oslofjord	Herring gull	Blood
13/1905	2119-12	Organism	Bird blood	Oslofjord	Herring gull	Blood
13/1906	2119-13	Organism	Bird blood	Oslofjord	Herring gull	Blood
13/1907	2119-14	Organism	Bird blood	Oslofjord	Herring gull	Blood
13/1908	2119-15	Organism	Bird blood	Oslofjord	Herring gull	Blood

Compartment spec.	Area	Lipid%	PeCB ng/g (w.w.)	HCB ng/g (w.w.)	PCB-18 ng/g (w.w.)	PCB-28 ng/g (w.w.)	PCB-31 ng/g (w.w.)
Bird blood	Oslofjord	0.38	0.01	0.15	0.07	0.22	0.15
Bird blood	Oslofjord	0.45	0.01	0.11	0.04	0.19	0.11
Bird blood	Oslofjord	0.11	0.03	0.61	0.03	0.16	0.07
Bird blood	Oslofjord	0.65	0.09	3.83	0.05	0.46	0.09
Bird blood	Oslofjord	0.67	0.01	0.16	0.04	0.13	0.08
Bird blood	Oslofjord	0.48	0.01	0.12	0.06	0.20	0.14
Bird blood	Oslofjord	0.45	0.03	0.59	0.04	0.22	0.09
Bird blood	Oslofjord	0.88	0.03	0.18	0.07	0.40	0.18
Bird blood	Oslofjord	0.51	0.02	0.47	0.04	0.32	0.10
Bird blood	Oslofjord	0.21	0.01	0.12	0.08	0.28	0.18
Bird blood	Oslofjord	0.48	0.01	0.27	0.04	0.14	0.08
Bird blood	Oslofjord	0.61	0.02	0.38	0.05	0.23	0.12
Bird blood	Oslofjord	0.63	<0.01	0.15	0.04	0.14	0.09
Bird blood	Oslofjord	0.31	0.05	1.72	0.05	0.28	0.11
Bird blood	Oslofjord	0.12	<0.01	0.14	0.05	0.20	0.10

Compartment spec.	Area	PCB-33 ng/g (w.w.)	PCB-37 ng/g (w.w.)	PCB-47 ng/g (w.w.)	PCB-52 ng/g (w.w.)	PCB-66 ng/g (w.w.)	PCB-74 ng/g (w.w.)
Bird blood	Oslofjord	0.11	<0.01	0.26	0.02	0.55	0.27
Bird blood	Oslofjord	0.09	0.02	0.34	0.15	0.95	0.43
Bird blood	Oslofjord	0.06	<0.01	0.28	0.05	1.37	0.59
Bird blood	Oslofjord	0.07	<0.01	0.76	0.02	1.82	1.48
Bird blood	Oslofjord	0.06	0.02	0.08	0.02	0.17	0.10
Bird blood	Oslofjord	0.11	0.03	0.05	0.03	0.09	0.05
Bird blood	Oslofjord	0.07	0.02	0.13	0.02	0.28	0.17
Bird blood	Oslofjord	0.15	<0.02	1.08	0.19	2.45	1.26
Bird blood	Oslofjord	0.08	0.02	0.37	0.09	0.87	0.42
Bird blood	Oslofjord	0.14	0.05	0.22	0.02	0.41	0.22
Bird blood	Oslofjord	0.05	<0.01	0.11	0.03	0.24	0.14
Bird blood	Oslofjord	0.10	0.04	0.16	0.03	0.43	0.20
Bird blood	Oslofjord	0.08	0.02	0.08	0.02	0.22	0.11
Bird blood	Oslofjord	0.09	0.03	0.57	<0.01	1.02	0.78
Bird blood	Oslofjord	0.09	<0.01	0.40	0.07	0.85	0.45

Compartment spec.	Area	PCB-99 ng/g (w.w.)	PCB-101 ng/g (w.w.)	PCB-105 ng/g (w.w.)	PCB-114 ng/g (w.w.)	PCB-118 ng/g (w.w.)	PCB-122 ng/g (w.w.)
Bird blood	Oslofjord	1.62	0.07	0.95	0.08	2.81	<0.01
Bird blood	Oslofjord	2.37	0.36	1.47	0.13	4.43	<0.01
Bird blood	Oslofjord	2.08	0.08	2.75	0.21	5.85	<0.01
Bird blood	Oslofjord	6.71	0.03	4.01	0.42	12.2	<0.01
Bird blood	Oslofjord	0.52	0.02	0.35	0.03	0.92	<0.01
Bird blood	Oslofjord	0.17	0.02	0.11	<0.01	0.28	<0.01
Bird blood	Oslofjord	0.78	0.02	0.41	0.05	1.34	<0.01
Bird blood	Oslofjord	5.05	0.27	3.03	0.19	9.03	<0.01
Bird blood	Oslofjord	1.65	0.13	1.17	0.07	2.99	0.17
Bird blood	Oslofjord	1.22	0.04	0.67	0.06	1.89	<0.01
Bird blood	Oslofjord	0.49	0.03	0.28	0.02	0.82	<0.01
Bird blood	Oslofjord	0.77	0.04	0.55	0.04	1.52	0.09
Bird blood	Oslofjord	0.39	0.01	0.27	0.02	0.70	0.04
Bird blood	Oslofjord	4.40	0.20	2.14	0.27	7.31	0.72
Bird blood	Oslofjord	2.41	0.06	1.44	0.12	3.93	0.27

Compartment spec.	Area	PCB-123 ng/g (w.w.)	PCB-128 ng/g (w.w.)	PCB-138 ng/g (w.w.)	PCB-141 ng/g (w.w.)	PCB-149 ng/g (w.w.)	PCB-153 ng/g (w.w.)
Bird blood	Oslofjord	0.05	0.80	5.09	<0.01	0.03	7.37
Bird blood	Oslofjord	0.07	1.19	7.75	0.05	0.34	11.6
Bird blood	Oslofjord	0.12	0.95	5.98	<0.01	0.23	8.70
Bird blood	Oslofjord	0.15	4.20	27.5	<0.01	<0.01	44.1
Bird blood	Oslofjord	0.02	0.31	1.93	<0.01	0.09	3.10
Bird blood	Oslofjord	<0.01	0.09	0.59	<0.01	0.06	0.95
Bird blood	Oslofjord	0.02	0.45	3.42	<0.01	0.05	5.78
Bird blood	Oslofjord	0.15	1.47	9.47	<0.01	0.29	14.2
Bird blood	Oslofjord	0.06	0.84	5.60	0.04	0.35	8.31
Bird blood	Oslofjord	0.03	0.50	3.74	<0.01	0.10	5.51
Bird blood	Oslofjord	<0.01	0.21	1.46	<0.01	0.09	2.43
Bird blood	Oslofjord	0.03	0.38	2.80	0.01	0.05	4.13
Bird blood	Oslofjord	0.01	0.21	1.35	<0.01	0.09	2.24
Bird blood	Oslofjord	0.09	2.07	19.3	<0.01	0.08	31.7
Bird blood	Oslofjord	0.07	1.12	8.22	<0.01	0.35	11.5

Compartment spec.	Area	PCB-156 ng/g (w.w.)	PCB-157 ng/g (w.w.)	PCB-167 ng/g (w.w.)	PCB-170 ng/g (w.w.)	PCB-180 ng/g (w.w.)	PCB-183 ng/g (w.w.)
Bird blood	Oslofjord	0.44	0.08	0.19	1.01	2.98	0.67
Bird blood	Oslofjord	0.63	0.14	0.33	1.30	3.76	0.92
Bird blood	Oslofjord	0.59	0.11	0.32	1.22	3.21	0.66
Bird blood	Oslofjord	2.12	0.51	1.02	5.54	15.3	2.90
Bird blood	Oslofjord	0.16	0.03	0.07	0.39	1.07	0.25
Bird blood	Oslofjord	0.05	<0.01	0.01	0.11	0.37	0.09
Bird blood	Oslofjord	0.26	0.05	0.13	0.72	2.20	0.46
Bird blood	Oslofjord	0.60	0.15	0.36	0.74	1.92	0.66
Bird blood	Oslofjord	0.44	0.07	0.22	1.22	3.56	0.74
Bird blood	Oslofjord	0.26	0.06	0.11	0.57	1.57	0.41
Bird blood	Oslofjord	0.12	<0.01	0.07	0.38	1.18	0.18
Bird blood	Oslofjord	0.23	0.04	0.11	0.71	2.08	0.43
Bird blood	Oslofjord	0.12	0.03	0.06	0.29	0.85	0.20
Bird blood	Oslofjord	1.51	0.33	0.61	4.15	11.3	2.44
Bird blood	Oslofjord	0.60	0.14	0.32	1.03	3.33	0.98

Compartment spec.	Area	PCB-187 ng/g (w.w.)	PCB-189 ng/g (w.w.)	PCB-194 ng/g (w.w.)	PCB-206 ng/g (w.w.)	PCB-209 ng/g (w.w.)	TBA pg/g (w.w.)
Bird blood	Oslofjord	0.96	0.05	<0.01	0.16	0.03	4.81
Bird blood	Oslofjord	1.56	0.07	<0.01	0.12	<0.01	3.50
Bird blood	Oslofjord	2.50	0.09	<0.01	0.06	0.06	6.08
Bird blood	Oslofjord	4.80	0.26	<0.01	0.59	0.51	4.93
Bird blood	Oslofjord	0.49	0.02	<0.01	0.02	0.02	1.87
Bird blood	Oslofjord	0.27	<0.01	<0.01	<0.01	0.02	2.31
Bird blood	Oslofjord	1.44	0.04	<0.01	0.12	0.13	3.27
Bird blood	Oslofjord	2.42	<0.01	<0.01	<0.01	<0.01	5.44
Bird blood	Oslofjord	2.04	0.04	<0.01	0.19	<0.01	<3.03
Bird blood	Oslofjord	0.90	0.02	<0.01	<0.01	<0.01	4.25
Bird blood	Oslofjord	0.57	0.01	<0.01	0.13	0.03	<2
Bird blood	Oslofjord	1.03	0.02	<0.01	0.13	<0.01	1.68
Bird blood	Oslofjord	0.45	0.02	<0.01	0.04	0.01	1.38
Bird blood	Oslofjord	4.71	0.20	<0.01	0.48	0.19	2.20
Bird blood	Oslofjord	1.72	0.05	<0.01	0.15	<0.01	3.43

