Norwegian Institute for Water Research

REPORT

Main Office
P.O. Box 173, Kjelsås
N-0411 Oslo
Norway
Phone (47) 22 18 51 00
Telefax (47) 22 18 52 00

Regional Office, Sørlandet
Televeien 1
N-4890 Grimstad
Norway
Phone (47) 37 29 50 55
Telefax (47) 37 04 45 13

Regional Office, Østlandet
Sandvikaveien 41
N-2312 Ottestad
Norway
Phone (47) 62 57 64 00
Telefax (47) 62 57 66 53

Regional Office, Vestlandet
Nordnesboder 5
N-5008 Bergen
Norway
Phone (47) 55 30 22 50
Telefax (47) 55 30 22 51

Akvaplan-NIVA A/S
Søndre Tollbugate 3
N-9000 Tromsø
Norway
Phone (47) 77 68 52 80
Telefax (47) 77 68 05 09

Title	Serial No.	Date
Joint Assessment and Monitoring Programme (JAMP). National Comments regarding the Norwegian Data for 1999 (Norwegian State Pollution Monitoring Programme Report no. 812/01. TA-no. 1780/2001)	4335-2001	21.05.2001 (rev. from 20.01.2001)
	Report No. Sub-No. O-80106	Pages Price 181
Author(s) Norman W. Green Ketil Hylland Mats Walday	Topic group Marine ecology	Distribution
	Geographical area Oslofjord to Varangerfjord	Printed NIVA

Client(s)	Client ref.
Norwegian Pollution Control Authority (SFT)	

Abstract

This report is part of the Norwegian contribution to the SIME 2001 meeting administrated by OSPAR. JAMP 1999 included the monitoring of micropollutants in blue mussels (45 stations) and fish (16 stations) along the coast of Norway from Oslo to Bergen, Lofoten and Varangerfjord. The results indicated elevated levels of contaminants (i.e. over provisional “high background”) in: Oslofjord proper (PCBs, ppDDE and mercury in fish) and Langesundsfjord (HCB in mussels) and Sørfjord and Hardangerfjord (cadmium, lead, mercury and ppDDE in mussels). A significant upward trend were found for mercury in cod from the inner Oslofjord and downward trends were found for cadmium and lead in mussels from the Sørfjord and Hardangerfjord for the period 1987-1999. The results from the remaining stations showed low or moderately levels of contamination. No change in “pollution” or “reference” index classification was found from 1997 to 1999. Studies were also conducted in two areas on the southern/south-western coast using biological effects methods in cod (6 stations), flatfish (5 stations) and imposex/intersex in dogwhelks (6 stations). Concentrations of organotin in mussels and imposex in dogwhelks were still apparent, especially in the Haugesund area compared to the 1998 investigation.

4 keywords, Norwegian	4 keywords, English
1. Miljøgifter	1. Contaminants
2. Organismer	2. Organisms
3. Marin	3. Marine
4. Norge	4. Norway

Norman W. Green
Project manager

ISBN 82-577-3969-3

Jens Skei
Head of research department

OSLO AND PARIS CONVENTIONS FOR THE PREVENTION OF MARINE POLLUTION

WORKING GROUP ON CONCENTRATIONS, TRENDS AND EFFECTS OF SUBSTANCES IN THE MARINE ENVIRONMENT (SIME)

NANTES 20-22 FEBRUARY 2001

O-80106

JOINT ASSESSMENT AND MONITORING PROGRAMME (JAMP)
NATIONAL COMMENTS REGARDING
THE NORWEGIAN DATA FOR 1999

Oslo, 21. May 2001[1]

Submitted by:	NORWAY Norman W. Green Norwegian Institute for Water Research (NIVA) PB 173 Kjelsås N-0411 Oslo
Submitted to:	Oslo and Paris Commissions (OSPAR) att. Dornford Rugg New Court 48 Carey Street London WC2A 2JQ
Copy to:	Norwegian Pollution Control Authority (SFT) att. Per Erik Iversen PB 8100 Dep. N-0032 Oslo International Council for the Exploration of the Seas (ICES) att. Janet Pawlak Palægade 2-4 DK-1261 Copenhagen

[1] First edition was published in January 2001. This current edition includes revisions to figures in Chapter 1.4 concerning the results from biological effects analyses.

Foreword

This report presents the Norwegian national comments on the 1999 investigations for the Joint Assessment and Monitoring Programme (JAMP). JAMP is administered by the Oslo and Paris Commissions (OSPAR) and their Environmental Assessment and Monitoring Committee (ASMO). JAMP receives guidance from the International Council for the Exploration of the Sea (ICES). ASMO has delegated implementation of part of the programme to the Working Group on Concentrations, Trends and Effects of Substances in the Marine Environment (SIME). The Norwegian 1999 investigations are directed to particular JAMP issues relating to contaminants and implemented by SIME. Some JAMP issues to be addressed lack adequate guidelines, in such cases guidelines used by the Joint Monitoring Programme (JMP) were applied.

The Norwegian JAMP for 1999 was carried out by the Norwegian Institute for Water Research (NIVA) by contract from the Norwegian Pollution Control Authority (SFT), (NIVA contract O-80106).

The Norwegian contribution to the JMP/JAMP was initiated by SFT in 1981 as part of the national monitoring programme. It now comprises three areas: the Oslofjord and adjacent areas (Hvaler-Singlefjord area and Langesundsfjord, 1981-), Sørfjord/Hardangerfjord (1983-84, 1987-) and Orkdalsfjord area (1984-89, 1991-93, 1995-96).

Since the North Sea Task Force Monitoring Master Plan was implemented in 1990 additional areas have also been monitored. These include: Arendal, Lista and Bømlo-Sotra areas. On the initiative of SFT and NIVA "reference" or merely diffusely contaminated areas from Bergen to Lofoten have been monitored since 1992 and from Lofoten to the Norwegian-Russian border from 1994.

The comments are presented in accordance with the agreed standardised format (ASMO 1997, Annex 12).

Thanks are due to many colleagues at NIVA, especially: Unni Efraimsen, Åse Kristine Rogne, Frank Kjellberg, Sigurd Øxnevad, Tom Tellefsen for field work, sample preparations, data entry; Torgunn Sætre, Alfhild Kringstad, Einar Brevik and colleagues for organic analyses; Norunn Følsvik for organotin analyses; Bente Hiort Lauritzen and her colleagues for metal analyses; Randi Romstad and her collegues for biological effects measurements, Gunnar Severinsen for data programme management and operation; and to the authors Ketil Hylland (biological effects methods), Jon Knutzen (contaminants) and Mats Walday (organotin). Thanks go also to the numerous fishermen and their boat crews we have had the pleasure of working with.

This report was first published in January 2001. The current edition includes corrections to figures in Chapter 1.4 concerning biological effects results.

Oslo, 21 May 2001.

Norman W. Green
Project co-ordinator

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1. General Details

1.1 Executive Summary

The Norwegian JAMP 1999 included the monitoring of micropollutants (contaminants) in blue mussels (45 stations including supplementary stations for Index, TBT and testing methods) and fish (16 cod/flatfish stations) from the border of Sweden in the south along the coast of Norway to Bergen area, Lofoten and the Varangerfjord bordering Russia. The results indicated elevated levels of contaminants (i.e. over provisional "high background") in:

- JAMP area 26: Oslofjord proper (PCBs, and to a lesser extent mercury, cadmium, lead, zinc and ppDDE) and Langesundsfjord (HCB, less so for cadmium, mercury and CB153). The median concentrations of CB153 found in cod liver and cod fillet from the inner Oslofjord were the highest since 1992. A significant upward trend was detected for mercury in cod fillet from "large" individuals from the inner Oslofjord 1984-1999.

- JAMP areas 63 and 62: Sørfjord and Hardangerfjord (cadmium, lead, mercury and ppDDE and to a lesser extent PCB). Marked overconcentrations of PCBs were found in cod liver from inner Sørfjord but not in flounder from the same area. Significant downward trends were found for cadmium and lead in mussels at two stations in the Sørfjord and Hardangerfjord 1987-1999.

Two environmental indices were applied for the fifth year to assess the levels of contamination of mussels in "polluted" and "reference" areas. The results indicated a "bad" condition (i.e., in the Norwegian Pollution Control Authority classification system) when applying the "pollution" index and a "fair" condition when applying the "reference" index. There was no change in classification from the 1997 results and no trend is evident.

The biological effects methods OH-pyrene (pyrene metabolite), δ-aminolevulinic acid dehydratase (ALA-D), cytochrome P4501A activity (EROD) and metallothionein (MT) were determined in cod from six stations from the southern and south-western coast from 1997 to 1999. Four of the five flatfish stations observed were in close proximity to the cod stations. Three cod and three flatfish stations were merely diffusely contaminated and the remainder were from two moderately contaminated areas. In all three years for cod and in 1999 for dab there were very high levels of OH-pyrene metabolites at a presumed clean site (Lista). There were also somewhat elevated levels at sites where fish would be expected to be exposed to PAHs (inner Sørfjord, inner Oslofjord). Results for ALA-D and EROD in the moderately polluted stations compared to the diffusely polluted stations were inconsistent for the three years. Results for MT are being reanalysed.

The presence of organotin (e.g. TBT) in Norwegian waters was still a problem in 1999, more severe close to harbours and major ship-routes. The results from the Haugesund area indicated that the area was more contaminated than in 1998. The prohibition against the use of TBT in antifouling on boats <25m of length has not lead to a clear improvement in the investigated areas.

Supplementary investigations of mussels in the Sørfjord and Hardangerfjord area indicated more than one source of DDT (ppDDE, ppDDT and ppTDE) in the mid/outer Sørfjord.

These supplementary investigations of mussels also revealed significant difference between the JAMP-method where mussels are depurated and shucked, and a simpler method where the mussels are merely frozen before being shucked. The JAMP-method yielded higher concentrations for cadmium but lower for lead, zinc, PCBs and DDTs.

1.2 Introduction

The Norwegian contribution to the "Joint Assessment and Monitoring Programme (JAMP) was initiated by the Norwegian Pollution Control Authority (SFT) and is integrated with SFT's State Pollution Monitoring Programme. The procedures and practice of JAMP has also provided a basis for other investigations of interest to SFT but not necessarily requested by JAMP (e.g. SFT's Pollution and Reference Indices, Chapter 1.3.8).

Data are submitted to ICES under three categories: for Purpose A (Health assessment) on a voluntary basis, Purpose C (spatial distribution) on a voluntary basis and Purpose D (temporal trend assessment) on a mandatory basis. Where practical, data collection was in accordance to agreed procedures (OSPAR 1990, 1997). Data were screened and submitted to ICES in accordance with procedures outlined by ICES (1996).

This report focuses on issues and situations in Norway concerning contaminants and considered of interest to the implementation of JAMP (Table 1).

Table 1. JAMP issues to which the Norwegian investigations for 1999 can be addressed (cf. ASMO 1997, Annex 30).

Issue	Subject	Description
1.2	Hg, Cd, and Pb	What are the concentrations and fluxes in sediments and biota?
1.3	TBT	To what extent do biological effects occur in the vicinity of major shipping routes, offshore installations, marinas and shipyards?
1.7	PCBs	Do high concentrations pose a risk to the marine ecosystem?
1.8	PCBs	Do high concentrations of non-ortho and mono-ortho CBs in seafood pose a risk to human health?
1.10	PAHs	What are the concentrations in the maritime area?
1.11	PAHs	Do PAHs affect fish and shellfish?
1.12	Other synthetic compounds	How widespread are synthetic organic compounds within the maritime area?
1.15	Chlorinated dioxins and dibenzofurans	What concentrations occur and have the policy goals (for the relevant parts of the maritime area) been met?
1.17	Biological effects of pollutants	Where do pollutants cause deleterious biological effects?
5.3	Chemical used [mariculture]	In which areas do pesticides and antibiotics affect marine biota?
6.1	Ecosystem health	How can ecosystem health be assessed in order to determine the extent of human impact?

This report is structured at the first and second level according to agreed format (ASMO 1997, Annex 12) which *inter alia* presents results before methodology.

1.3 Information on measurements

An overview of JAMP stations in Norway is shown in the tables in Appendix E. and maps in Appendix F. . The stations and sample counts relevant to the 1999 investigations are noted in the tables in Appendix E. and Appendix G. , respectively.