Compartment spec.	Area	BDE-28 pg/g (w.w.)	BDE-47 pg/g (w.w.)	BDE-49 pg/g (w.w.)	BDE-66 pg/g (w.w.)	BDE-71 pg/g (w.w.)	BDE-77 pg/g (w.w.)
Bird blood	Oslofjord	3.84	181	4.76	<2.34	<1.9	<1.42
Bird blood	Oslofjord	<3.18	260	3.31	<3.24	<2.64	1.32
Bird blood	Oslofjord	4.85	449	6.54	3.65	<1.5	<1.12
Bird blood	Oslofjord	16.5	3 774	80.1	17.4	<1.66	<1.24
Bird blood	Oslofjord	2.33	293	5.74	2.40	<1.47	<1.1
Bird blood	Oslofjord	4.29	306	5.86	<4.22	<3.43	<2.57
Bird blood	Oslofjord	5.70	618	16.0	34.6	3.87	4.06
Bird blood	Oslofjord	7.23	1 252	21.2	15.8	<4.08	2.84
Bird blood	Oslofjord	6.67	1 512	10.4	40.0	<2.31	4.01
Bird blood	Oslofjord	4.25	331	6.96	<1.75	<1.42	<1.07
Bird blood	Oslofjord	4.86	552	5.82	4.75	<1.15	<0.86
Bird blood	Oslofjord	3.88	1 094	9.39	10.7	<1.06	<0.79
Bird blood	Oslofjord	2.01	204	4.11	1.67	<1.19	<0.89
Bird blood	Oslofjord	2.80	2 824	39.9	6.45	<1.65	0.98
Bird blood	Oslofjord	7.71	439	13.8	8.66	<1.71	<1.28

Compartment spec.	Area	BDE-85 pg/g (w.w.)	BDE-99 pg/g (w.w.)	BDE-100 pg/g (w.w.)	BDE-119 pg/g (w.w.)	BDE-126 pg/g (w.w.)	BDE-138 pg/g (w.w.)
Bird blood	Oslofjord	<4.11	91.9	46.1	<3.18	<2.73	<10.49
Bird blood	Oslofjord	<3.32	141	89.7	<2.57	<2.2	<12.51
Bird blood	Oslofjord	3.98	223	129	<3.11	<2.67	<7.28
Bird blood	Oslofjord	12.2	611	959	36.8	<2.62	6.83
Bird blood	Oslofjord	6.10	365	91.1	<3.28	<2.81	10.9
Bird blood	Oslofjord	2.48	81.1	65.9	<2.44	<2.09	<10.67
Bird blood	Oslofjord	8.09	374	156	8.81	0.87	4.42
Bird blood	Oslofjord	18.1	639	335	<4.5	<3.86	<21.57
Bird blood	Oslofjord	85.0	2 365	435	6.04	<2.15	<4.16
Bird blood	Oslofjord	<3.35	108	87.2	<3.66	<3.14	<14.5
Bird blood	Oslofjord	15.0	764	181	<1.61	<1.38	27.1
Bird blood	Oslofjord	41.1	1 676	282	<2.18	<1.87	41.7
Bird blood	Oslofjord	<2.73	105	44.1	<2.11	<1.81	4.27
Bird blood	Oslofjord	11.4	669	749	12.8	2.69	10.2
Bird blood	Oslofjord	5.00	152	99.5	<4.02	1.59	6.81

Compartment spec.	Area	BDE-153 pg/g (w.w.)	BDE-154 pg/g (w.w.)	BDE-183 pg/g (w.w.)	BDE-196 pg/g (w.w.)	BDE-206 pg/g (w.w.)	BDE-209 pg/g (w.w.)
Bird blood	Oslofjord	57.1	13.1	27.3	<25.03	<21.72	332
Bird blood	Oslofjord	50.8	18.2	12.4	<19.59	<16.62	249
Bird blood	Oslofjord	69.8	29.9	33.0	26.5	<14.52	115
Bird blood	Oslofjord	283	345	49.8	22.4	23.2	851
Bird blood	Oslofjord	176	27.5	29.3	20.7	<13.72	238
Bird blood	Oslofjord	34.4	17.8	24.0	<19.04	<15.19	283
Bird blood	Oslofjord	123	47.3	27.0	20.6	15.4	422
Bird blood	Oslofjord	109	74.2	28.0	<35.96	<28.98	482
Bird blood	Oslofjord	644	140	130	95.8	91.6	2 930
Bird blood	Oslofjord	44.1	17.7	14.4	<24.37	<25.22	225
Bird blood	Oslofjord	282	68.1	87.3	45.9	16.1	836
Bird blood	Oslofjord	556	84.2	81.2	63.0	81.8	4 560
Bird blood	Oslofjord	84.8	14.1	20.2	10.3	5.59	183
Bird blood	Oslofjord	185	234	27.0	<7.55	10.1	591
Bird blood	Oslofjord	28.6	29.6	4.98	<11	<11.21	139

Compartment spec.	Area	EHTeBB pg/g (w.w.)	BEHTBP pg/g (w.w.)	a-HBCD ng/g (w.w.)	b-HBCD ng/g (w.w.)	g-HBCD ng/g (w.w.)
Bird blood	Oslofjord	8.60	32.2	<0.08	<0.19	<0.06
Bird blood	Oslofjord	<6.88	73.8	<0.07	<0.16	<0.05
Bird blood	Oslofjord	4.31	23.5	0.11	<0.23	<0.05
Bird blood	Oslofjord	8.29	27.1	0.21	<0.31	<0.07
Bird blood	Oslofjord	3.48	32.7	<0.08	<0.2	<0.05
Bird blood	Oslofjord	4.63	34.2	<0.13	<0.31	<0.07
Bird blood	Oslofjord	<11.2	27.5	0.12	<0.25	<0.06
Bird blood	Oslofjord	12.0	45.0	0.30	<0.71	<0.16
Bird blood	Oslofjord	8.69	36.8	0.54	<0.31	<0.11
Bird blood	Oslofjord	7.40	53.6	<0.17	<0.42	<0.11
Bird blood	Oslofjord	5.74	26.0	<0.09	<0.23	<0.05
Bird blood	Oslofjord	6.75	55.8	0.26	<0.25	<0.05
Bird blood	Oslofjord	4.92	19.6	<0.07	<0.16	<0.04
Bird blood	Oslofjord	4.64	19.7	0.58	<0.17	<0.04
Bird blood	Oslofjord	15.6	80.3	<0.12	<0.3	<0.07

Compartment spec.	Area	TiBP ng/g (w.w.)	TBP ng/g (w.w.)	TCEP ng/g (w.w.)	TCPP ng/g (w.w.)	DBPhP ng/g (w.w.)	BdPhP ng/g (w.w.)
Bird blood	Oslofjord	10.7	4.00	<10.5	5.33	<0.5	<2.9
Bird blood	Oslofjord	3.50	2.00	<10.5	3.80	<0.5	<2.9
Bird blood	Oslofjord	3.50	1.80	<10.5	<3.6	<0.5	<2.9
Bird blood	Oslofjord	3.50	1.80	<10.5	<3.6	<0.5	<2.9
Bird blood	Oslofjord	2.50	<1.6	<10.5	<3.6	<0.5	<2.9
Bird blood	Oslofjord	3.67	1.70	<10.5	<3.6	<0.5	<2.9
Bird blood	Oslofjord	3.00	<1.6	<10.5	<3.6	<0.5	<2.9
Bird blood	Oslofjord	16.0	12.0	<10.5	<3.6	<0.5	<2.9
Bird blood	Oslofjord	3.00	2.00	<10.5	<3.6	<0.5	<2.9
Bird blood	Oslofjord	4.00	1.70	<10.5	<3.6	<0.5	<2.9
Bird blood	Oslofjord	4.00	2.50	<10.5	<3.6	<0.5	<2.9
Bird blood	Oslofjord	3.00	2.50	<10.5	<3.6	<0.5	<2.9
Bird blood	Oslofjord	3.30	1.80	<10.5	<3.6	<0.5	<2.9
Bird blood	Oslofjord	3.50	2.30	<10.5	<3.6	<0.5	<2.9
Bird blood	Oslofjord	5.60	2.40	<10.5	<3.6	<0.5	<2.9

Compartment spec.	Area	TDCPP ng/g (w.w.)	TBEP ng/g (w.w.)	TPP ng/g (w.w.)	EHDP ng/g (w.w.)	TEHP ng/g (w.w.)	ooo-TCP ng/g (w.w.)
Bird blood	Oslofjord	<1.2	<2.5	<0.8	<0.6	<0.5	<2.4
Bird blood	Oslofjord	<1.2	<2.5	<0.8	<0.6	<0.5	<2.4
Bird blood	Oslofjord	<1.2	3.00	<0.8	<0.6	<0.5	<2.4
Bird blood	Oslofjord	<1.2	3.50	<0.8	<0.6	<0.5	<2.4
Bird blood	Oslofjord	<1.2	<2.5	<0.8	<0.6	<0.5	<2.4
Bird blood	Oslofjord	<1.2	<2.5	<0.8	0.70	<0.5	<2.4
Bird blood	Oslofjord	<1.2	<2.5	<0.8	<0.6	<0.5	<2.4
Bird blood	Oslofjord	<1.2	<2.5	<0.8	<0.6	<0.5	<2.4
Bird blood	Oslofjord	<1.2	<2.5	<0.8	<0.6	<0.5	<2.4
Bird blood	Oslofjord	<1.2	<2.5	<0.8	0.70	<0.5	<2.4
Bird blood	Oslofjord	<1.2	<2.5	<0.8	<0.6	<0.5	<2.4
Bird blood	Oslofjord	<1.2	<2.5	<0.8	<0.6	<0.5	<2.4
Bird blood	Oslofjord	<1.2	<2.5	<0.8	<0.6	<0.5	<2.4
Bird blood	Oslofjord	<1.2	<2.5	<0.8	2.50	<0.5	<2.4
Bird blood	Oslofjord	<1.2	<2.5	<0.8	1.20	<0.5	<2.4

Compartment spec.	Area	Sum-TCP ng/g (w.w.)	Hg µg/g (w.w.)	Cr µg/g (w.w.)	Fe µg/g (w.w.)	Ni µg/g (w.w.)	Cu µg/g (w.w.)
Bird blood	Oslofjord	<2.4	0.02	0.01	376	0.00	0.49
Bird blood	Oslofjord	<2.4	0.06	0.00	514	<0	0.49
Bird blood	Oslofjord	<2.4	0.03	0.00	354	0.00	0.52
Bird blood	Oslofjord	<2.4	0.13	0.00	498	0.00	0.52
Bird blood	Oslofjord	<2.4	0.02	<0	514	<0	0.37
Bird blood	Oslofjord	<2.4	0.02	0.01	431	0.00	0.55
Bird blood	Oslofjord	<2.4	0.05	0.00	513	0.00	0.44
Bird blood	Oslofjord	<2.4	0.04	0.01	389	<0.01	0.56
Bird blood	Oslofjord	<2.4	0.05	0.01	464	<0	0.56
Bird blood	Oslofjord	<2.4	0.04	<0	552	<0.01	0.50
Bird blood	Oslofjord	<2.4	0.08	<0	490	<0	0.58
Bird blood	Oslofjord	<2.4	0.05	0.00	554	<0	0.57
Bird blood	Oslofjord	<2.4	0.06	0.00	507	0.00	0.38
Bird blood	Oslofjord	<2.4	0.05	0.00	426	<0	0.46
Bird blood	Oslofjord	<2.4	0.15	0.00	541	<0	0.75

Compartment spec.	Area	Zn µg/g (w.w.)	As µg/g (w.w.)	Ag µg/g (w.w.)	Cd µg/g (w.w.)	Pb µg/g (w.w.)	SCCP ng/g (w.w.)
Bird blood	Oslofjord	3.94	<0	0.00	0.00	0.08	<0.5
Bird blood	Oslofjord	5.72	0.07	0.00	0.00	0.07	3.00
Bird blood	Oslofjord	5.38	0.44	0.00	0.00	0.21	3.90
Bird blood	Oslofjord	5.12	0.06	<0	0.00	0.13	<0.6
Bird blood	Oslofjord	6.00	0.01	<0	<0	0.08	<0.6
Bird blood	Oslofjord	5.24	0.00	<0	0.00	0.18	<0.6
Bird blood	Oslofjord	5.43	0.01	0.00	0.00	0.09	<0.4
Bird blood	Oslofjord	7.96	0.06	0.00	<0	0.07	6.00
Bird blood	Oslofjord	7.77	0.02	0.00	0.00	0.40	20.0
Bird blood	Oslofjord	6.85	0.02	<0	0.00	0.05	<0.4
Bird blood	Oslofjord	5.66	0.05	<0	<0	0.13	4.80
Bird blood	Oslofjord	7.45	0.05	0.00	0.00	0.23	<0.4
Bird blood	Oslofjord	4.97	0.05	<0	<0	0.06	<0.3
Bird blood	Oslofjord	6.01	0.11	0.00	0.00	0.15	<0.3
Bird blood	Oslofjord	6.16	0.15	0.00	0.00	0.18	26.0

Compartment spec.	Area	MCCP ng/g (w.w.)	D4 ng/g (w.w.)	D5 ng/g (w.w.)	D6 ng/g (w.w.)	BPA ng/g (w.w.)	TBBPA ng/g (w.w.)
Bird blood	Oslofjord	<0.3	<0.65	<0.49	<2.5	<0.2	0.60
Bird blood	Oslofjord	<0.2	<0.65	<0.49	<2.5	<0.3	1.18
Bird blood	Oslofjord	<0.4	<0.65	0.91	<2.5	<0.8	<0.5
Bird blood	Oslofjord	<0.3	<0.65	<0.49	<2.5	<0.3	<0.8
Bird blood	Oslofjord	<0.7	<0.65	<0.49	<2.5	<0.4	<0.8
Bird blood	Oslofjord	<0.6	<0.65	<0.49	<2.5	<0.5	<3.4
Bird blood	Oslofjord	<0.4	<0.65	<0.49	<2.5	<0.5	<3.8
Bird blood	Oslofjord	<1.2	<0.65	2.31	<2.5	<0.3	<1.7
Bird blood	Oslofjord	<0.4	<0.65	<0.49	<2.5	<0.5	<2.7
Bird blood	Oslofjord	<0.6	<0.65	<0.49	<2.5	<0.4	3.91
Bird blood	Oslofjord	<0.4	<0.65	<0.49	<2.5	<0.3	<3.1
Bird blood	Oslofjord	2.30	<0.65	<0.49	<2.5	<0.7	<4.4
Bird blood	Oslofjord	3.10	<0.65	<0.49	<2.5	<0.6	<3.7
Bird blood	Oslofjord	<0.7	<0.65	<0.49	<2.5	56.3	<0.3
Bird blood	Oslofjord	3.40	<0.65	<0.49	<2.5	<0.6	<0.4

Compartment spec.	Area	44-BPF ng/g (w.w.)	22-BPF ng/g (w.w.)	BPAF ng/g (w.w.)	BPBP ng/g (w.w.)	BPS ng/g (w.w.)	4-NP ng/g (w.w.)
Bird blood	Oslofjord	<0.6	8.34	3.63	8.95	28.4	4.39
Bird blood	Oslofjord	<0.7	7.53	2.95	7.19	26.3	4.79
Bird blood	Oslofjord	35.7	9.37	1.55	0.82	0.70	7.13
Bird blood	Oslofjord	<0.9	9.56	4.77	3.51	26.7	10.5
Bird blood	Oslofjord	<1	7.63	5.07	7.78	28.2	12.5
Bird blood	Oslofjord	<1.3	17.0	4.98	2.54	22.2	0.38
Bird blood	Oslofjord	<1.4	12.9	3.71	2.39	14.5	45.1
Bird blood	Oslofjord	126	32.6	5.20	7.60	7.75	22.3
Bird blood	Oslofjord	208	78.8	5.15	4.60	7.18	0.62
Bird blood	Oslofjord	27.5	17.9	5.48	8.61	2.92	<2.3
Bird blood	Oslofjord	12.3	15.5	2.59	4.07	9.04	0.18
Bird blood	Oslofjord	8.71	18.4	5.66	12.4	6.97	9.22
Bird blood	Oslofjord	32.5	18.5	5.38	2.82	18.7	32.4
Bird blood	Oslofjord	36.0	2.43	0.10	0.92	<0.1	<0.1
Bird blood	Oslofjord	<1.2	18.7	<0.1	<0.5	<0.1	0.13

Compartment spec.	Area	4-OP ng/g (w.w.)	PFBA ng/ml	PFPA ng/ml	PFHxA ng/ml	PFHpA ng/ml	PFOA ng/ml
Bird blood	Oslofjord	115	<4	<1	<0.5	<0.3	<0.4
Bird blood	Oslofjord	53.9	<4	<1	<0.5	<0.3	<0.4
Bird blood	Oslofjord	0.30	<4	<1	<0.5	<0.3	0.58
Bird blood	Oslofjord	69.9	<4	<1	<0.5	<0.3	<0.4
Bird blood	Oslofjord	91.8	<4	<1	<0.5	<0.3	<0.4
Bird blood	Oslofjord	77.5	<4	<1	<0.5	<0.3	<0.4
Bird blood	Oslofjord	22.8	<4	<1	<0.5	<0.3	<0.4
Bird blood	Oslofjord	8.86	<4	<1	<0.5	<0.3	0.48
Bird blood	Oslofjord	6.53	<4	<1	<0.5	<0.3	0.70
Bird blood	Oslofjord	8 649	<4	<1	<0.5	<0.3	<0.4
Bird blood	Oslofjord	0.56	<4	<1	<0.5	<0.3	<0.4
Bird blood	Oslofjord	5.82	<4	<1	<0.5	<0.3	<0.4
Bird blood	Oslofjord	19.3	<4	<1	<0.5	<0.3	<0.4
Bird blood	Oslofjord	0.15	<4	<1	<0.5	<0.3	<0.4
Bird blood	Oslofjord	0.13	<4	<1	<0.5	<0.3	0.57

Compartment spec.	Area	PFNA ng/ml	PFDA ng/ml	PFUdA ng/ml	PFDoA ng/ml	PFTrA ng/ml	PFTeA ng/ml
Bird blood	Oslofjord	<0.6	0.81	<0.3	<0.3	<0.3	<0.3
Bird blood	Oslofjord	<0.6	0.91	0.61	0.43	0.37	0.39
Bird blood	Oslofjord	<0.6	0.75	<0.3	<0.3	<0.3	<0.3
Bird blood	Oslofjord	0.66	0.8	0.45	<0.3	0.39	<0.3
Bird blood	Oslofjord	0.72	1.9	0.87	2.1	0.75	1.0
Bird blood	Oslofjord	<0.6	<0.6	0.33	<0.3	<0.3	<0.3
Bird blood	Oslofjord	<0.6	<0.6	0.47	0.54	0.66	0.42
Bird blood	Oslofjord	<0.6	<0.6	<0.3	<0.3	<0.3	<0.3
Bird blood	Oslofjord	<0.6	<0.6	<0.3	0.32	0.63	<0.3
Bird blood	Oslofjord	<0.6	<0.6	<0.3	<0.3	<0.3	<0.3
Bird blood	Oslofjord	<0.6	<0.6	0.43	0.50	<0.3	<0.3
Bird blood	Oslofjord	<0.6	<0.6	<0.3	<0.3	<0.3	<0.3
Bird blood	Oslofjord	<0.6	<0.6	0.31	<0.3	<0.3	<0.3
Bird blood	Oslofjord	<0.6	<0.6	<0.3	<0.3	<0.3	<0.3
Bird blood	Oslofjord	<0.6	<0.6	0.66	0.76	0.79	0.38

Compartment spec.	Area	PFBS ng/ml	PFHxS ng/ml	PFOS ng/ml	ip-PFNS ng/ml	PFDS ng/ml	PFDoS ng/ml
Bird blood	Oslofjord	<0.05	0.14	1.1	<0.03	0.06	<0.05
Bird blood	Oslofjord	<0.05	0.2	6.9	<0.03	0.15	<0.05
Bird blood	Oslofjord	<0.05	0.36	2.4	<0.03	0.26	<0.05
Bird blood	Oslofjord	<0.05	0.56	3.7	<0.03	0.18	<0.05
Bird blood	Oslofjord	<0.05	0.27	6.7	<0.03	0.18	<0.05
Bird blood	Oslofjord	<0.05	0.21	1.3	<0.03	0.17	<0.05
Bird blood	Oslofjord	<0.05	0.16	8.1	<0.03	0.23	<0.05
Bird blood	Oslofjord	<0.05	0.21	2.2	<0.03	0.09	<0.05
Bird blood	Oslofjord	<0.05	0.33	1.6	<0.03	<0.05	<0.05
Bird blood	Oslofjord	<0.05	<0.02	1.0	<0.03	0.05	<0.05
Bird blood	Oslofjord	<0.05	0.19	2.3	<0.03	0.06	<0.05
Bird blood	Oslofjord	<0.05	0.20	1.6	<0.03	0.13	<0.05
Bird blood	Oslofjord	<0.05	0.06	1.5	<0.03	0.13	<0.05
Bird blood	Oslofjord	<0.05	0.18	1.9	<0.03	<0.05	<0.05
Bird blood	Oslofjord	<0.05	0.54	4.4	<0.03	0.17	<0.05