Blue mussels were sampled at 45 stations (including supplementary stations for Index (22), TBT (3) and method testing (3)) and fish from 16 cod/flatfish stations from the border to Sweden in the south to the border to Russia in the north. Generally, mussels are not abundant on the exposed coastline from Lista (south Norway) to the North of Norway. A number of samples were collected from dock areas, buoys or anchor lines (see footnotes in Appendix E.).

1.3.1 Oslofjord area

Moderate overconcentrations of CB153 in mussels were found in the inner Oslofjord (st.30A, up to nearly 4 times provisional "high background" - see Chapter 2.1.2) (Figure 1 and temporal trend analyses in Appendix H.). Overconcentrations were also found in cod liver from the inner Oslofjord (st.30B, up to 6 times “high background”; Figure 2). The median concentration of CB153 in cod liver from the inner Oslofjord was nearly 1300 ppb w.w. and higher than any previous year (1990-1998, Figure 2, Appendix H. and Appendix I.). Similarly, the median concentration in cod fillet for 1999 was 8.4 ppb and higher than previous years except 1992 (Appendix H.). Slight overconcentrations were found in cod liver from the outer Oslofjord (st.36B, less than twice "high background").

Overconcentrations were also found for sum of 7 PCBs (CB-28, -52, 101, -118, -138, -153 and -180) in mussels and cod liver from inner Oslofjord stations (st.30A and 30B), about 3 and 6 times “high background”, respectively (Appendix I.). Slight overconcentrations (less than 2 times "high background") were found in cod livers from the outer Oslofjord (st.36B). In 1994 the Norwegian Food Control Authority (SNT) advised not to consume liver of cod from the inner Oslofjord (north of st.31A) due to concerns about PCB contamination (Table 3, page 28).

The reason for higher concentrations of PCB may be partly due to analytical aspects. Control analyses of certified reference materiale were on the average about 30% higher for CB-153, one of the more persistent PCB congeners (Table 7, Appendix A.).

No significant linear trend was detected (see method description in Chapter 2.1.3) for CB153 for mussel from four stations (30A, 31A, 35A and 36A) from 1988 to 1999 or for cod (30B and 36B) from 1990 to 1999.

Power analyses (see Chapter 2.1.3) indicated that a hypothetical trend of 10% change per year in CB153 concentration in the blue mussel or cod liver from the inner Oslofjord would take up to 15 years to be detected with 90% significance (Appendix H.).

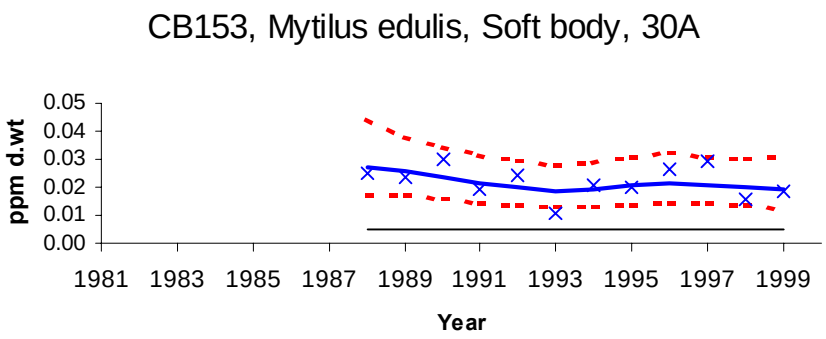
Overconcentrations of mercury were found in the fillet of both “large” and "small" cod (st.30B) from the inner Oslofjord (Figure 3), over 3 times "high background". A significant *upward trend* was detected for the period 1984-1999 for "large" cod. Slight overconcentration was found for cod from the outer Oslofjord (st.36B). The power, indicated as number of years, to detect a change in mercury in cod fillet from either station was slightly better for “small” fish (10-11 years) than “large” fish (13 years) (cf. Appendix H.). Concentration of mercury were in general (considering the entire period) significantly higher in "large" cod compared to "small" cod. Slight overconcentrations were also found in fillet of flounder from mid Oslofjord (st.33B).

In cod liver, slight overconcentrations (less than 2 times "high background") were also found for cadmium, ppDDE (st. 30B) and zinc (st.30B and 36B).

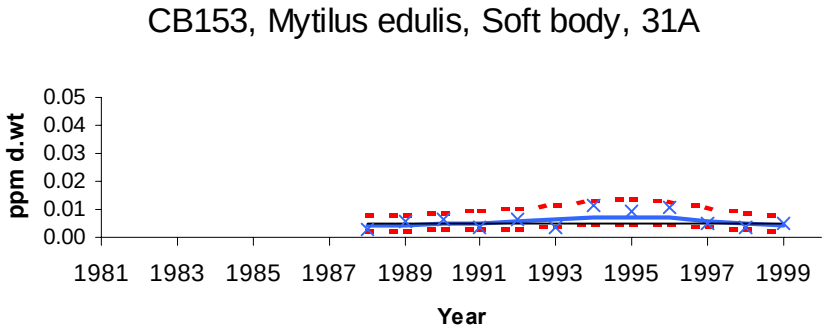
Median concentration of lead in cod liver from the inner Oslofjord was 0.85 ppm w.w. and over 3 times "high background" and over 4 times higher than any other year.

Slight overconcentrations of copper in dab liver from the outer Oslofjord were found in 1999. The median value was 14 ppm w.w. and higher than any previous year (i.e. 1990-1998).

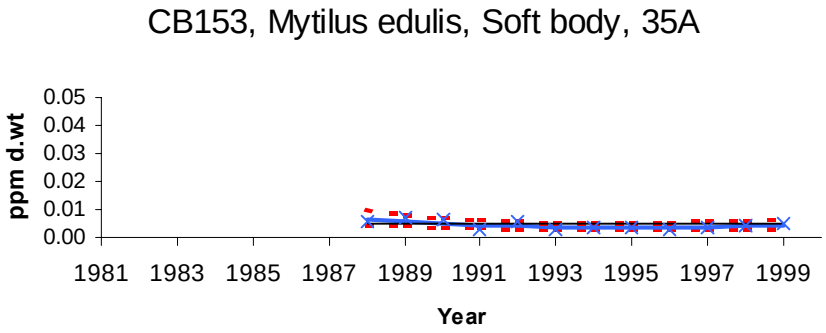
A



B



C



D

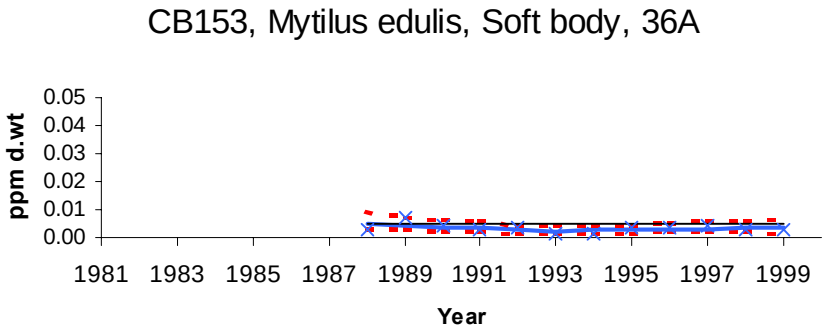


Figure 1. Median CB153 concentration in blue mussel (*Mytilus edulis*) from inner (st.30A) to outer (st.36A) Oslofjord. (cf. Appendix F. and key in Figure 21).

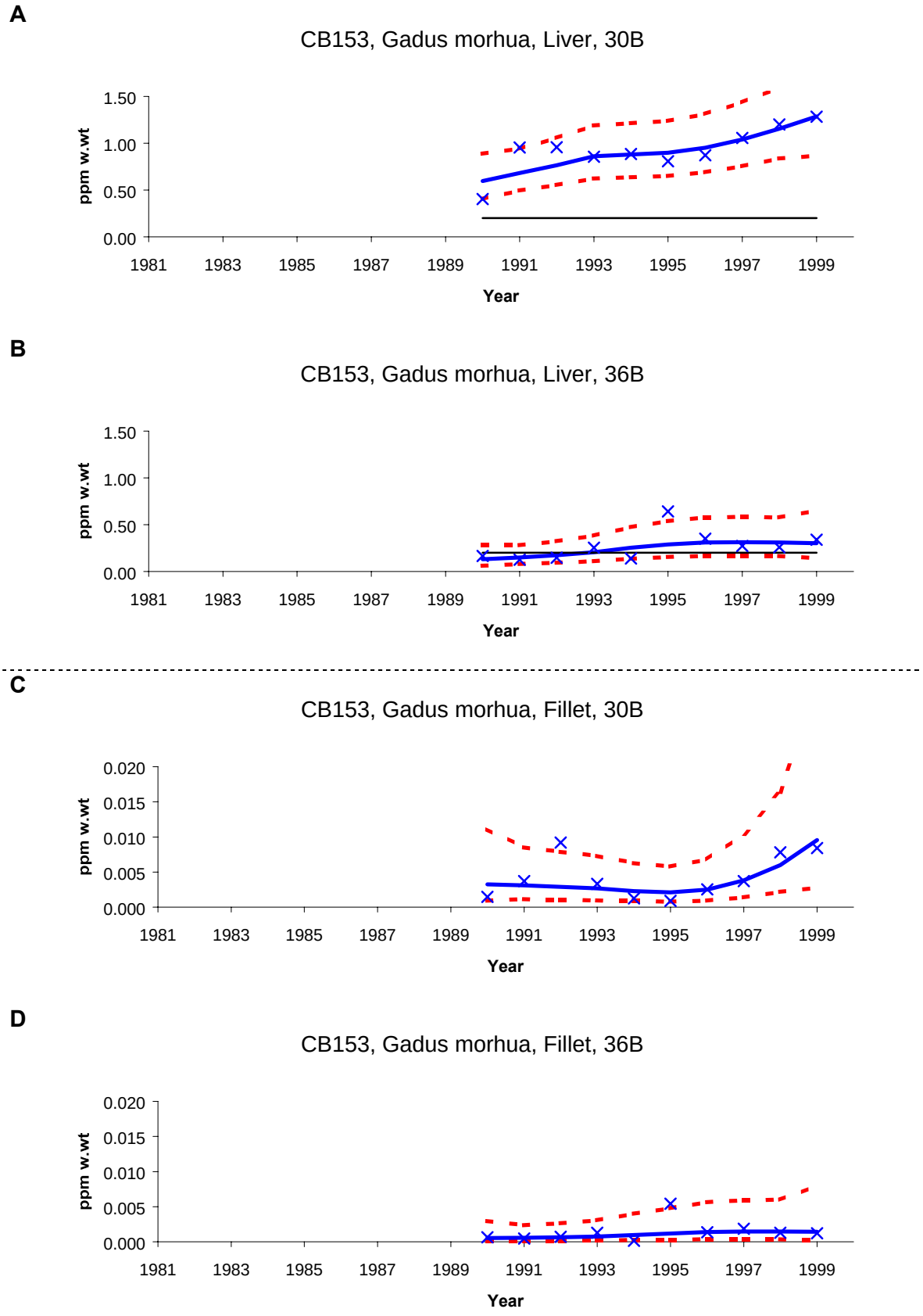
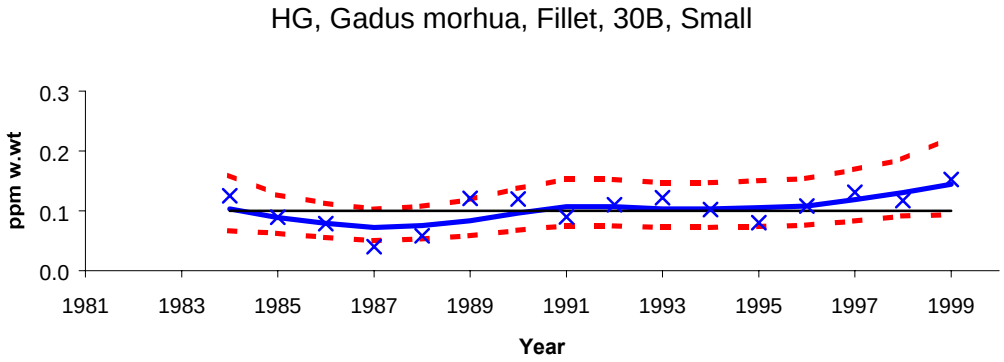
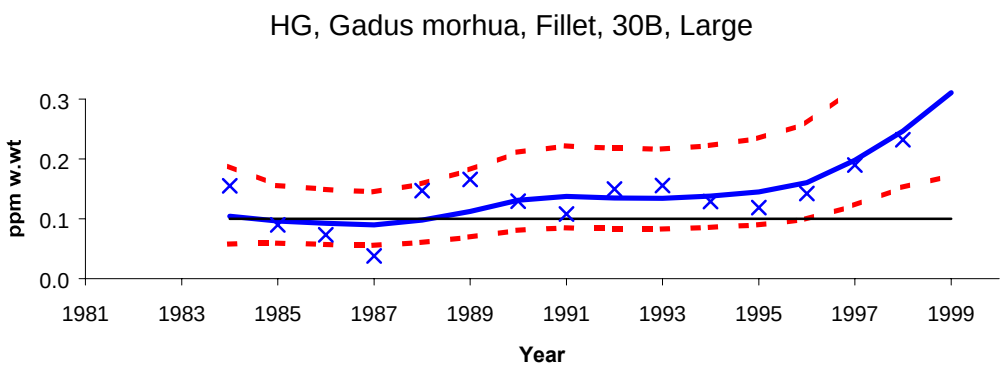