Compartment spec.	Area	PFOSA ng/ml	me-PFOSA ng/ml	et-PFOSA ng/ml	me-PFOSE ng/ml	et-PFOSE ng/ml	6:2 FTS ng/ml
Bird blood	Oslofjord	<0.02	<0.1	<0.2	<2	<2	<0.3
Bird blood	Oslofjord	<0.02	<0.1	<0.2	<2	<2	<0.3
Bird blood	Oslofjord	0.04	<0.1	<0.2	<2	<2	<0.3
Bird blood	Oslofjord	<0.02	<0.1	<0.2	<2	<2	<0.3
Bird blood	Oslofjord	<0.02	<0.1	<0.2	<2	<2	<0.3
Bird blood	Oslofjord	<0.02	<0.1	<0.2	<2	<2	<0.3
Bird blood	Oslofjord	<0.02	<0.1	<0.2	<2	<2	<0.3
Bird blood	Oslofjord	0.19	<0.1	<0.2	<2	<2	<0.3
Bird blood	Oslofjord	<0.02	<0.1	<0.2	<2	<2	<0.3
Bird blood	Oslofjord	<0.02	<0.1	<0.2	<2	<2	<0.3
Bird blood	Oslofjord	<0.02	<0.1	<0.2	<2	<2	<0.3
Bird blood	Oslofjord	<0.02	<0.1	<0.2	<2	<2	<0.3
Bird blood	Oslofjord	<0.02	<0.1	<0.2	<2	<2	<0.3
Bird blood	Oslofjord	<0.02	<0.1	<0.2	<2	<2	<0.3
Bird blood	Oslofjord	0.07	<0.1	<0.2	<2	<2	<0.3

NILU-no.	NIVA-no.	Compartment	Compartment spec.	Area
13/1924	Pr. 1	Storm water	Water	Bryn Ring3/E6
13/1925	Pr. 2	Storm water	Water	Breivoll/Alnabru Tem.
13/1926	Pr. 3	Storm water	Water	Breivoll E6, Downstr. Term.
13/1927	Pr. 4	Storm water	Water	Hasle, snow dep.
13/1928	Pr. 1	Storm water	Particles	Bryn Ring3/E6
13/1929	Pr. 2	Storm water	Particles	Breivoll/Alnabru Tem.
13/1930	Pr. 3	Storm water	Particles	Breivoll E6, Downstr. Term.
13/1931	Pr. 4	Storm water	Particles	Hasle, snow dep.

NILU-no.	NIVA-no.	Compartment	Compartment spec.	Area
13/1933	13-2117-01	Sediment	Sediment	Alna
13/1934	13-2117-02	Sediment	Sediment	Alna
13/1935	13-2117-03	Sediment	Sediment	Alna
13/1938	13_2117-04	Sediment	Sediment	Bekkelaget
13/1939	13-2117-05	Sediment	Sediment	Bekkelaget
13/1940	13-2117-06	Sediment	Sediment	Bekkelaget
13/1943	13-2117-07	Sediment	Sediment	Frognerkilen
13/1944	13-2117-08	Sediment	Sediment	Frognerkilen
13/1945	13-2117-09	Sediment	Sediment	Frognerkilen

Compartment spec.	Area	PeCB ng/L	HCB ng/L	PCB-18 ng/L	PCB-28 ng/L	PCB-31 ng/L
Water	Bryn Ring3/E6	0.05	0.08	0.02	0.08	0.03
Water	Breivoll/Alnabru Tem.	0.04	0.08	0.02	0.08	0.03
Water	Breivoll E6, Downstr. Term.	0.26	0.43	0.15	0.27	0.14
Water	Hasle, snow dep.	0.03	0.07	0.01	0.08	0.02
Particles	Bryn Ring3/E6	<0.01	0.18	0.02	0.12	0.05
Particles	Breivoll/Alnabru Tem.	<0.01	0.14	<0.02	0.10	0.05
Particles	Breivoll E6, Downstr. Term.	0.32	0.71	0.17	0.60	0.40
Particles	Hasle, snow dep.	0.12	0.85	<0.03	0.18	0.08

Compartment spec.	Area	PeCB ng/g (d.w.)	HCB ng/g (d.w.)	PCB-18 ng/g (d.w.)	PCB-28 ng/g (d.w.)	PCB-31 ng/g (d.w.)
Sediment	Alna	0.35	2.80	0.42	1.34	0.98
Sediment	Alna	0.37	3.68	0.43	1.39	1.01
Sediment	Alna	0.41	2.58	0.39	1.31	1.00
Sediment	Bekkelaget	0.13	0.91	0.08	0.43	0.28
Sediment	Bekkelaget	0.15	0.82	0.12	0.65	0.43
Sediment	Bekkelaget	0.28	2.31	0.75	2.39	1.77
Sediment	Frognerkilen	0.11	0.92	0.06	0.33	0.21
Sediment	Frognerkilen	0.20	1.94	0.62	2.26	1.72
Sediment	Frognerkilen	0.21	1.86	0.69	2.32	1.82

Compartment spec.	Area	PCB-33 ng/L	PCB-37 ng/L	PCB-47 ng/L	PCB-52 ng/L	PCB-66 ng/L
Water	Bryn Ring3/E6	0.02	<0.01	0.41	0.33	0.68
Water	Breivoll/Alnabru Term.	<0.01	<0.01	0.35	0.28	0.63
Water	Breivoll E6, Downstr. Term.	0.05	0.07	0.65	0.67	1.15
Water	Hasle, snowdep.	0.02	<0.01	0.43	0.30	0.70
Particles	Bryn Ring3/E6	0.04	0.04	10.2	0.33	0.74
Particles	Breivoll/Alnabru Term.	<0.01	<0.02	15.7	0.24	0.50
Particles	Breivoll E6, Downstr. Term.	0.23	0.33	17.2	0.93	1.21
Particles	Hasle, snowdep.	0.05	<0.02	26.5	0.45	0.90

Compartment spec.	Area	PCB-33 ng/g (d.w.)	PCB-37 ng/g (d.w.)	PCB-47 ng/g (d.w.)	PCB-52 ng/g (d.w.)	PCB-66 ng/g (d.w.)
Sediment	Alna	0.41	0.44	6.71	2.90	2.77
Sediment	Alna	0.43	0.46	6.09	3.09	3.02
Sediment	Alna	0.43	0.43	5.89	2.52	2.57
Sediment	Bekkelaget	0.12	0.16	3.98	0.40	0.95
Sediment	Bekkelaget	0.18	0.23	3.90	0.59	1.34
Sediment	Bekkelaget	0.76	0.75	8.22	3.39	5.01
Sediment	Frognerkilen	0.09	0.12	4.82	0.28	0.69
Sediment	Frognerkilen	0.73	0.68	11.3	4.55	6.05
Sediment	Frognerkilen	0.79	0.75	12.2	3.41	5.88

Compartment spec.	Area	PCB-74 ng/L	PCB-99 ng/L	PCB-101 ng/L	PCB-105 ng/L	PCB-114 ng/L
Water	Bryn Ring3/E6	0.40	2.16	1.30	<0.02	0.07
Water	Breivoll/Alnabru Term.	0.35	1.92	1.23	0.81	0.05
Water	Breivoll E6, Downstr. Term.	0.67	3.47	2.23	1.50	0.15
Water	Hasle, snowdep.	0.40	2.03	1.23	0.86	0.07
Particles	Bryn Ring3/E6	0.43	2.18	1.54	0.99	0.07
Particles	Breivoll/Alnabru Term.	0.28	1.57	1.18	0.73	<0.01
Particles	Breivoll E6, Downstr. Term.	0.66	2.44	2.48	1.16	0.10
Particles	Hasle, snowdep.	0.50	2.85	1.92	1.23	0.09

Compartment spec.	Area	PCB-74 ng/g (d.w.)	PCB-99 ng/g (d.w.)	PCB-101 ng/g (d.w.)	PCB-105 ng/g (d.w.)	PCB-114 ng/g (d.w.)
Sediment	Alna	1.29	2.47	6.14	2.61	0.15
Sediment	Alna	1.43	2.60	6.47	2.64	0.15
Sediment	Alna	1.21	2.20	5.42	2.14	0.14
Sediment	Bekkelaget	0.38	0.65	0.90	0.67	0.03
Sediment	Bekkelaget	0.53	0.97	1.33	0.98	0.04
Sediment	Bekkelaget	2.09	3.44	7.11	3.33	0.19
Sediment	Frognerkilen	0.28	0.46	0.61	0.46	0.02
Sediment	Frognerkilen	2.69	4.09	8.44	3.99	0.24
Sediment	Frognerkilen	2.52	3.32	6.13	3.30	0.19

Compartment spec.	Area	PCB-118 ng/L	PCB-122 ng/L	PCB-123 ng/L	PCB-128 ng/L	PCB-138 ng/L
Water	Bryn Ring3/E6	3.07	<0.01	0.06	0.68	4.66
Water	Breivoll/Alnabru Tem.	2.84	<0.02	0.05	0.67	4.38
Water	Breivoll E6, Downstr. Term.	5.14	<0.01	0.10	1.27	7.60
Water	Hasle, snowdep.	2.94	<0.01	0.05	0.69	4.34
Particles	Bryn Ring3/E6	3.37	<0.01	0.05	0.87	5.35
Particles	Breivoll/Alnabru Tem.	2.50	<0.01	0.04	0.64	3.81
Particles	Breivoll E6, Downstr. Term.	3.94	<0.02	0.08	1.21	5.93
Particles	Hasle, snowdep.	4.14	0.36	0.08	1.12	6.39

Compartment spec.	Area	PCB-118 ng/g (d.w.)	PCB-122 ng/g (d.w.)	PCB-123 ng/g (d.w.)	PCB-128 ng/g (d.w.)	PCB-138 ng/g (d.w.)
Sediment	Alna	5.57	0.06	0.10	1.90	8.53
Sediment	Alna	5.65	0.06	0.10	1.91	8.44
Sediment	Alna	4.80	0.05	0.09	1.64	7.17
Sediment	Bekkelaget	1.47	0.02	0.03	0.45	2.05
Sediment	Bekkelaget	2.17	0.02	0.05	0.66	3.04
Sediment	Bekkelaget	7.29	0.09	0.15	2.32	11.1
Sediment	Frognerkilen	1.02	<0.01	0.02	0.31	1.42
Sediment	Frognerkilen	8.80	0.11	0.19	2.59	9.05
Sediment	Frognerkilen	7.08	0.09	0.16	2.18	8.12

Compartment spec.	Area	PCB-141 ng/L	PCB-149 ng/L	PCB-153 ng/L	PCB-156 ng/L	PCB-157 ng/L
Water	Bryn Ring3/E6	0.26	0.66	9.15	0.35	0.07
Water	Breivoll/Alnabru Tem.	0.24	0.67	8.65	0.32	0.07
Water	Breivoll E6, Downstr. Term.	0.46	1.35	14.8	0.58	0.14
Water	Hasle, snowdep.	0.25	0.66	8.37	0.31	0.07
Particles	Bryn Ring3/E6	0.38	0.94	9.76	0.43	0.10
Particles	Breivoll/Alnabru Tem.	0.30	0.77	7.26	0.34	0.03
Particles	Breivoll E6, Downstr. Term.	0.69	2.13	11.0	0.58	0.11
Particles	Hasle, snowdep.	0.48	1.27	11.9	0.54	0.10

Compartment spec.	Area	PCB-141 ng/g (d.w.)	PCB-149 ng/g (d.w.)	PCB-153 ng/g (d.w.)	PCB-156 ng/g (d.w.)	PCB-157 ng/g (d.w.)
Sediment	Alna	1.71	7.85	8.85	0.98	0.17
Sediment	Alna	1.77	7.92	8.76	0.98	0.17
Sediment	Alna	1.58	6.49	7.54	0.81	0.14
Sediment	Bekkelaget	0.26	1.62	2.10	0.19	0.04
Sediment	Bekkelaget	0.40	2.43	3.14	0.29	0.06
Sediment	Bekkelaget	2.05	9.91	11.9	1.18	0.19
Sediment	Frognerkilen	0.18	1.10	1.46	0.14	0.03
Sediment	Frognerkilen	1.86	9.73	12.1	1.34	0.23
Sediment	Frognerkilen	1.66	8.44	10.3	1.02	0.18

Compartment spec.	Area	PCB-167 ng/L	PCB-170 ng/L	PCB-180 ng/L	PCB-183 ng/L	PCB-187 ng/L
Water	Bryn Ring3/E6	0.27	0.90	2.35	0.61	0.67
Water	Breivoll/Alnabru Tem.	0.25	0.86	2.29	0.62	0.67
Water	Breivoll E6, Downstr. Term.	0.45	1.57	4.19	1.18	1.38
Water	Hasle, snowdep.	0.25	0.83	2.16	0.58	0.66
Particles	Bryn Ring3/E6	0.31	0.97	2.57	0.68	0.79
Particles	Breivoll/Alnabru Tem.	0.23	0.73	1.98	0.54	0.61
Particles	Breivoll E6, Downstr. Term.	0.33	1.32	3.62	0.92	1.34
Particles	Hasle, snowdep.	0.37	1.17	3.39	0.92	1.08

Compartment spec.	Area	PCB-167 ng/g (d.w.)	PCB-170 ng/g (d.w.)	PCB-180 ng/g (d.w.)	PCB-183 ng/g (d.w.)	PCB-187 ng/g (d.w.)
Sediment	Alna	0.43	2.29	5.97	1.40	3.37
Sediment	Alna	0.41	2.34	5.91	1.31	3.22
Sediment	Alna	0.35	2.02	5.11	1.09	2.67
Sediment	Bekkelaget	0.09	0.51	1.18	0.26	0.78
Sediment	Bekkelaget	0.15	0.76	1.80	0.41	1.18
Sediment	Bekkelaget	0.55	3.12	8.06	1.81	4.93
Sediment	Frognerkilen	0.07	0.36	0.83	0.18	0.54
Sediment	Frognerkilen	0.54	2.99	6.94	1.51	4.28
Sediment	Frognerkilen	0.46	2.74	6.74	1.41	4.11

Compartment spec.	Area	PCB-189 ng/L	PCB-194 ng/L	PCB-206 ng/L	PCB-209 ng/L	TBA pg/L
Water	Bryn Ring3/E6	0.05	0.43	0.24	0.02	<6.62
Water	Breivoll/Alnabru Tem.	<0.01	0.37	0.20	0.03	<4.53
Water	Breivoll E6, Downstr. Term.	0.08	0.68	0.43	0.07	126
Water	Hasle, snowdep.	0.04	0.34	0.17	0.04	<5.91
Particles	Bryn Ring3/E6	0.03	0.42	0.25	0.03	<2.64
Particles	Breivoll/Alnabru Tem.	<0.02	0.32	0.11	<0.01	<3.44
Particles	Breivoll E6, Downstr. Term.	0.07	0.60	0.30	<0.01	<2.53
Particles	Hasle, snowdep.	0.07	0.53	0.15	0.04	<4.72

Compartment spec.	Area	PCB-189 ng/g (d.w.)	PCB-194 ng/g (d.w.)	PCB-206 ng/g (d.w.)	PCB-209 ng/g (d.w.)	TBA pg/g (d.w.)
Sediment	Alna	0.11	1.05	0.83	0.18	149
Sediment	Alna	0.10	1.21	0.78	0.17	79.4
Sediment	Alna	0.09	0.76	0.60	0.13	92.7
Sediment	Bekkelaget	0.02	0.27	0.21	0.06	45.6
Sediment	Bekkelaget	0.03	0.39	0.34	0.11	48.5
Sediment	Bekkelaget	0.15	1.40	1.88	0.44	58.8
Sediment	Frognerkilen	0.02	0.18	0.14	0.04	50.1
Sediment	Frognerkilen	0.12	1.66	1.86	0.42	119
Sediment	Frognerkilen	0.12	1.52	1.58	0.36	122

Compartment spec.	Area	BDE-28 pg/L	BDE-47 pg/L	BDE-49 pg/L	BDE-66 pg/L	BDE-71 pg/L
Water	Bryn Ring3/E6	<9.26	305	46.2	<18.44	<12.68
Water	Breivoll/Alnabru Tem.	<9.75	331	49.8	<10.84	<7.45
Water	Breivoll E6, Downstr. Term.	14.8	726	94.6	<12.28	<8.45
Water	Hasle, snowdep.	<12.88	316	61.7	<16.33	<11.23
Particles	Bryn Ring3/E6	16.2	401	66.3	<6.07	<4.18
Particles	Breivoll/Alnabru Tem.	<7.72	300	42.6	<7.95	<5.47
Particles	Breivoll E6, Downstr. Term.	21.9	974	77.3	<6.32	<4.35
Particles	Hasle, snowdep.	<12.42	438	56.0	<12.31	<8.47

Compartment spec.	Area	BDE-28 pg/g (d.w.)	BDE-47 pg/g (d.w.)	BDE-49 pg/g (d.w.)	BDE-66 pg/g (d.w.)	BDE-71 pg/g (d.w.)
Sediment	Alna	12.4	366	86.3	17.8	<3
Sediment	Alna	11.2	301	99.8	11.9	<5.76
Sediment	Alna	9.93	325	89.7	19.4	<6.71
Sediment	Bekkelaget	5.26	225	33.3	6.31	<2.76
Sediment	Bekkelaget	6.97	302	43.1	7.64	<3.85
Sediment	Bekkelaget	10.3	149	45.3	5.89	<10.57
Sediment	Frognerkilen	6.46	179	30.1	8.94	7.20
Sediment	Frognerkilen	6.29	127	39.1	9.08	<3.61
Sediment	Frognerkilen	<4.52	131	42.0	<9.54	<7.5

Compartment spec.	Area	BDE-77 pg/L	BDE-85 pg/L	BDE-99 pg/L	BDE-100 pg/L	BDE-119 pg/L
Water	Bryn Ring3/E6	<11.47	<20.45	53.3	114	<12.97
Water	Breivoll/Alnabru Tem.	<6.74	294	<11.62	26.0	<12.2
Water	Breivoll E6, Downstr. Term.	<7.64	<14.89	295	244	<9.44
Water	Hasle, snowdep.	<10.16	<22.4	39.3	113	<14.21
Particles	Bryn Ring3/E6	<3.78	<8.94	71.8	147	<5.67
Particles	Breivoll/Alnabru Tem.	<4.94	<16.61	60.5	103	<10.53
Particles	Breivoll E6, Downstr. Term.	<3.93	<18.68	972	280	1 020
Particles	Hasle, snowdep.	<7.66	<17.47	98.2	154	<11.08

Compartment spec.	Area	BDE-77 pg/g (d.w.)	BDE-85 pg/g (d.w.)	BDE-99 pg/g (d.w.)	BDE-100 pg/g (d.w.)	BDE-119 pg/g (d.w.)
Sediment	Alna	1.76	<14.46	513	103	<12.81
Sediment	Alna	<4.18	<5.18	430	95.7	<11.27
Sediment	Alna	<4.86	22.7	502	106	<22.02
Sediment	Bekkelaget	<2	6.65	251	65.1	<4.8
Sediment	Bekkelaget	<2.92	<4.65	335	88.4	<6.85
Sediment	Bekkelaget	<8	<13.6	141	48.7	<11.37
Sediment	Frognerkilen	6.94	11.8	176	60.7	4.39
Sediment	Frognerkilen	<2.8	<16.2	119	33.3	<11.65
Sediment	Frognerkilen	<5.81	<8.97	153	42.5	162

Compartment spec.	Area	BDE-126 pg/L	BDE-138 pg/L	BDE-153 pg/L	BDE-154 pg/L	BDE-183 pg/L
Water	Bryn Ring3/E6	<18	<69.13	<49.59	<29.02	<32.12
Water	Breivoll/Alnabru Tem.	0.00	<62.16	<44.59	<26.09	<45.53
Water	Breivoll E6, Downstr. Term.	0.00	<42.85	<30.73	64.2	62.7
Water	Hasle, snow dep.	<15	<61.08	<43.82	<25.64	<40.77
Particles	Bryn Ring3/E6	22.5	<32.09	<23.01	35.3	<19.51
Particles	Breivoll/Alnabru Tem.	<3	<36.94	<26.5	31.8	<23.33
Particles	Breivoll E6, Downstr. Term.	1.45	<22.63	355	122	1 918
Particles	Hasle, snow dep.	<9	<36.92	<26.48	<15.5	<30.01

Compartment spec.	Area	BDE-126 pg/g (d.w.)	BDE-138 pg/g (d.w.)	BDE-153 pg/g (d.w.)	BDE-154 pg/g (d.w.)	BDE-183 pg/g (d.w.)
Sediment	Alna	<60	<18.36	111	69.9	229
Sediment	Alna	<5.71	<29.27	83.6	66.4	187
Sediment	Alna	<37	<51.46	122	62.9	380
Sediment	Bekkelaget	547	<17.8	46.2	44.5	28.5
Sediment	Bekkelaget	579	<18.94	54.1	56.5	44.5
Sediment	Bekkelaget	8.93	<32.76	<26.81	25.9	38.2
Sediment	Frognerkilen	202	20.4	41.1	46.0	44.9
Sediment	Frognerkilen	9.77	<35.76	<27.86	<16.69	<24.48
Sediment	Frognerkilen	<5.8	<19.77	<15.4	<9.22	<20.59

Compartment spec.	Area	BDE-196 pg/L	BDE-206 pg/L	BDE-209 pg/L	EHTeBB pg/L	BEHTBP pg/L
Water	Bryn Ring3/E6	<109.46	<213.38	<2688.75	77.6	2 280
Water	Breivoll/Alnabru Tem.	<939.35	<1641.89	<18106.22	47.4	2 528
Water	Breivoll E6, Downstr. Term.	<96.68	<169.57	<1740.9	91.4	947
Water	Hasle, snow dep.	<106.19	<260.03	<2906.2	35.6	1 295
Particles	Bryn Ring3/E6	<45.92	<87.85	<999.58	26.8	177
Particles	Breivoll/Alnabru Tem.	<91.12	<154.19	<1531.88	35.9	409
Particles	Breivoll E6, Downstr. Term.	367	995	23 735	36.5	755
Particles	Hasle, snow dep.	<92.65	<179.52	<1730.51	271	1 272