Figure 2. Median CB-153 concentration in liver and fillet of cod (*Gadus morhua*) from the inner (st.30B) to outer (st.36B) Oslofjord. (cf. Appendix F. and key in Figure 21). **Note: for some years the upper confidence interval line is off-scale in Figure D. Note: horizontal line for Class I near x-axis.**

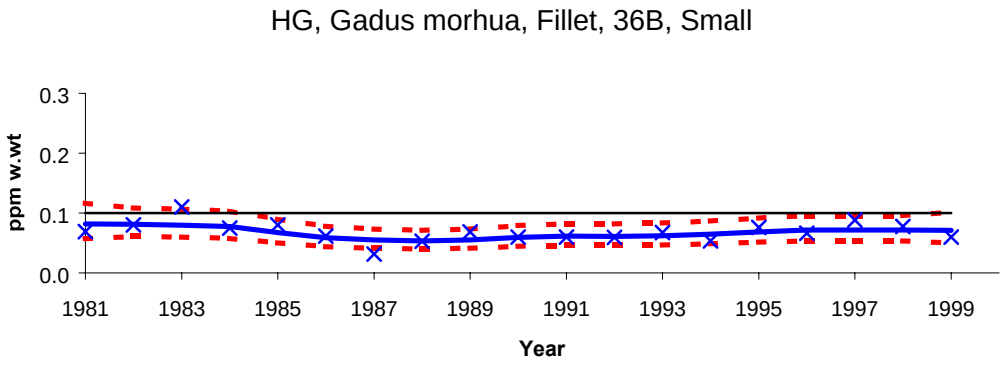
A



B



C



D

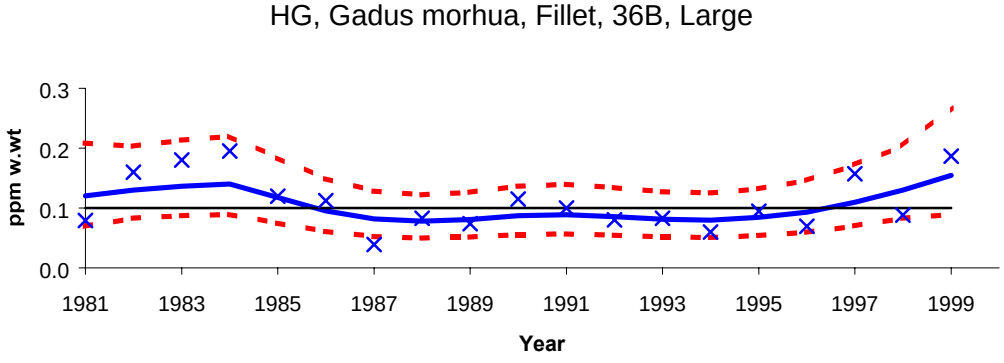


Figure 3. Median mercury (Hg) concentration in fillet of cod (*Gadus morhua*): for the inner Oslofjord (st.30B) "small" (**A**) and "large" (**B**) fish, and for the outer Oslofjord (st.36B) "small" (**C**) and "large" (**D**) fish. (cf. Appendix F. and key in Figure 21).

Mussels from Langesundsfjord (st.71A) had in 1999 marked overconcentrations of HCB (over 6 times "high background", Appendix H.) and higher than 1998. Concentrations have varied greatly during the investigation period (since 1983) but median value have decreased distinctly since 1989 (Figure 4) due to about a 99% reduction in discharge of HCB and other organochlorines from a magnesium factory after 1990 (cf. Knutzen *et al.* 1999a).

The variability in the data is much less after 1989. The relatively large variability found in this series prior to 1990 accounts for the poor power. The power of the monitoring program for the period 1990-1999 is 14 years and better than the power for the entire period which is over 25 years (cf. Appendix H. for entire period). Separate analysis for the 1990-1999 data also indicated no significant trend. The 1990-1998 period had a significant downward trend but the result for 1999 was higher and the trend was no longer significant.

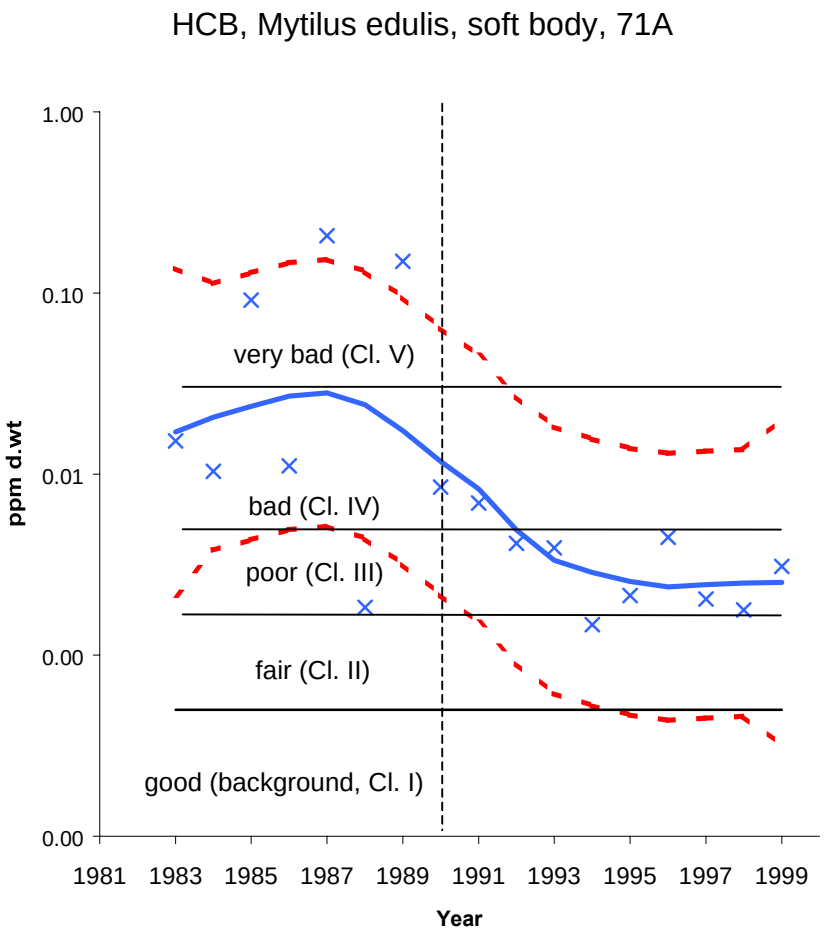


Figure 4. Median HCB concentration in blue mussel (*Mytilus edulis*) from Langesundsfjord (west of Oslofjord). (cf. Appendix F. and key in Figure 21). Vertical line indicates when a magnesium factory reduced it's discharge by 99%. Horizontal lines indicate classes as defined in Table 6. **NB: log-scale.**

1.3.2 Sørfjord and Hardangerfjord

The development of the contaminant conditions in these connected fjords and the main remedial actions that have been taken, have been outlined in the national comments for 1989 (Green 1991) and in a recent report concerning Sørfjord in particular (Skei 2000). The results from JAMP 1999 are coupled to other studies in this area (cf. Knutzen *et al.* 1997, 1999c; Knutzen & Green 2000) and confirm that the fjords continue to be contaminated especially with cadmium (e.g. Figure 5, Figure 6 and Figure 7), lead, mercury, ppDDE (e.g. Figure 5, Figure 8 and Figure 9) and to a lesser extent PCB.

Results for mussels collected from the Sørfjord (st. 51A, 52A, 56A and 57A) indicated marked overconcentrations of cadmium (7-17 times provisional "high background", Appendix H.), lead (3-12 times) and mercury (2-14 times). Overconcentrations of cadmium, lead and mercury could be traced to Ranaskjær (st.63A) in the Hardangerfjord, about 60 km from the head of Sørfjord. A significant *downward* trend was found for cadmium and lead at st. 57A and 63A from 1987 to 1999 (Appendix H.). In 2000 the Norwegian Food Control Authority (SNT) extended their advice against the consumption mussels to include all seafood in the Sørfjord (Table 3) due to concerns about metal and PCB contamination.

The median concentration of mercury found in mussels from the Sørfjord, September/October 1999 were up to 5 times those of 1998. This may have been due to effluents containing high concentrations of mercury. During the winter/spring of 1999 there were two accidental discharges of effluents: one containing high concentrations of cadmium and zinc and one during the spring that contained high concentrations of mercury (Skei 2000, Skei & Knutzen 2000).

Marked overconcentrations were found for cadmium in cod liver and flounder liver from inner Sørfjord (7 and 9 times "high background", respectively). Slight overconcentrations were found for mercury in fillet and lead in liver for these fish species.

The power of the sampling strategies for mussels was relatively poor for samples collected from Odda; the inner most part of Sørfjord (st.52A). For example for lead in mussels, it is estimated that it would take over 25 years to detect a hypothetical trend of 10% per year with 90% significance (Appendix H.). This reflects the large variability found in the data series from this area. The variability is mostly due to the irregular/accidental input of contaminated discharges. The power improved with distance from Odda, and at Ranaskjær (st.63A, ca.50km from Odda) it was only 10 years.

Overconcentrations of ppDDE were found in mussels from the head of the Sørfjord to about 60 km seaward (Figure 8 and Figure 9). The highest median concentration in mussels was 35 ppb d.w. (overconcentrations of over 3 times). With the exception of 1998, the highest concentrations since 1992 have been found midway in the Sørfjord (st.56A). However, analyses of supplementary stations (51A, 56A-1, 56A-2 and 57A-1) between 56A and 57A revealed another and higher maximum (at 57A-1, Figure 5, Appendix M.) indicating that there is more than one source of contamination.

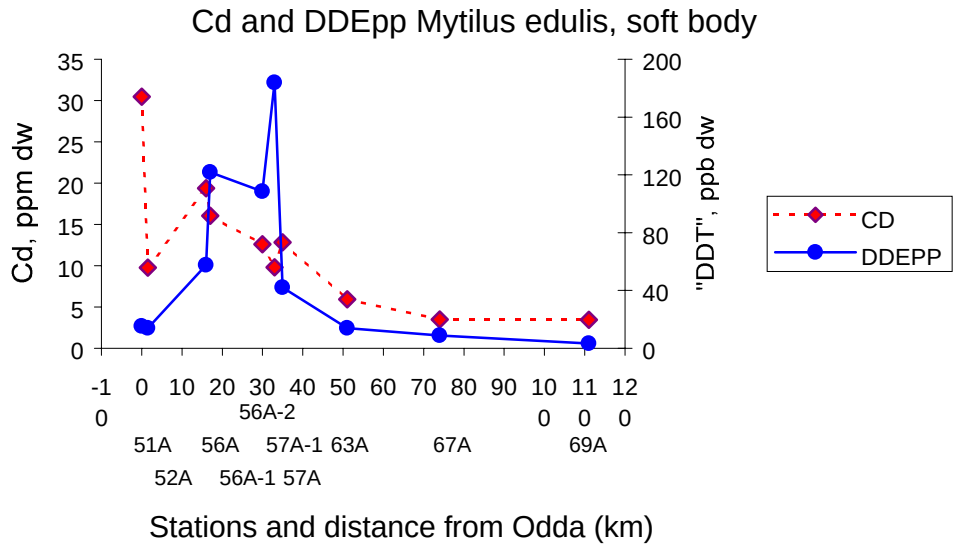


Figure 5. Median cadmium (Cd) and ppDDE concentration in blue mussel (*Mytilus edulis*) from the Sørfjord and Hardangerfjord region (cf. Appendix M.).

Slight overconcentrations (less than 2 times) were found in flounder liver and cod liver from the inner Sørfjord (st.53B), less than 2 times "high background" (Figure 10, Appendix H.).

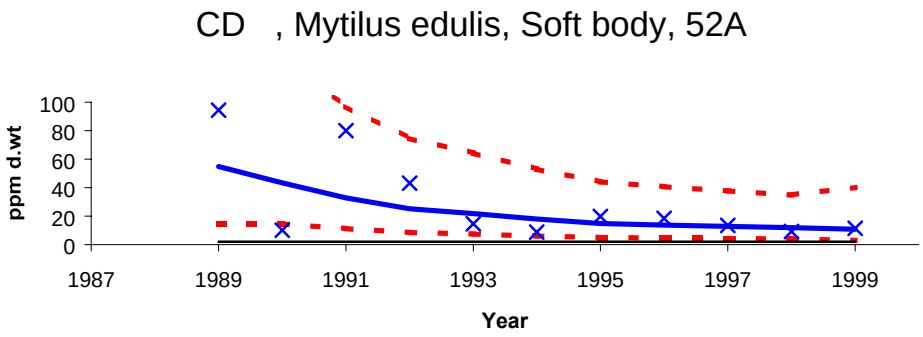
The source of ppDDE is uncertain but the Sørfjord and Hardangerfjord area has a considerable number of fruit orchards. Earlier use and persistence of DDT and leaching from contaminated soil is probably the main reason for the elevated levels found. DDT products have been prohibited in Norway since 1970 (excepting the dipping of spruce seedling until 1987).

Concentrations of sum of 7 PCBs (CB-28, -52, 101, -118, -138, -153 and -180) and CB153 (Figure 11, Appendix H. and Appendix I.) in cod liver from Sørfjord were at or below "high background". The variation was relatively low i.e. standard deviation roughly equal to the median value. These points contrast considerably with the results for 1998 which noted the highest values registered from either Sørfjord or Hardangerfjord since 1990. In 2000 the Norwegian Food Control Authority (SNT) has advised against consumption of cod liver from the inner Sørfjord (Table 3) due to concerns about PCB contamination.

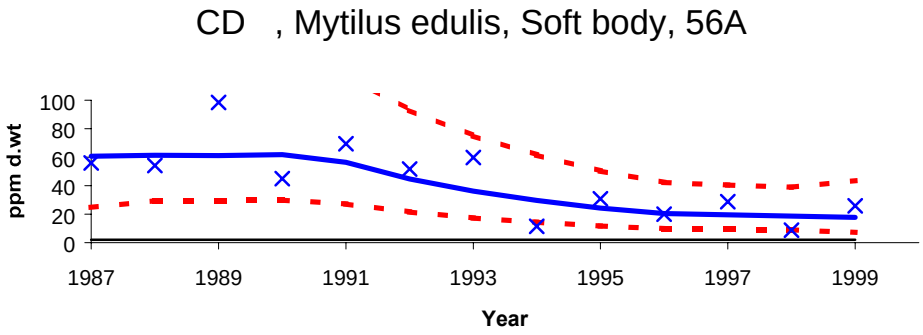
Slight overconcentrations of HCB (less than 2 times "high background") were found in mussels from Sørfjord (st.52A, 56A, 57A) and Hardangerfjord (st.63A, 67A) A significant *downward trend* was found at the three most distant from Odda (st. 56A, 63A, 65A).

No trends were evident in these organisms for ppDDE and CB153 during the period 1990-1999.

A



B



C

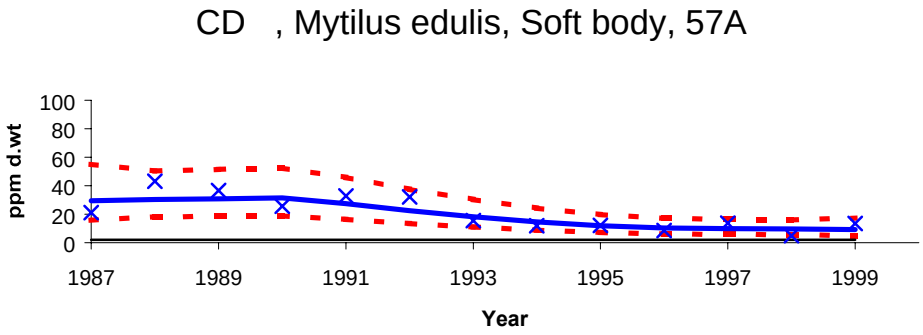
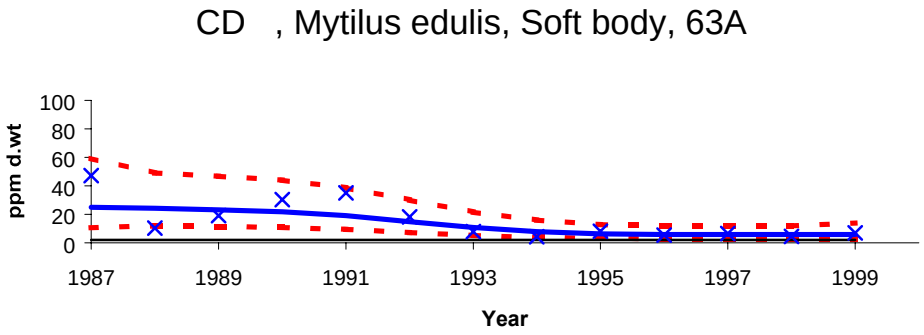
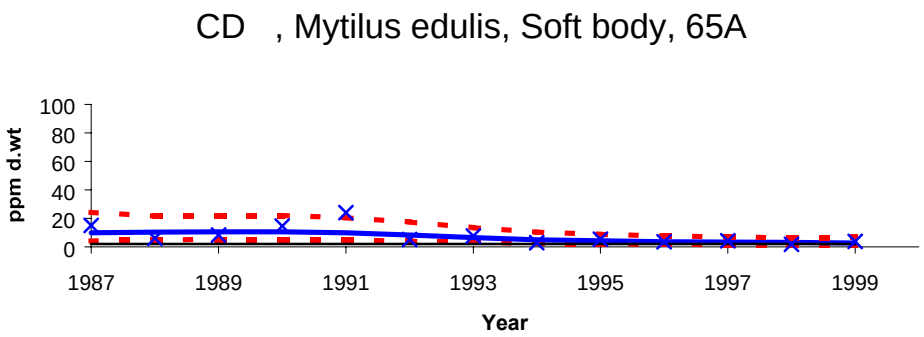


Figure 6. Median cadmium (Cd) concentration in blue mussel (*Mytilus edulis*) from inner (st.52A) to outer (st.57A) Sørfjord. NB: (cf. Appendix F. and key in Figure 21). **Note: for some years the upper confidence interval line is off-scale in figures A and B. Note: horizontal line for Class I near x-axis.**

A



B



C

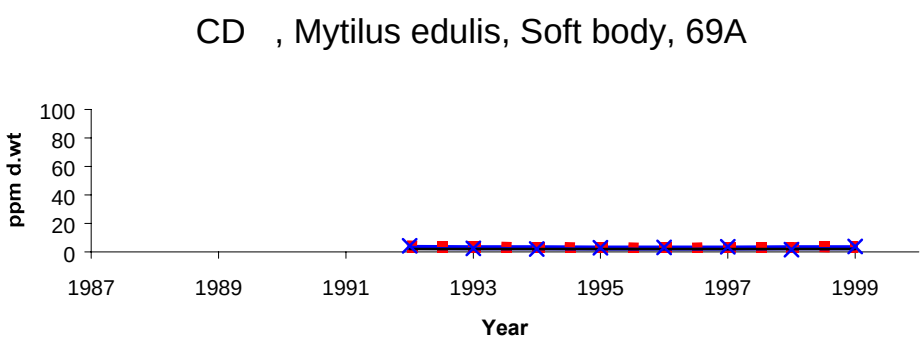
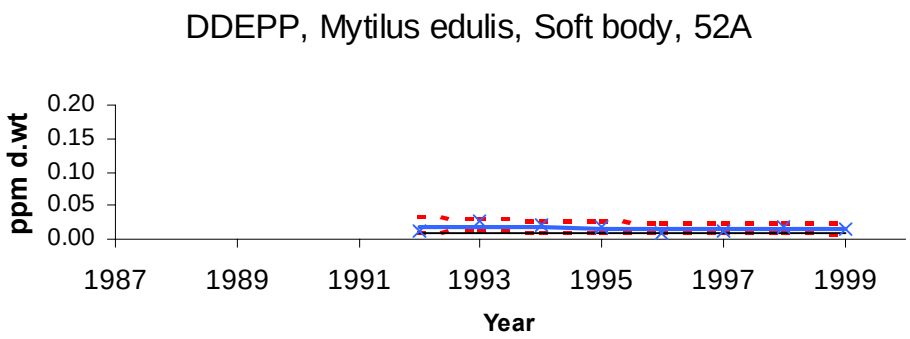
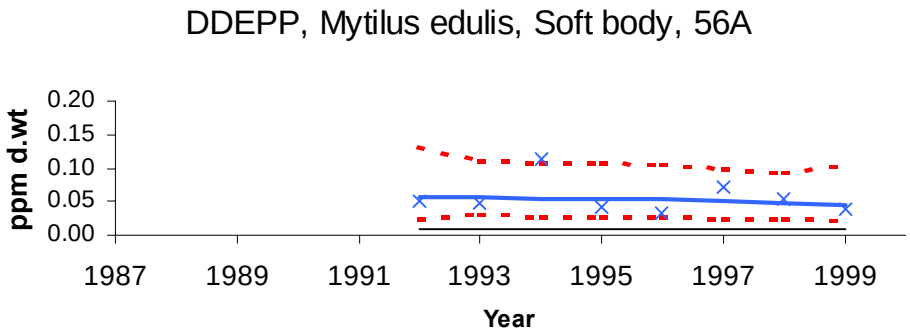


Figure 7. Median cadmium (Cd) concentration in blue mussel (*Mytilus edulis*) from Hardangerfjord (st. 63A, 65A and 69A). (cf. Appendix F. and key in Figure 21). **Note difference in scale from Figure 6 and that for some years the upper confidence interval line is off-scale in Figure A. Note: horizontal line for Class I near x-axis.**

A



B



C

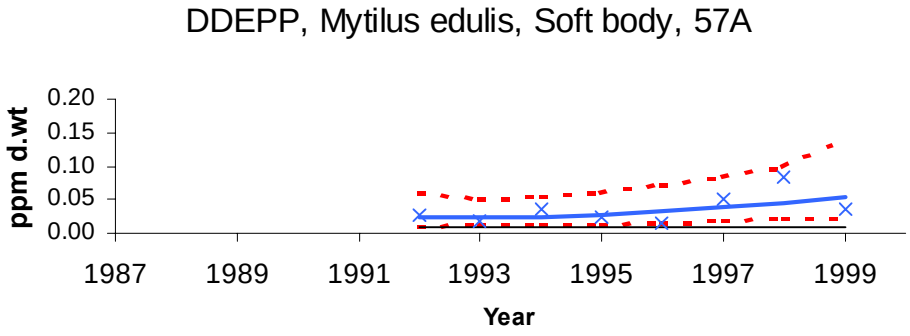
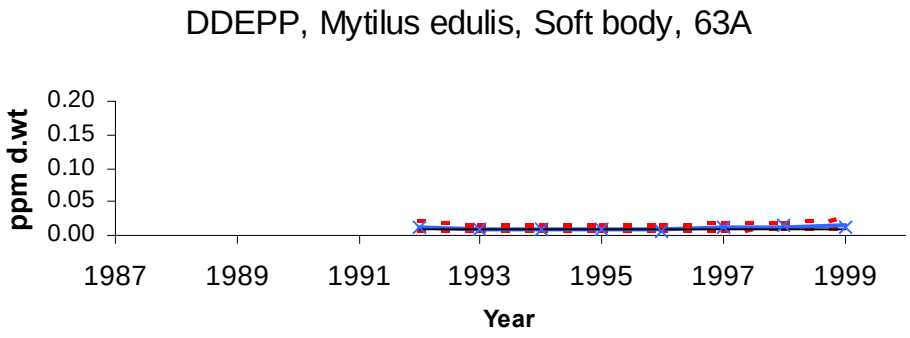
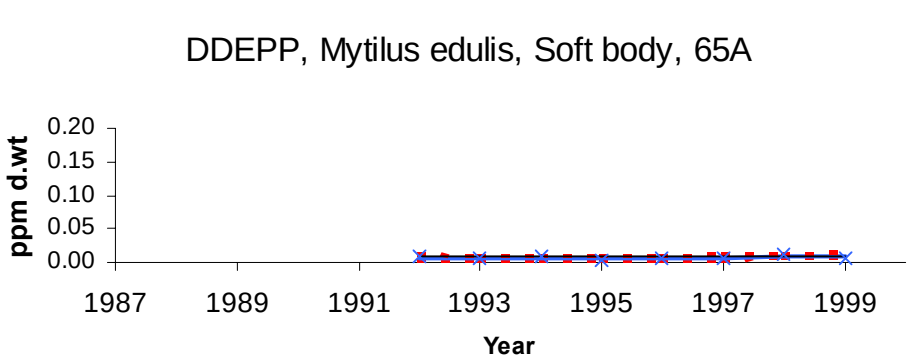


Figure 8. Median ppDDE (DDEPP) concentration in blue mussel (*Mytilus edulis*) from inner (st.52A) to outer (st.57A) Sørfjord. (cf. Appendix F. and key in Figure 21).