Compartment spec.	Area	BDE-196 pg/g (d.w.)	BDE-206 pg/g (d.w.)	BDE-209 pg/g (d.w.)	EHTeBB pg/g (d.w.)	BEHTBP pg/g (d.w.)
Sediment	Alna	<319	766	16 304	47.9	1 290
Sediment	Alna	<196	1 367	34 856	70.4	986
Sediment	Alna	<322	699	14 398	102	2 357
Sediment	Bekkelaget	64.7	285	9 141	19.2	2 113
Sediment	Bekkelaget	68.4	560	14 603	22.3	2 437
Sediment	Bekkelaget	<172.4	471	9 073	<34.1	603
Sediment	Frognerkilen	21.9	194	5 573	11.6	360
Sediment	Frognerkilen	<172	328	8 635	<27.5	591
Sediment	Frognerkilen	<117	369	7 508	14.9	746

Compartment spec.	Area	a-HBCD ng/L	b-HBCD ng/L	g-HBCD ng/L
Water	Bryn Ring3/E6	0.27	0.10	0.08
Water	Breivoll/Alnabru Tem.	0.29	<0.06	<0.02
Water	Breivoll E6, Downstr. Term.	1.25	0.17	1.35
Water	Hasle, snowdep.	0.13	<0.16	<0.04
Particles	Bryn Ring3/E6	0.71	<0.19	0.10
Particles	Breivoll/Alnabru Tem.	1.36	<0.12	0.13
Particles	Breivoll E6, Downstr. Term.	10.6	2.02	9.92
Particles	Hasle, snowdep.	0.68	<0.14	0.15

Compartment spec.	Area	a-HBCD ng/g (d.w.)	b-HBCD ng/g (d.w.)	g-HBCD ng/g (d.w.)
Sediment	Alna	4.30	0.73	2.83
Sediment	Alna	3.62	0.64	2.37
Sediment	Alna	6.57	0.98	2.80
Sediment	Bekkelaget	0.54	<0.04	0.40
Sediment	Bekkelaget	<1.72	<9.17	<1.86
Sediment	Bekkelaget	1.12	0.17	0.71
Sediment	Frognerkilen	0.35	<0.09	0.25
Sediment	Frognerkilen	0.66	<1.16	1.38
Sediment	Frognerkilen	1.17	<0.85	0.96

Compartment spec.	Area	TiBP ng/L	TBP ng/L	TCEP ng/L	TCPP ng/L	DBPhP ng/L
Water	Bryn Ring3/E6	<369	<86	526	<265	15.0
Water	Breivoll/Alnabru Tem.	<369	<86	<346	<265	11.6
Water	Breivoll E6, Downstr. Term.	<369	86.0	667	482	2.20
Water	Hasle, snowdep.	<369	<86	766	274	6.40
Particles	Bryn Ring3/E6	<130	<93	<563	<169	0.80
Particles	Breivoll/Alnabru Tem.	<130	<93	<563	<169	0.80
Particles	Breivoll E6, Downstr. Term.	3 002	<93	689	1 224	1.00
Particles	Hasle, snowdep.	<130	<93	<563	276	0.60

Compartment spec.	Area	TiBP ng/g (d.w.)	TBP ng/g (d.w.)	TCEP ng/g (d.w.)	TCPP ng/g (d.w.)	DBPhP ng/g (d.w.)
Sediment	Alna	<19.6	4.70	85.9	102	<0.4
Sediment	Alna	<19.6	4.80	<70	111	<0.4
Sediment	Alna	<19.6	5.95	93.4	170	<0.4
Sediment	Bekkelaget	<19.6	4.05	<70	<28.6	<0.4
Sediment	Bekkelaget	<19.6	4.60	<70	36.8	<0.4
Sediment	Bekkelaget	<19.6	8.80	<70	30.3	<0.4
Sediment	Frognerkilen	<19.6	3.20	<70	<28.6	<0.4
Sediment	Frognerkilen	<19.6	26.5	<70	<28.6	<0.4
Sediment	Frognerkilen	532	14.5	<70	<28.6	<0.4

Compartment spec.	Area	BdPhP ng/L	TDCPP ng/L	TBEP ng/L	TPP ng/L	EHDP ng/L
Water	Bryn Ring3/E6	<1	54.0	168	<6.1	<5.2
Water	Breivoll/Alnabru Tem.	<1	63.0	128	<6.1	<5.2
Water	Breivoll E6, Downstr. Term.	<1	33.2	208	<6.1	5.80
Water	Hasle, snowdep.	1.00	40.0	233	<6.1	7.60
Particles	Bryn Ring3/E6	<1.3	<7.9	<5.2	<10.2	<9.5
Particles	Breivoll/Alnabru Tem.	<1.3	<7.9	<5.2	<10.2	10.4
Particles	Breivoll E6, Downstr. Term.	<1.3	25.4	32.0	72.4	156
Particles	Hasle, snowdep.	<1.3	13.0	10.8	<10.2	37.2

Compartment spec.	Area	BdPhP ng/g (d.w.)	TDCPP ng/g (d.w.)	TBEP ng/g (d.w.)	TPP ng/g (d.w.)	EHDP ng/g (d.w.)
Sediment	Alna	<0.2	2.40	50.8	9.70	19.6
Sediment	Alna	<0.2	1.65	55.3	9.65	20.8
Sediment	Alna	<0.2	4.80	78.5	12.7	21.3
Sediment	Bekkelaget	<0.2	<1.4	21.0	<4.4	1.65
Sediment	Bekkelaget	<0.2	<1.4	21.6	<4.4	2.30
Sediment	Bekkelaget	<0.2	3.70	26.1	<4.4	10.1
Sediment	Frognerkilen	<0.2	<1.4	14.5	<4.4	1.95
Sediment	Frognerkilen	<0.2	1.40	17.0	5.55	7.05
Sediment	Frognerkilen	<0.2	1.45	14.7	<4.4	7.50

Compartment spec.	Area	TEHP ng/L	ooo-TCP ng/L	Sum-TCP ng/L	Hg **ng/L**	Cr µg/L
Water	Bryn Ring3/E6	1.20	<1.7	<1.7	1.56	2.45
Water	Breivoll/Alnabru Tem.	<0.5	<1.7	<1.7	1.78	1.11
Water	Breivoll E6, Downstr. Term.	1.00	<1.7	<1.7	2.49	0.99
Water	Hasle, snowdep.	<0.5	<1.7	<1.7	0.79	5.24
Particles	Bryn Ring3/E6	43.0	<0.8	<0.8	5.78	4.20
Particles	Breivoll/Alnabru Tem.	17.0	<0.8	<0.8	2.62	1.80
Particles	Breivoll E6, Downstr. Term.	99.2	<0.8	17.4	76.1	16.6
Particles	Hasle, snowdep.	51.0	<0.8	<0.8	5.55	11.7

Compartment spec.	Area	TEHP ng/g (d.w.)	ooo-TCP ng/g (d.w.)	Sum-TCP ng/g (d.w.)	Hg µg/g (d.w.)	Cr µg/g (d.w.)
Sediment	Alna	155	0.75	18.5	0.45	51.1
Sediment	Alna	160	0.70	16.1	0.44	54.0
Sediment	Alna	146	0.75	20.7	0.26	43.5
Sediment	Bekkelaget	26.3	0.15	4.65	0.13	39.6
Sediment	Bekkelaget	38.0	0.25	8.25	0.11	44.5
Sediment	Bekkelaget	55.7	2.90	32.6	0.17	37.9
Sediment	Frognerkilen	19.9	<0.05	4.05	1.08	68.3
Sediment	Frognerkilen	53.1	2.90	24.0	1.89	52.0
Sediment	Frognerkilen	51.6	2.30	24.2	1.03	53.0

Compartment spec.	Area	Fe µg/L	Ni µg/L	Cu µg/L	Zn µg/L	As µg/L
Water	Bryn Ring3/E6	199	1.01	13.1	33.8	0.44
Water	Breivoll/Alnabru Tem.	938	1.25	4.44	30.2	0.38
Water	Breivoll E6, Downstr. Term.	355	2.47	14.0	70.8	0.45
Water	Hasle, snowdep.	217	1.28	4.13	6.06	1.26
Particles	Bryn Ring3/E6	1 172	1.84	12.8	33.2	0.26
Particles	Breivoll/Alnabru Tem.	495	0.81	5.56	33.2	0.22
Particles	Breivoll E6, Downstr. Term.	6 539	7.95	40.3	211	1.88
Particles	Hasle, snowdep.	3 548	8.58	10.4	59.2	0.79

Compartment spec.	Area	Fe µg/g (d.w.)	Ni µg/g (d.w.)	Cu µg/g (d.w.)	Zn µg/g (d.w.)	As µg/g (d.w.)
Sediment	Alna	22 266	21.7	76.8	183	10.9
Sediment	Alna	21 946	22.9	85.6	201	8.56
Sediment	Alna	17 608	19.4	64.6	183	5.08
Sediment	Bekkelaget	21 697	19.0	25.7	76.3	19.2
Sediment	Bekkelaget	22 811	20.7	23.9	74.6	16.3
Sediment	Bekkelaget	23 253	17.2	29.0	84.0	24.6
Sediment	Frognerkilen	22 816	21.6	72.8	147	14.5
Sediment	Frognerkilen	20 014	20.8	76.6	160	11.2
Sediment	Frognerkilen	25 195	22.4	74.5	146	18.0

Compartment spec.	Area	Ag µg/L	Cd µg/L	Pb µg/L	SCCP ng/L	MCCP ng/L
Water	Bryn Ring3/E6	0.01	0.02	0.42	4.70	22.7
Water	Breivoll/Alnabru Tem.	0.00	0.02	0.54	6.10	12.0
Water	Breivoll E6, Downstr. Term.	0.01	0.09	1.42	31.0	26.0
Water	Hasle, snowdep.	0.00	0.03	0.44	1.90	17.0
Particles	Bryn Ring3/E6	0.01	0.02	1.66	12.0	4.40
Particles	Breivoll/Alnabru Tem.	0.01	0.04	1.21	12.0	7.70
Particles	Breivoll E6, Downstr. Term.	0.18	0.20	20.5	350	170
Particles	Hasle, snowdep.	0.03	0.17	5.81	16.0	45.0