A



B



C

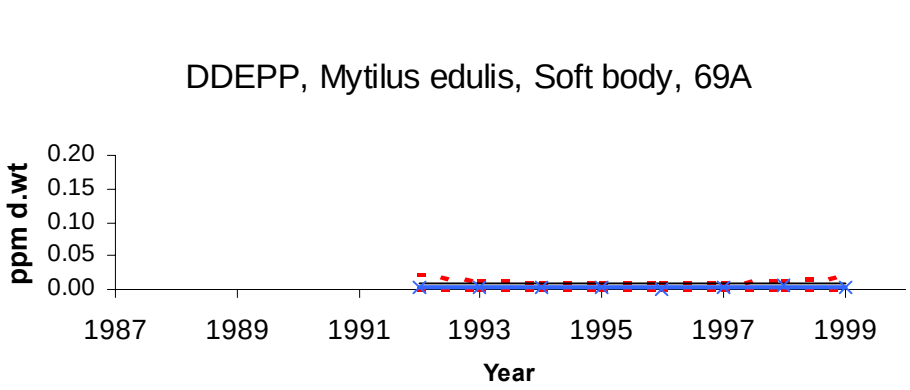
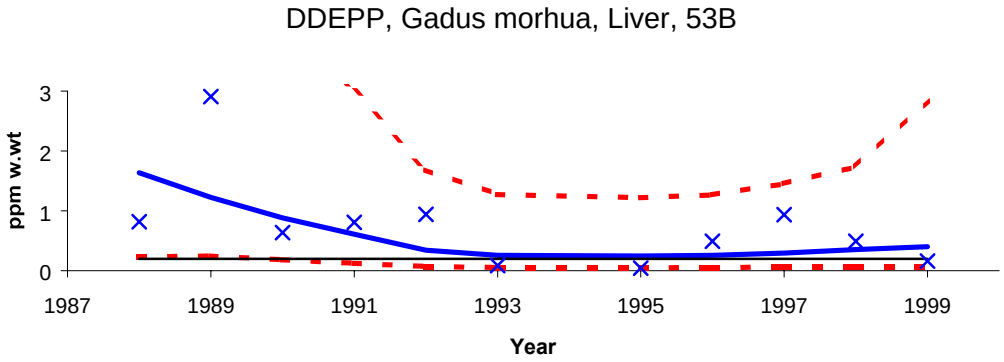
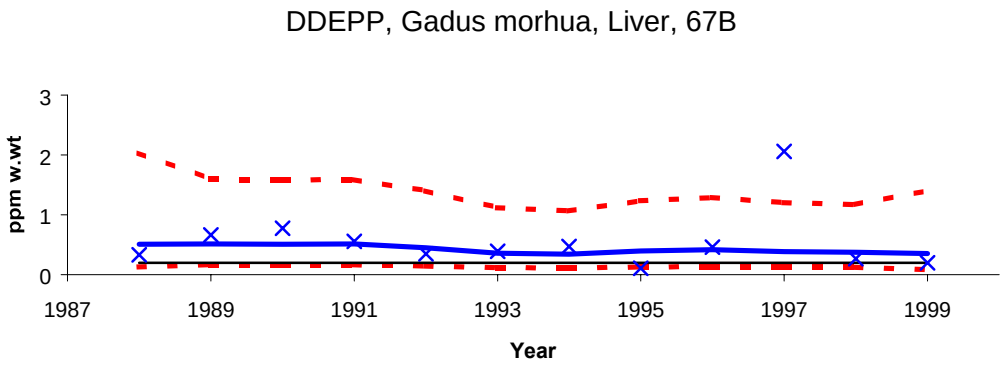


Figure 9. Median ppDDE (DDEPP) concentrations in blue mussel (*Mytilus edulis*) from Hardangerfjord (st. 63A, 65A and 69A). (cf. Appendix F. and key in Figure 21).

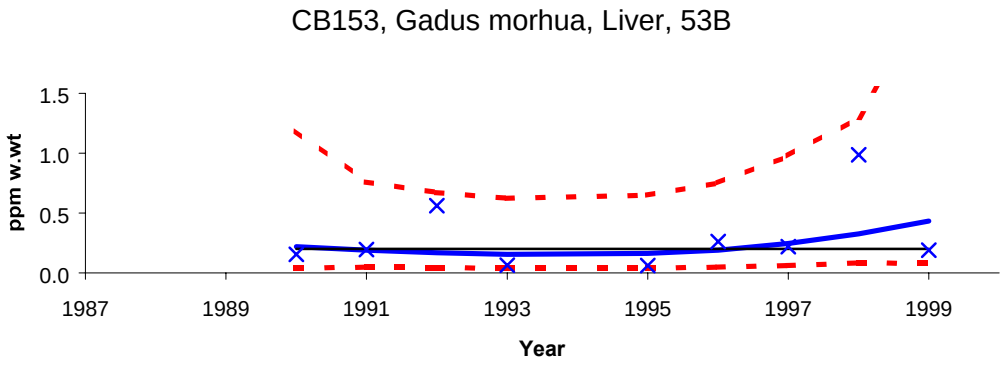
A



B



C



D

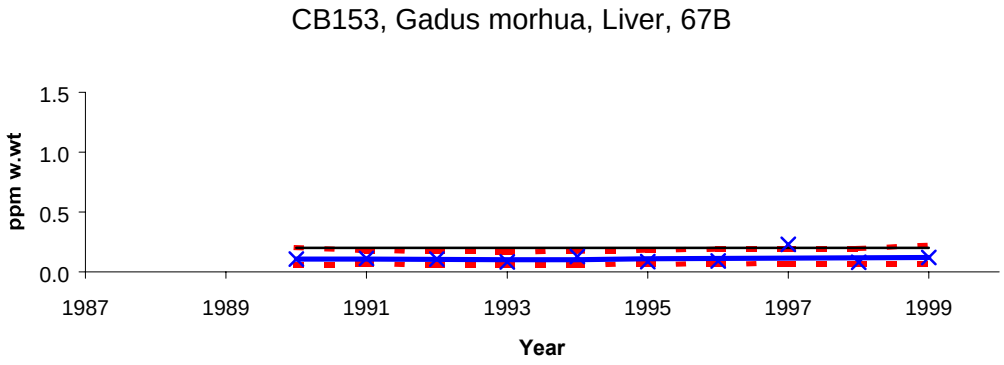


Figure 10. Median ppDDE (DDEPP) and CB153 concentrations in cod (*Gadus morhua*) from Sørfjord (st.53B) and Hardangerfjord (st.67B) (cf. Appendix F. and key in Figure 21). **Note that for some years the upper confidence interval line is off-scale in Figures A and B.**

1.3.3 Lista area

No overconcentrations of metals or chlorinated hydrocarbons were found in mussels, cod or dab (st.15A/B/F, Appendix H. and Appendix I.), with the exception of a slight overconcentration for zinc in cod liver (less than 2 times).

1.3.4 Bømlo-Sotra area

No overconcentrations of metals or chlorinated hydrocarbons were found in mussels or cod from this area (22A and 23B, Appendix H. and Appendix I.), exception for mercury in cod fillet and lead in plaice liver where only a slight overconcentration was found (less than 2 times "high background") (Appendix H.).

It was impractical to continue sampling for flatfish at st.22F Borøyfjorden. Thus, a new station in Åkrafjorden, 21F Kyrping, was initiated. This station is about 82km southeast of 22F, but like 22F, still can be considered in a reference area.

Megrim was sampled at st.21F in 1999. No "high background" has been suggested for contaminants in this species. The median concentrations of mercury and DDE were about 2-3 times higher for megrim caught at st.67B in the more perturbed Hardangerfjord, otherwise the levels were about the same for the other contaminants (Appendix I.).

1.3.5 Orkdalsfjord area

Investigations in the area have been discontinued. Data for mussels is available for the period 1984-1996.

1.3.6 Open coast areas from Bergen to Lofoten

This stretch of coastline covers 7° of latitude to 68°N (Appendix F.). Only one mussel station (st.98A) was investigated. Mussels were collected from 98A in 1992-1993. However, during the period 1994-1996 mussels were not found at this station but were collected from nearby Skrova harbour (98X). Since 1997 a "new" 98A location was found roughly 18 km north in a small fjord remote from apparent point source of contamination.

Slight overconcentrations (less than 2 times "high background") of cadmium and mercury were found in mussels but no overconcentrations were found in cod, or plaice (st.98A/B/F, Appendix H. and Appendix I.).

1.3.7 Exposed area of Varangerfjord near the Russian border

The remaining and northern area of JAMP in Norway stretches north of 68°N and a longitude from 17 to 29°E (Appendix F.). In 1999 only two mussel stations, one cod and one plaice station were investigated in the Varangerfjord (at approximately 70°N) that borders with Russia.

Slight overconcentrations (less than 2 times “high background”) of cadmium and HCB were found in cod liver (st.10B) (Appendix H. and Appendix I.).

1.3.8 Norwegian Pollution and Reference Indices

The Norwegian Pollution Control Authority (SFT) has requested a select and small group of indices to assess the quality of the environment with respect to contaminants. One index is based on the levels and trends of contaminant concentrations in the blue mussel collected annually from a selection of the more contaminated fjords in Norway (Appendix J.). SFT has also requested the testing of this index against “reference” stations from selected areas and fjords.

The Index scale varies from 1, in which no overconcentrations were found at any station, to 5, in which at least one sample from each area or fjord could be classified as “very bad” in SFT's system.

Nine fjord areas were used to calculate the Pollution Index. The Index for 1999 is 3.1, and unchanged since 1997. A value between 3 and 4 would be classified as "bad" in the SFT system.

Only four fjord/areas were included in Reference Index for 1998-1999 compared to seven to eight used in previous years. The Index for 1999 is 1.3. A value between 1 and 2 would be classified as “Fair”.

1.4 Biological effects methods for cod and flatfish

The JAMP-programme for 1999 included five biological effects methods (BEM): FAC, ALA-D, EROD, MT and TBT (Table 2). The first four are discussed in this chapter (Figure 11 to Figure 18, Appendix K.) and TBT is discussed separately (cf., Chapter 1.5).

All parameters were measured in Atlantic cod collected at six locations (15B, 23B, 30B, 36B, 53B, 67B). The same parameters were also measured in flounder at three locations (218F, 53F, 67F) and dab at two locations (15F, 36F). The locations can be divided into two groups: one group of stations can be considered to be moderately to markedly polluted (30B, 53B/F, 67B/F), whereas the other locations were from areas with little or no known pollution input.

Table 2. Summary of biological methods employed by the JAMP-1999.

Code	Name	tissue sampled	Specificity
FAC	Pyrene metabolites of PAH	fish bile	PAH
ALA-D	δ-amino levulinic acid dehydrase inhibition	fish red blood cells	Pb
EROD	Cytochrome P4501A-activity (CYP1A/P4501A1, EROD)	fish liver	planar PCB/PCNs, PAHs, dioxins
MT	Metallothionein	fish liver	Cd Cu Zn (Hg)
TBT	Imposex/Intersex	snail soft tissue	organotin

The reason to use biological effects methods within monitoring programmes is to evaluate whether marine organisms are affected by contaminant inputs. Such knowledge can not be derived from tissue levels of contaminants only. In addition to enable conclusions on the health of marine organisms, some biomarkers assist in the interpretation of contaminant bioaccumulation. The biological effects component of the Norwegian JAMP is possibly the most extensive of its type in Europe and includes imposex in gastropods as well as biomarkers in fish. The four chosen methods for fish were selected for specificity, for robustness and because they are among a limited set of methods proposed by international organisations, including OSPAR and ICES.

As in previous years, 25 individual cod were sampled for biological effects measurements at the six locations. Similarly, 25 dab were collected at 15F and 25 flounder at 53F and 67F. A new reference flatfish station was also sampled, but only 11 flounder were collected (218F). At location 36F, 21 individual dab were sampled for biological effects measurements. All fish were collected by local fishermen and kept alive until arrival of NIVA staff within 5 days. Obviously, only live fish is sampled. There is an ongoing process to train and inform the fishermen that collect fish for JAMP to ensure the quality of the material.

1.4.1 OH-pyrene metabolites in bile

The concentrations of OH-pyrene metabolites in bile were significantly elevated in cod from station 15B in all three years ($p<0.0001$) (Figure 11). In 1997, there were also significantly increased levels in cod from stations 53B and 67B (but see below), whereas there were increased concentrations of pyrene metabolites in cod from stations 53B and 30B in 1998 and 1999 compared to other locations. There is generally good consistency between years for concentrations of OH-pyrene metabolites in cod bile (exceptions being 15B - 1998 and 67B - 1997). The consistently high levels in cod from station 15B merits further study. This is an area with input from an aluminium-smelter, but there are otherwise no known sources of PAH. The fish are collected on the open coast and the discharge from the smelter is a small bay about 2 km away.

It has been thought that holding conditions prior to sampling could at least partly explain the observed response (the fish were held in a small fishing harbour), but measures were taken in 1998 and 1999 to minimise or remove this exposure. Given the precautions taken, it is highly unlikely that the observed levels have been caused by storage prior to sampling. The increased level of pyrene metabolites in cod from station 67B in 1997 were presumably due to holding conditions as the fish were moved to a more contaminated location before sampling could be effected (see comment under ALA-D). The increased levels of pyrene metabolites at stations 53B and 30B (1998 and 1999) presumably reflect the general contamination of the two areas (inner Sørfjord and inner Oslofjord).

A similarly increased level of OH-pyrene metabolites in bile was found in dab collected in the same area, 15F (Figure 12). Somewhat surprisingly, flatfish (flounder) from the polluted area 53F did not have higher levels of metabolites in bile than flatfish from other locations. An improved method for the analysis of PAH-metabolites has now been implemented (using HPLC separation and synchronous scan fluorimetry detection). In 1999, both the former and the new method were used in parallel. The results indicate good agreement between the two methods.

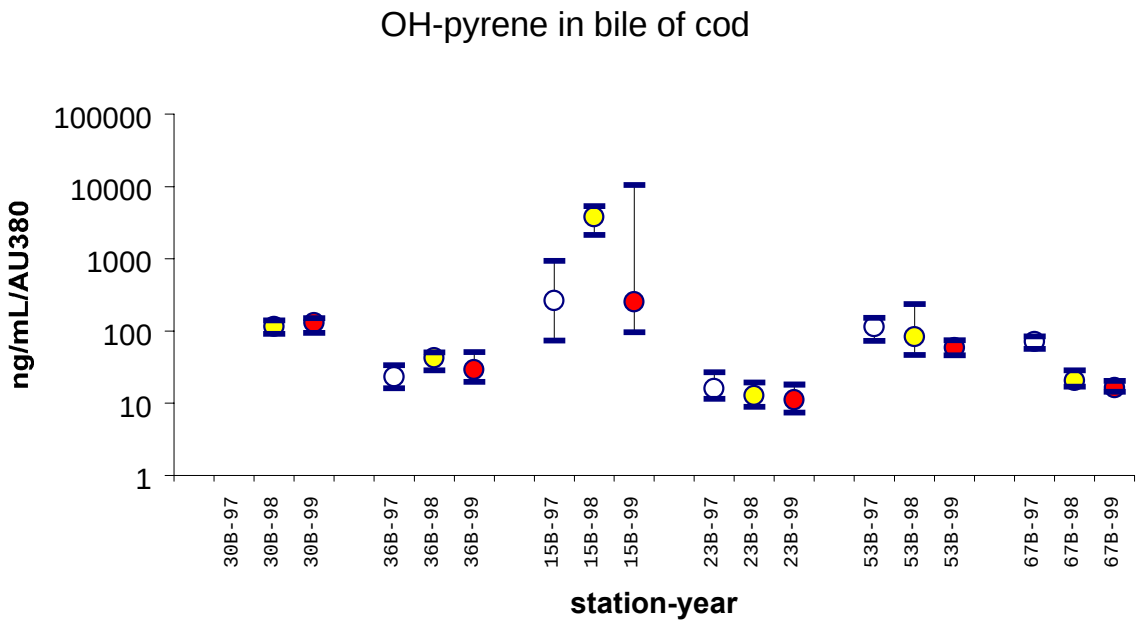


Figure 11. Concentration of OH-pyrene (ng/mL/AU_{380}) in bile from Atlantic cod collected at the indicated stations from 1997 to and 1999. Medians and quartiles (25%, 75%). Note logarithmic axis and that values were standardised to absorbance at 380 nm. (Biliverdin was used as a standardising faktor in 1997). No values are available for 30B in 1997. Stations 36B, 15B and 23B are considered less perturbed than stations 30B, 67B and 53B.

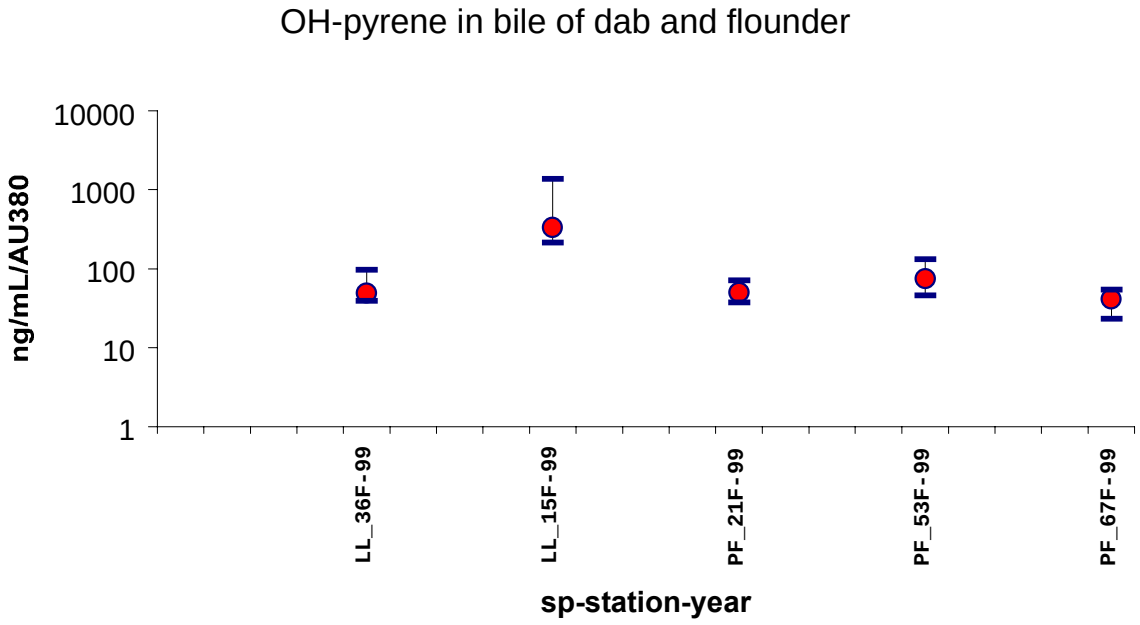


Figure 12. Concentration of OH-pyrene in bile from dab (LL, st.15F, 36F) and flounder (PF, st.21F, 53F, 67F) collected at the indicated stations in 1999. Medians and quartiles (25%, 75%). Note logarithmic axis and that values were standardised to absorbance at 380 nm.

1.4.2 ALA-D in blood cells

The activity of ALA-D in cod blood was consistent at the different stations between years. In both 1997 and 1998, the activity of ALA-D was significantly inhibited at the two most contaminated stations, i.e. 30B and 53B, compared to cleaner stations (i.e. 23B, 36B) (Figure 13). In 1997, ALA-D was also inhibited in fish at station 67B, presumably due to post-capture exposure (see above). In 1999, cod from all other stations had significantly lower activity of the enzyme than cod collected at 23B and 67B. It is not clear why the enzyme was depressed in cod from 15B and 36B, two “clean” locations.

The pattern seen for cod in 1999 was also found in flounder and dab – the highest activity (i.e. “cleanest” location) was found at 67F and lowest activity at 53F (expected) and 36F (not expected) (Figure 14).

The activity of ALA-D is known to be inhibited by exposure to lead. The results indicate that very low levels of the metal affect fish. Although all results indicate that ALA-D inhibition is lead-specific, it is not possible to rule out interference by other metals or organic contaminants. Note that the absolute activity has been adjusted following the implementation of a new method. This has been corrected for earlier years (no change in relative relationships between 1997 and 1998).

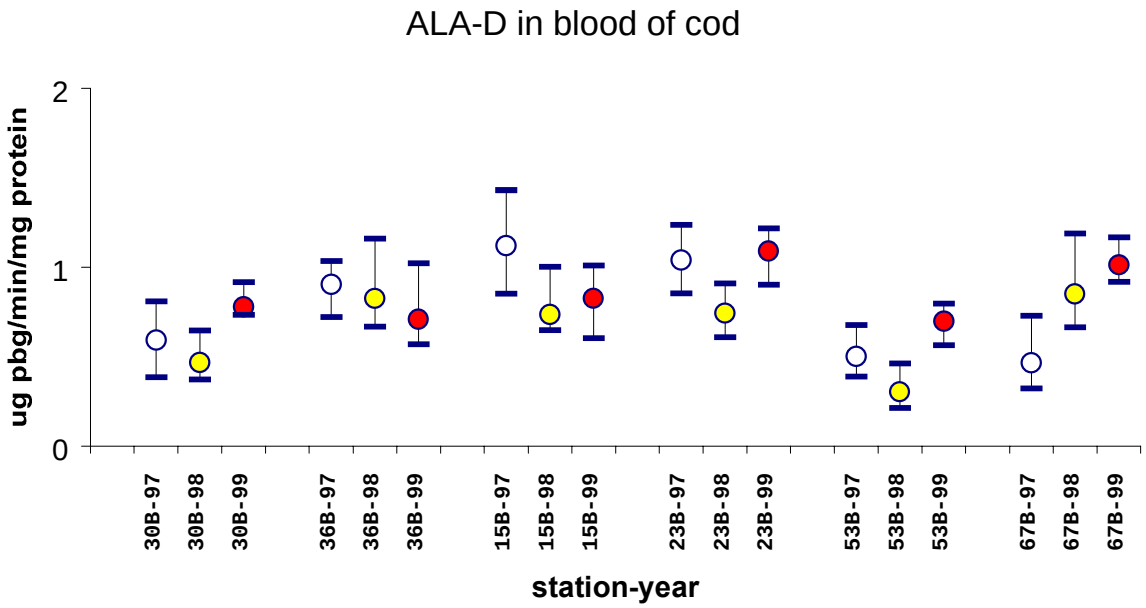


Figure 13. Activity of δ-aminolevulinic acid dehydratase (ALA-D, µg pbg/min/mg protein) in red blood cells from Atlantic cod collected at the indicated stations from 1997 to 1999. Median and quartiles (25%, 75%).