Compartment spec.	Area	Ag µg/g (d.w.)	Cd µg/g (d.w.)	Pb µg/g (d.w.)	SCCP ng/g (d.w.)	MCCP ng/g (d.w.)
Sediment	Alna	1.43	0.56	51.7	94.0	96.0
Sediment	Alna	1.57	0.63	55.5	121	171
Sediment	Alna	1.06	0.63	40.8	81.0	224
Sediment	Bekkelaget	0.53	0.04	22.0	11.0	40.0
Sediment	Bekkelaget	0.57	0.06	20.0	21.0	21.0
Sediment	Bekkelaget	0.58	0.04	26.0	67.0	66.0
Sediment	Frognerkilen	2.06	0.18	59.5	9.60	12.0
Sediment	Frognerkilen	5.05	0.34	65.5	46.0	5.30
Sediment	Frognerkilen	1.99	0.18	59.9	42.0	3.80

Compartment spec.	Area	D4 ng/L	D5 ng/L	D6 ng/L	BPA ng/L	TBBPA ng/L
Water	Bryn Ring3/E6	<5.1	<7.48	<4.65	<0.2	5.18
Water	Breivoll/Alnabru Tem.	<5.1	<7.48	<4.65		
Water	Breivoll E6, Downstr. Term.	<5.1	<7.48	<4.65		
Water	Hasle, snow dep.	<5.1	<7.48	<4.65		
Particles	Bryn Ring3/E6	<5.1	<7.48	<4.65	103	4.20
Particles	Breivoll/Alnabru Tem.	<5.1	<7.48	<4.65	142	4.75
Particles	Breivoll E6, Downstr. Term.	<5.1	<7.48	<4.65	154	13.9
Particles	Hasle, snow dep.	<5.1	<7.48	<4.65	175	5.94

Compartment spec.	Area	D4 ng/g (d.w.)	D5 ng/g (d.w.)	D6 ng/g (d.w.)	BPA ng/g (d.w.)	TBBPA ng/g (d.w.)
Sediment	Alna	4.52	221	33.2	8.60	0.64
Sediment	Alna	3.35	193	27.9	61.9	1.04
Sediment	Alna	3.87	193	35.5	824	7.94
Sediment	Bekkelaget	1.50	178	38.2	<0.3	8.58
Sediment	Bekkelaget	1.46	162	34.8	0.00	0.99
Sediment	Bekkelaget	1.65	152	33.9	<0.4	2.71
Sediment	Frognerkilen	0.96	46.5	9.33	49.5	0.38
Sediment	Frognerkilen	1.13	54.6	10.7	254	0.87
Sediment	Frognerkilen	1.28	49.2	10.7	39.9	0.47

Compartment spec.	Area	44-BPF ng/L	22-BPF ng/L	BPAF ng/L	BPBP ng/L	BPS ng/L
Water	Bryn Ring3/E6	<0.3	47.1	2.25	<0.2	0.00
Water	Breivoll/Alnabru Tem.					
Water	Breivoll E6, Downstr. Term.					
Water	Hasle, snow dep.					
Particles	Bryn Ring3/E6	99.1	103	0.21	<0.1	0.42
Particles	Breivoll/Alnabru Tem.	129	148	0.33	1.06	1.06
Particles	Breivoll E6, Downstr. Term.	160	284	1.16	<0.2	1.85
Particles	Hasle, snow dep.	130	160	0.00	0.47	0.34

Compartment spec.	Area	44-BPF ng/g (d.w.)	22-BPF ng/g (d.w.)	BPAF ng/g (d.w.)	BPBP ng/g (d.w.)	BPS ng/g (d.w.)
Sediment	Alna	<0.1	24.3	0.03	6.92	0.00
Sediment	Alna	<0.3	11.5	0.15	40.1	0.00
Sediment	Alna	6.48	89.7	9.19	426	<0.2
Sediment	Bekkelaget	14.7	22.9	1.57	400	<0.1
Sediment	Bekkelaget	0.78	2.14	0.24	31.3	0.00
Sediment	Bekkelaget	9.81	18.5	0.78	423	<0.1
Sediment	Frognerkilen	<0.1	4.64	0.10	67.9	0.00
Sediment	Frognerkilen	9.47	39.1	6.26	418	<0.2
Sediment	Frognerkilen	2.37	4.95	0.76	47.5	0.00

Compartment spec.	Area	4-NP ng/L	4-OP ng/L	PFBA ng/L	PFPA ng/L	PFHxA ng/L
Water	Bryn Ring3/E6	<0.1	0.53	<1	<1	1.2
Water	Breivoll/Alnabru Tem.			<1	<1	1.5
Water	Breivoll E6, Downstr. Term.			<1	<1	5.3
Water	Hasle, snowdep.			<1	<1	1.8
Particles	Bryn Ring3/E6	<0.1	<0.1	<1	<1	<0.5
Particles	Breivoll/Alnabru Tem.	<0.1	<0.1	<1	<1	<0.5
Particles	Breivoll E6, Downstr. Term.	<0.5	<0.5	<1	<1	<0.5
Particles	Hasle, snowdep.	<0.2	<0.2	<1	<1	<0.5

Compartment spec.	Area	4-NP ng/g (d.w.)	4-OP ng/g (d.w.)	PFBA ng/g (d.w.)	PFPA ng/g (d.w.)	PFHxA ng/g (d.w.)
Sediment	Alna	0.09	0.00	<4	<5	<0.5
Sediment	Alna	0.43	0.87	<4	<5	<0.5
Sediment	Alna	0.95	0.59	<4	<5	<0.5
Sediment	Bekkelaget	3.35	12.6	<4	<5	<0.5
Sediment	Bekkelaget	0.00	0.10	<4	<5	<0.5
Sediment	Bekkelaget	4.44	<18.7	<4	<5	<0.5
Sediment	Frognerkilen	0.05	<0.1	<4	<5	<0.5
Sediment	Frognerkilen	39.1	43.2	<4	<5	<0.5
Sediment	Frognerkilen	0.00	0.72	<4	<5	<0.5

Compartment spec.	Area	PFHpA ng/L	PFOA ng/L	PFNA ng/L	PFDA ng/L	PFUdA ng/L
Water	Bryn Ring3/E6	0.94	2.2	0.99	<0.4	<0.3
Water	Breivoll/Alnabru Tem.	0.98	3.1	0.53	<0.4	<0.3
Water	Breivoll E6, Downstr. Term.	4.4	5.3	0.62	0.60	<0.3
Water	Hasle, snowdep.	0.77	1.5	<0.4	<0.4	<0.3
Particles	Bryn Ring3/E6	<0.3	<0.4	<0.4	<0.4	<0.3
Particles	Breivoll/Alnabru Tem.	<0.3	<0.4	<0.4	<0.4	<0.3
Particles	Breivoll E6, Downstr. Term.	<0.3	<0.4	<0.4	<0.4	<0.3
Particles	Hasle, snowdep.	<0.3	<0.4	<0.4	<0.4	<0.3

Compartment spec.	Area	PFHpA ng/g (d.w.)	PFOA ng/g (d.w.)	PFNA ng/g (d.w.)	PFDA ng/g (d.w.)	PFUdA ng/g (d.w.)
Sediment	Alna	<1	<1	<1	<1	<1
Sediment	Alna	<1	<1	<1	<1	<1
Sediment	Alna	<1	<1	<1	<1	<1
Sediment	Bekkelaget	<1	<1	<1	<1	<1
Sediment	Bekkelaget	<1	<1	<1	<1	<1
Sediment	Bekkelaget	<1	<1	<1	<1	<1
Sediment	Frognerkilen	<1	<1	<1	<1	<1
Sediment	Frognerkilen	<1	<1	<1	<1	<1
Sediment	Frognerkilen	<1	<1	<1	<1	<1

Compartment spec.	Area	PFDoA ng/L	PFTrA ng/L	PFTeA ng/L	PFBS ng/L	PFHxS ng/L
Water	Bryn Ring3/E6	<0.3	<0.3	<0.3	0.93	0.14
Water	Breivoll/Alnabru Tem.	<0.3	<0.3	<0.3	0.42	0.23
Water	Breivoll E6, Downstr. Term.	<0.3	<0.3	<0.3	1.8	0.95
Water	Hasle, snowdep.	<0.3	<0.3	<0.3	0.73	0.32
Particles	Bryn Ring3/E6	<0.3	<0.3	<0.3	<0.1	<0.1
Particles	Breivoll/Alnabru Tem.	<0.3	<0.3	<0.3	<0.1	<0.1
Particles	Breivoll E6, Downstr. Term.	<0.3	<0.3	<0.3	<0.1	<0.1
Particles	Hasle, snowdep.	<0.3	<0.3	<0.3	<0.1	<0.1

Compartment spec.	Area	PFDoA ng/g (d.w.)	PFTrA ng/g (d.w.)	PFTeA ng/g (d.w.)	PFBS ng/g (d.w.)	PFHxS ng/g (d.w.)
Sediment	Alna	<1	<1	<1	<0.3	<0.3
Sediment	Alna	<1	<1	<1	<0.3	<0.3
Sediment	Alna	<1	<1	<1	<0.3	<0.3
Sediment	Bekkelaget	<1	<1	<1	<0.3	<0.3
Sediment	Bekkelaget	<1	<1	<1	<0.3	<0.3
Sediment	Bekkelaget	<1	<1	<1	<0.3	<0.3
Sediment	Frognerkilen	<1	<1	<1	<0.3	<0.3
Sediment	Frognerkilen	<1	<1	<1	<0.3	<0.3
Sediment	Frognerkilen	<1	<1	<1	<0.3	<0.3

Compartment spec.	Area	PFOS ng/L	ip-PFNS ng/L	PFDS ng/L	PFDoS ng/L	PFOSA ng/L
Water	Bryn Ring3/E6	0.84	<0.1	<0.1	<0.1	0.10
Water	Breivoll/Alnabru Tem.	1.4	<0.1	<0.1	<0.1	0.11
Water	Breivoll E6, Downstr. Term.	2.5	<0.1	<0.1	<0.1	0.11
Water	Hasle, snowdep.	0.64	<0.1	<0.1	<0.1	0.10
Particles	Bryn Ring3/E6	<0.1	<0.1	<0.1	<0.1	<0.1
Particles	Breivoll/Alnabru Tem.	<0.1	<0.1	<0.1	<0.1	<0.1
Particles	Breivoll E6, Downstr. Term.	<0.1	<0.1	<0.1	<0.1	<0.1
Particles	Hasle, snowdep.	<0.1	<0.1	0.28	<0.1	<0.1