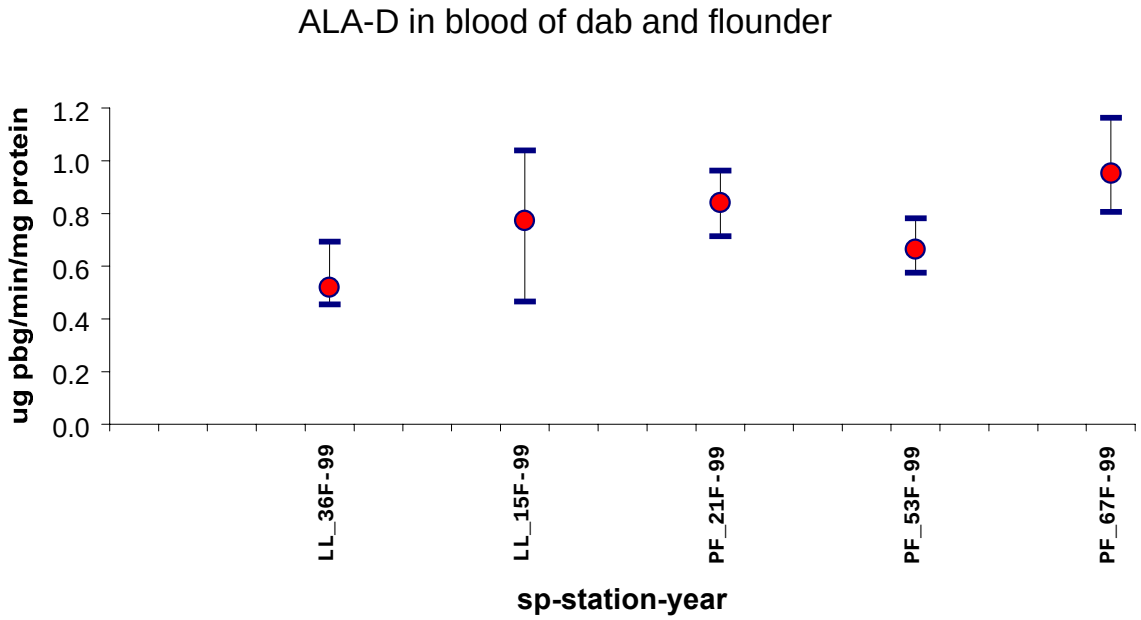


Figure 14. Activity of δ-aminolevulinic acid dehydratase (ALA-D, µg pbg/min/mg protein) in red blood cells from dab (LL, st.15F, 36F) and flounder (PF, st.21F, 53F, 67F) collected at the indicated stations in 1999. Median and quartiles (25%, 75%).

1.4.3 EROD in liver

In 1997, the activity of hepatic cytochrome P4501A (EROD) in cod was significantly elevated at the most polluted station, 53B, whereas 30B, 53B and 67B were all significantly elevated in 1998 (Figure 15). In 1999, somewhat increased levels were also found at 67B, but significantly higher EROD activity in cod from 15B compared to the other stations.

As mentioned above, an exposure to PAHs is indicated for this cod population (15B), and it is probable that the elevated EROD is a result of that exposure. In 1997 and 1998, EROD in cod was found to be consistently increased in areas with some industrial input, but there were no strong trends.

The 1999 results for dab were similar to each other and significantly higher than flounder (Figure 16). No significant difference was found in flounder from the more polluted Sørfjord (st.53F) as compared to the Hardangerfjord (67F).

No adjustment for water temperature, season, size or sex has been made. Fish is sampled at a time of year (September-November) when differences between the sexes should be at a minimum. EROD is induced by planar organic contaminants, e.g. PAH, dioxins and planar PCBs. Whereas there was higher EROD activity in cod collected at the more contaminated sites in 1998, such response was not apparent in 1997 and 1999. In 1999, there was higher variability in fish collected at the three contaminated sites compared to fish collected in reference areas. This pattern is commonly seen for EROD and indicate that populations with different exposure history is sampled. There is evidence from other fish species that continuous exposure to e.g. PCBs may cause adaptation, i.e. decreased response, in the EROD response following contaminant exposure.

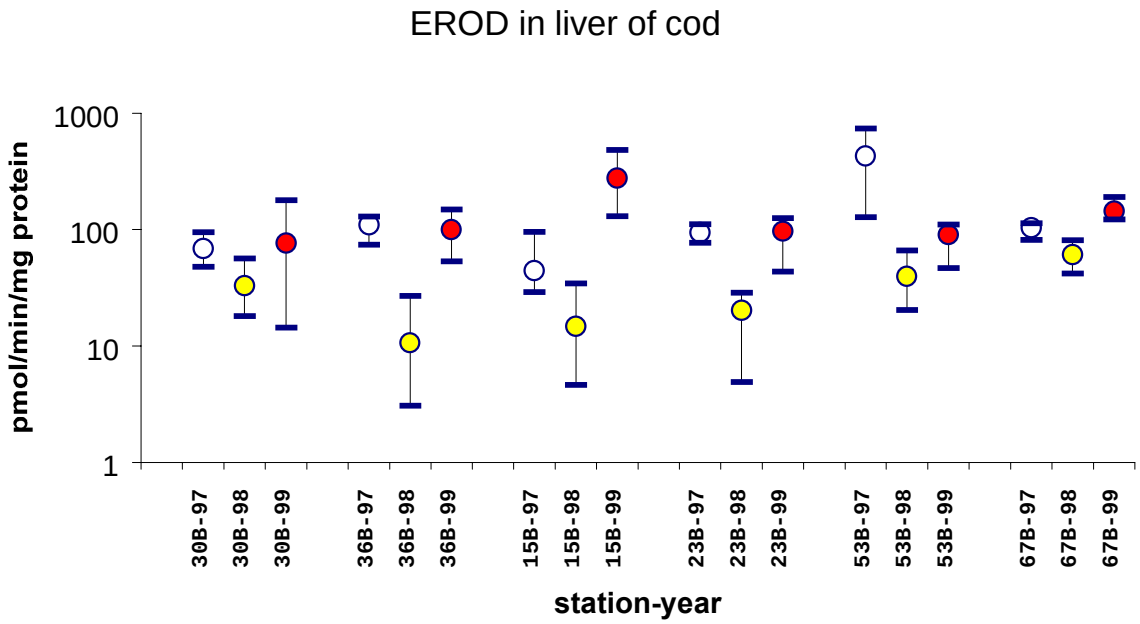


Figure 15. Activity of cytochrome P4501A (EROD, pmol/min/mg protein) in liver from Atlantic cod collected at the indicated stations from 1997 to 1999. Median and quartiles (25%, 75%). Note logarithmic axis. Values for individual years were standardised to median value at station 23B (in reality very close to real values expressed in pmol/min/mg protein).

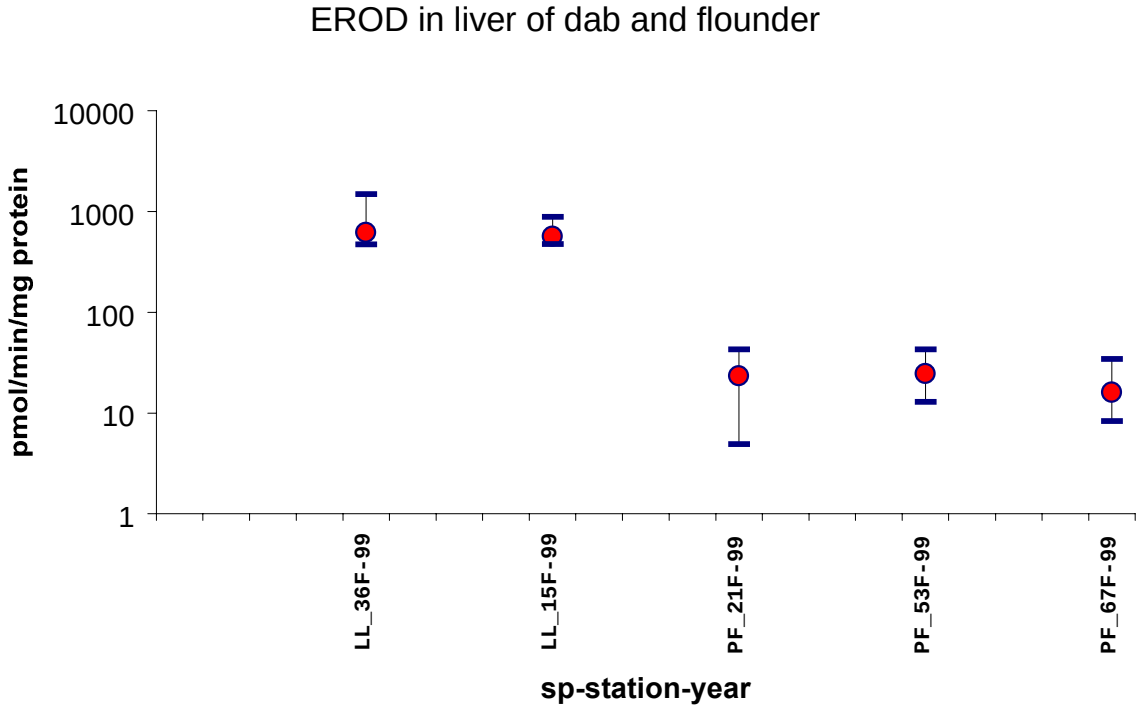


Figure 16. Activity of cytochrome P4501A (EROD, pmol/min/mg protein) in liver from dab (LL, st.15F, 36F) and flounder (PF, st.21F, 53F, 67F) collected at the indicated stations in 1999. Median and quartiles (25%, 75%). Note logarithmic axis.

1.4.4 Metallothionein in liver

The results for cod for 1999 are being reanalysed. For the sake of consistency the results for 1997-1998 are presented. There were no clear trends in the hepatic concentrations of the metal-binding protein metallothionein (MT) in cod from the six stations in 1997 and 1998 (Figure 17). In 1997, MT concentrations were significantly lower at the most polluted station, 53B, compared to levels at the other five stations, which were similar. In 1998, the concentrations were highest in cod at a clean station, 23B and lowest at the Oslofjord stations, 30B and 36B.

For flatfish, MT-concentrations in 1999 were significantly higher at st.67F, a moderately polluted station, whereas the other stations including the most polluted station (53F) were similar (Figure 18.)

This protein is induced by and binds the metals Cd, Zn, Cu and Hg. As for EROD, no adjustment has been made for sex, size or metal levels in tissues. The lack of relationship with other physiological parameters (e.g. trace metal levels) has prompted a check of the analytical method used. Results from all three years need to be quality controlled before being reported.

1.4.5 Concluding remarks

The application of BEM methods within JAMP in previous years (1997 and 1998) has indicated that the location 15B, previously regarded as only diffusely polluted, has an input of PAH which is sufficient to affect fish in the area. Increased levels of PAH-metabolites in bile indicates exposure to PAHs. Chronic exposure to PAHs may lead to liver lesions and reproductive disorders in fish, as shown through National Ocean and Atmospheric Administration's (NOAA (USA)) studies in Puget Sound. The highest levels of PAH metabolites observed in the bile of cod from station 15B are high compared to other studies, but it is not at present possible to infer population effects on cod in the area. It would be relevant to include DNA adduct analyses at some stage to clarify whether the cellular repair system of cod is sufficient to protect against damage from PAH radicals.

Results from 1997 and 1998 also clearly indicated that there are metal effects, indicated by decreased activity of the enzyme ALA-D, in the two most strongly polluted areas (30B and 53B). Results from 1997 and 1998 also gave indications of methods that may not be very useful with the species (cod) and tissue (liver) used. There is a continuous assessment of methods, but it is important to use the selected set of methods over at least a five year period before a final assessment is made.