Compartment spec.	Area	PFOS ng/g (d.w.)	ip-PFNS ng/g (d.w.)	PFDS ng/g (d.w.)	PFDoS ng/g (d.w.)	PFOSA ng/g (d.w.)
Sediment	Alna	<0.1	<0.2	<0.2	<0.3	<0.4
Sediment	Alna	<0.1	<0.2	<0.2	<0.3	<0.4
Sediment	Alna	<0.1	<0.2	<0.2	<0.3	<0.4
Sediment	Bekkelaget	0.25	<0.2	<0.2	<0.3	<0.4
Sediment	Bekkelaget	0.22	<0.2	<0.2	<0.3	<0.4
Sediment	Bekkelaget	<0.1	<0.2	<0.2	<0.3	<0.4
Sediment	Frognerkilen	<0.1	<0.2	<0.2	<0.3	<0.4
Sediment	Frognerkilen	<0.1	<0.2	<0.2	<0.3	<0.4
Sediment	Frognerkilen	<0.1	<0.2	<0.2	<0.3	<0.4

Compartment spec.	Area	me-PFOSA ng/L	et-PFOSA ng/L	me-PFOSE ng/L	et-PFOSE ng/L	6:2 FTS ng/L
Water	Bryn Ring3/E6	<0.1	<0.1	<2	<2	<0.2
Water	Breivoll/Alnabru Tem.	<0.1	<0.1	<2	<2	<0.2
Water	Breivoll E6, Downstr. Term.	<0.1	<0.1	<2	<2	1.33
Water	Hasle, snowdep.	<0.1	<0.1	<2	<2	<0.2
Particles	Bryn Ring3/E6	<0.1	<0.1	<2	<2	<0.2
Particles	Breivoll/Alnabru Tem.	<0.1	<0.1	<2	<2	<0.2
Particles	Breivoll E6, Downstr. Term.	<0.1	<0.1	<2	<2	<0.2
Particles	Hasle, snowdep.	<0.1	<0.1	<2	<2	<0.2

Compartment spec.	Area	me-PFOSA ng/g (d.w.)	et-PFOSA ng/g (d.w.)	me-PFOSE ng/g (d.w.)	et-PFOSE ng/g (d.w.)	6:2 FTS ng/g (d.w.)
Sediment	Alna	<0.5	<0.5	<2	<2	<0.5
Sediment	Alna	<0.5	<0.5	<2	<2	<0.5
Sediment	Alna	<0.5	<0.5	<2	<2	<0.5
Sediment	Bekkelaget	<0.5	<0.5	<2	<2	<0.5
Sediment	Bekkelaget	<0.5	<0.5	<2	<2	<0.5
Sediment	Bekkelaget	<0.5	<0.5	<2	<2	<0.5
Sediment	Frognerkilen	<0.5	<0.5	<2	<2	<0.5
Sediment	Frognerkilen	<0.5	<0.5	<2	<2	<0.5
Sediment	Frognerkilen	<0.5	<0.5	<2	<2	<0.5

Compartment spec.	Area	Nap. ng/L	Acy. ng/L	Ace. ng/L	Fle. ng/L	Dbthi. ng/L
Water	Bryn Ring3/E6	6.6	<2	<2	<2	<2
Water	Breivoll/Alnabru Tem.	6.6	<2	<2	2.4	2.3
Water	Breivoll E6, Downstr. Term.	12	<2	<2	<2	2.5
Water	Hasle, snowdep.	11	<2	<2	<2	<2
Particles	Bryn Ring3/E6	6.7	2.6	<2	<2	<2
Particles	Breivoll/Alnabru Tem.	7.1	4	<2	5.5	<2
Particles	Breivoll E6, Downstr. Term.	22	29	<5	9.3	8.6
Particles	Hasle, snowdep.	21	7.3	<3	4.1	2.1

Compartment spec.	Area	Nap. ng/g (d.w.)	Acy. ng/g (d.w.)	Ace. ng/g (d.w.)	Fle. ng/g (d.w.)	Dbthi. ng/g (d.w.)
Sediment	Alna	150	91	34	56	
Sediment	Alna	150	97	34	58	
Sediment	Alna	120	87	31	59	
Sediment	Bekkelaget	60	19	10	16	
Sediment	Bekkelaget	65	16	30	35	
Sediment	Bekkelaget	150	97	37	73	
Sediment	Frognerkilen	490	140	40	68	
Sediment	Frognerkilen	240	150	43	66	
Sediment	Frognerkilen	220	130	43	68	

Compartment spec.	Area	Phe. ng/L	Ant. ng/L	Flu. ng/L	Pyr. ng/L	B(a)A ng/L
Water	Bryn Ring3/E6	<2	<2	<2	2.5	<2
Water	Breivoll/Alnabru Tem.	2.2	i	<2	<2	<2
Water	Breivoll E6, Downstr. Term.	2.6	<6	<2	<2	<2
Water	Hasle, snowdep.	<2	<2	<2	<2	<2
Particles	Bryn Ring3/E6	8.9	<2	15	25	3
Particles	Breivoll/Alnabru Tem.	15	9.5	14	30	4.5
Particles	Breivoll E6, Downstr. Term.	120	34	210	230	64
Particles	Hasle, snowdep.	20	5.5	27	31	11

Compartment spec.	Area	Phe. ng/g (d.w.)	Ant. ng/g (d.w.)	Flu. ng/g (d.w.)	Pyr. ng/g (d.w.)	B(a)A ng/g (d.w.)
Sediment	Alna	480	210	750	820	360
Sediment	Alna	460	210	740	810	350
Sediment	Alna	590	260	950	980	420
Sediment	Bekkelaget	100	39	140	170	76
Sediment	Bekkelaget	160	60	140	160	73
Sediment	Bekkelaget	650	300	1000	1000	450
Sediment	Frognerkilen	530	230	890	1000	470
Sediment	Frognerkilen	570	260	1000	1100	530
Sediment	Frognerkilen	590	220	950	1100	480

Compartment spec.	Area	Chr. ng/L	B(bj)F. ng/L	B(k)F. ng/L	B(e)P. ng/L	B(a)P. ng/L
Water	Bryn Ring3/E6	<2	<2	<2	<2	<2
Water	Breivoll/Alnabru Tem.	<2	<2	<2	<2	<2
Water	Breivoll E6, Downstr. Term.	<2	<2	<2	<2	<2
Water	Hasle, snowdep.	<2	<2	<2	<2	<2
Particles	Bryn Ring3/E6	7.2	10	4.5	12	5.8
Particles	Breivoll/Alnabru Tem.	8.4	12	4.4	13	5.8
Particles	Breivoll E6, Downstr. Term.	100	130	45	110	77
Particles	Hasle, snowdep.	14	26	10	26	18

Compartment spec.	Area	Chr. ng/g (d.w.)	B(bj)F. ng/g (d.w.)	B(k)F. ng/g (d.w.)	B(e)P. ng/g (d.w.)	B(a)P. ng/g (d.w.)
Sediment	Alna	360	560	230		350
Sediment	Alna	360	550	230		360
Sediment	Alna	430	570	240		360
Sediment	Bekkelaget	81	130	54		78
Sediment	Bekkelaget	69	100	44		67
Sediment	Bekkelaget	450	590	240		380
Sediment	Frognerkilen	450	860	360		550
Sediment	Frognerkilen	550	930	380		590
Sediment	Frognerkilen	460	840	360		550

Compartment spec.	Area	Per. ng/L	I(123-cd)P. ng/L	Db(ac/ah)A. ng/L	B(ghi)P. ng/L
Water	Bryn Ring3/E6	<2	<2	<2	<2
Water	Breivoll/Alnabru Tem.	<2	<2	<2	<2
Water	Breivoll E6, Downstr. Term.	<2	<2	<2	<2
Water	Hasle, snow dep.	<2	<2	<2	<2
Particles	Bryn Ring3/E6	<3	5.4	<3	24
Particles	Breivoll/Alnabru Tem.	<3	4.9	<2	15
Particles	Breivoll E6, Downstr. Term.	40	68	25	140
Particles	Hasle, snow dep.	7.8	13	5.9	29

Compartment spec.	Area	Per. ng/g (d.w.)	I(123-cd)P. ng/g (d.w.)	Db(ac/ah)A. ng/g (d.w.)	B(ghi)P. ng/g (d.w.)	DBT ng/g (d.w.)
Sediment	Alna		280	77	380	
Sediment	Alna		270	74	370	
Sediment	Alna		260	74	360	
Sediment	Bekkelaget		68	17	100	
Sediment	Bekkelaget		54	15	81	
Sediment	Bekkelaget		260	79	370	
Sediment	Frognerkilen		470	120	600	137
Sediment	Frognerkilen		500	130	640	140
Sediment	Frognerkilen		450	120	590	123

Compartment spec.	Area	
Water	Bryn Ring3/E6	
Water	Breivoll/Alnabru Tem.	
Water	Breivoll E6, Downstr. Term.	
Water	Hasle, snow dep.	
Particles	Bryn Ring3/E6	
Particles	Breivoll/Alnabru Tem.	
Particles	Breivoll E6, Downstr. Term.	
Particles	Hasle, snow dep.	

Compartment spec.	Area	DOT ng/g (d.w.)	MBT ng/g (d.w.)	MOT ng/g (d.w.)	TetraBT ng/g (d.w.)	TBT ng/g (d.w.)
Sediment	Alna					
Sediment	Alna					
Sediment	Alna					
Sediment	Bekkelaget					
Sediment	Bekkelaget					
Sediment	Bekkelaget					
Sediment	Frognerkilen	1.49	53.6	2.84	1.46	274
Sediment	Frognerkilen	1.86	65.7	2.62	<1.03	292
Sediment	Frognerkilen	1.75	49	2.82	1.52	258

Compartment spec.	Area	
Water	Bryn Ring3/E6	
Water	Breivoll/Alnabru Tem.	
Water	Breivoll E6, Downstr. Term.	
Water	Hasle, snowdep.	
Particles	Bryn Ring3/E6	
Particles	Breivoll/Alnabru Tem.	
Particles	Breivoll E6, Downstr. Term.	
Particles	Hasle, snowdep.	

Compartment spec.	Area	TPhT ng/g (d.w.)	TCHT ng/g (d.w.)	Diuron µg/g (d.w.)	Irgarol µg/g (d.w.)	ETU ng/g (d.w.)
Sediment	Alna					
Sediment	Alna					
Sediment	Alna					
Sediment	Bekkelaget					
Sediment	Bekkelaget					
Sediment	Bekkelaget					
Sediment	Frognerkilen	5.07	<2.04	<0.05	<0.05	<10
Sediment	Frognerkilen	4.33	<2.05	<0.05	<0.05	<10
Sediment	Frognerkilen	4.26	<2.02	<0.05	<0.05	<10

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The Norwegian Environment Agency's primary tasks are to reduce greenhouse gas emissions, manage Norwegian nature, and prevent pollution.

We are under the Ministry of Climate and Environment and have over 700 employees at our two offices in Trondheim and Oslo and at the Norwegian Nature Inspectorate's more than sixty local offices.

Our principal functions include monitoring the state of the environment, conveying environment-related information, exercising authority, overseeing and guiding regional and municipal authorities, cooperating with relevant industry authorities, acting as an expert advisor, and assisting in international environmental efforts.