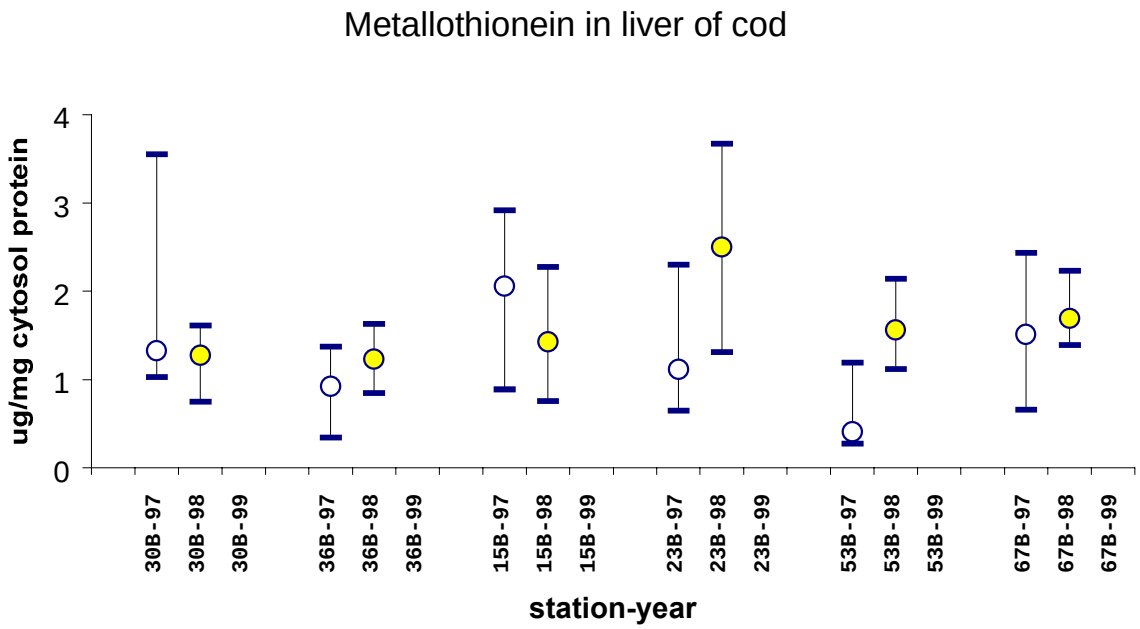


Figure 17. Hepatic concentrations of metallothionein (MT, µg/mg cytosol protein) in liver from Atlantic cod collected at the indicated stations from 1997 to 1998. Median and quartiles (25%, 75%). The 1999 materiale was being reanalysed and not available when this publication went to press.

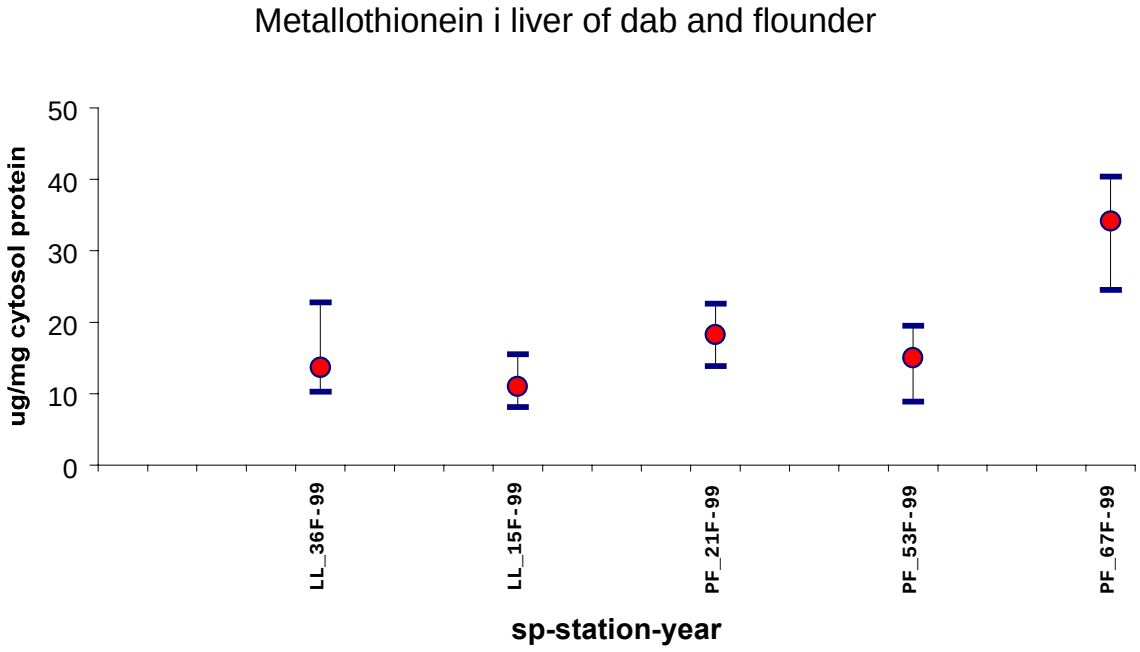


Figure 18. Hepatic concentrations of metallothionein (MT, µg/mg cytosol protein) in liver from dab (LL, st.15F, 36F) and flounder (PF, st.21F, 53F, 67F) collected at the indicated stations in 1999. Median and quartiles (25%, 75%).

1.5 Effects and concentrations of organotin

Effects from organotin in dogwhelks (*Nucella lapillus*) and concentrations in blue mussels (*Mytilus edulis*) were investigated in two areas on the coast of southern Norway, 1999.

Dogwhelks (*N. lapillus*) were sampled at five stations in the Haugesund area and one in outer Oslofjord (st.36G) in October 1999 (Appendix F. , Map 5). Whelks were present at all stations, but, as for 1998, with low abundance at st. 226G in the Haugesund area. Mussels (*M. edulis*) were sampled from three stations in the Haugesund area, one in outer Oslofjord and one in inner Oslofjord area. TBT-induced development of male sex-characters in females, known as imposex (VDSI and RPSI), was analysed according to OSPAR-JAMP guidelines. Detailed information about the chemical analyses of the animals is given in Følsvik *et al*. (1999). The results are shown in Figure 19 and Figure 20.

1.5.1 Dogwhelks

Effects from organotin was in 1999 observed at all stations, least in the open area at Færder (st. 36G), and at the northern- and southernmost stations (220G and 224G) in the Haugesund area (particularly for RPSI, only small differences in VDSI, Figure 19).

Generally, there was an apparent improvement in VDSI from 1991/1993 to 1997, but there has been little change since then (Figure 19). The development of the 'relative penis size index' (RPSI) is not as consistent over the years, and the 1999 investigations indicate a deterioration on four of the Haugesund stations. The Færder area (st. 36G) is clearly least affected area considering the RPSI-index (Figure 19).

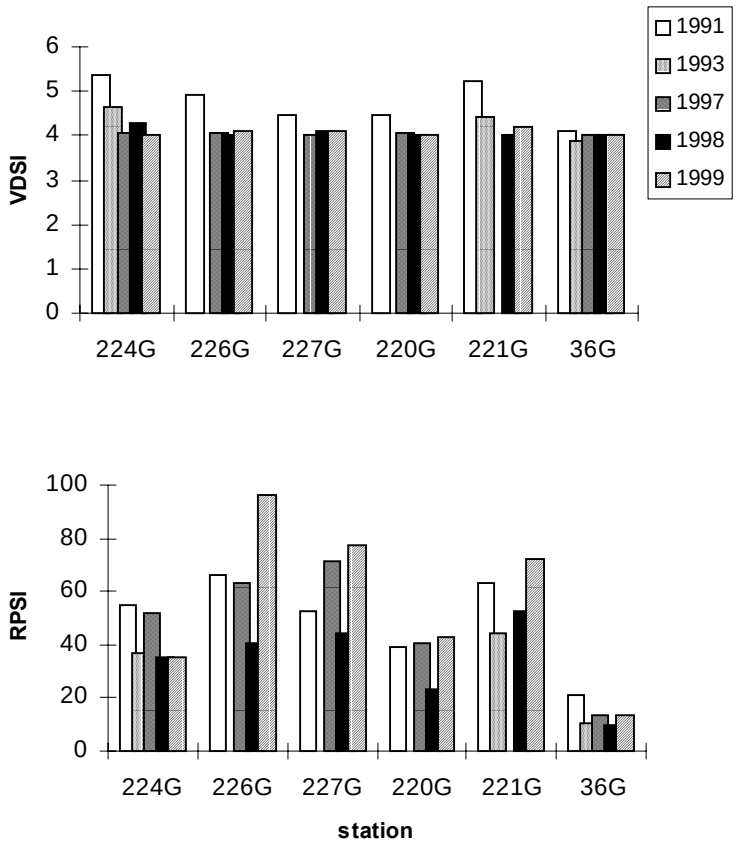


Figure 19. Imposex (VDSI and RPSI) in dogwhelks (*Nucella lapillus*) at 6 stations in southern Norway in 1991 (Harding *et al*. 1992), 1993 (Walday *et al*. 1997), 1997, 1998 and 1999. (cf. Appendix F. , Map 2 and 5).

1.5.2 Mussels

Three parallels were analysed, except for station 30A and 36A where two parallels were analysed. Concentrations of organotin in mussels were high in most areas, except for the Outer Oslofjord, and extremely high at one station in the Haugesund area (221A). Levels ranged between 79 and 2100 µg Sn/kg d.w. (Figure 20 and Table 13 in Appendix L.). According to the Norwegian classification of environmental quality (Molvær *et al*. 1997) the inner Oslofjord- and Haugesund area were markedly to extremely polluted with TBT, while outer Oslofjord was moderately polluted.

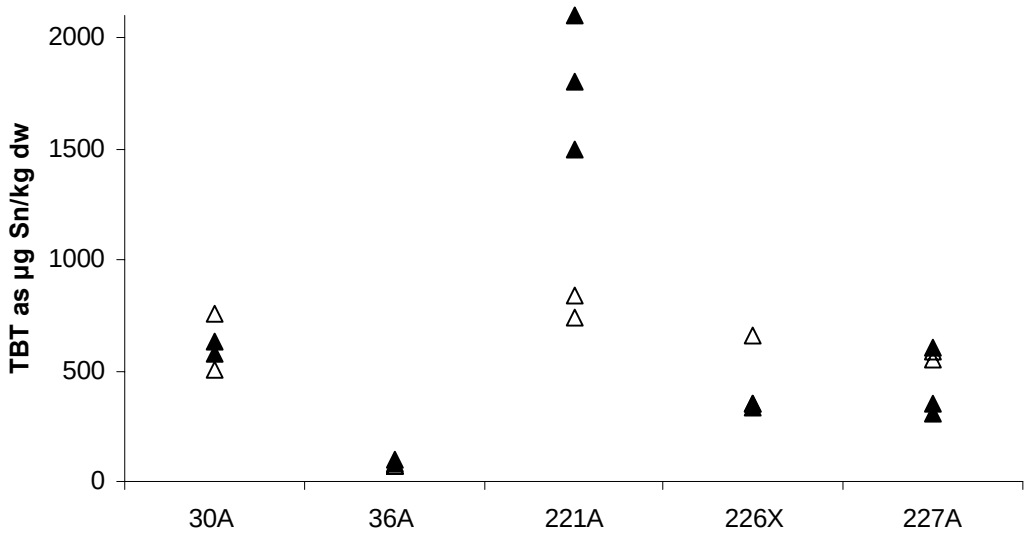


Figure 20. Levels of organotin (µg Sn/kg d.w.) in *Mytilus edulis* from parallels at five stations in Southern Norway in 1998 (Δ) and 1999 (▲). (cf. Appendix F. , Map 2 and 5).

1.5.3 Concluding remark

The presence of organotin (as TBT) in Norwegian waters was still a problem in 1999. Concentrations of organotin in mussels were elevated, and biological effects from TBT were found in all dogwhelks from the investigated areas, higher than last year (RPSI) at most of the stations in the Haugesund area. The prohibition against the use of TBT in antifouling on boats <25 m of length has not lead to a clear improvement in the investigated areas. This is cause for concern.

1.6 Overall conclusions

In regards to JMP/JAMP Purpose A (health assessment), attention should be called to the list from Norwegian Food Control Authority (SNT) which names the restrictions and recommendations concerning the sale and consumption of seafood in Norway (Table 3).

In regards to JMP/JAMP Purpose C (spatial distribution assessment), the concentrations found in 1999 are indicated in the bar graphs shown in Appendix I. . Provisional “high background" levels were used to identify elevated concentrations. This initial assessment revealed no new areas of concern that are not currently under surveillance.

In regards to JMP/JAMP Purpose D (temporal trend assessment) there is evidence that the median concentrations of cadmium in mussels from the Sørfjord have decreased since 1987. An analysis of HCB concentrations in mussels from the Langesundsfjord 1990-1998 have also shown a decrease.

Table 3. Summary of action taken by the Norwegian Food Control Authority (SNT, http://www.snt.no/nytt/tema/kosthold/kyst.html) concerning the consumption and sale of fish products along the Norwegian Coast (SFT, pers. comm. 1999).

Area of concern (km^2)	Last year of issue/ evaluation	Main parameters of concern	Main fish/shellfish product of concerned	Recommendations or restrictions of concern:
Inner Oslofjord (190)	2000	PCB	fish liver	Consumption
Inner Drammensfjord (45)	1992	Dioxins/PCB	fish liver	Consumption and Sale
Inner Sandefjordfjord (3)	1993	PCB	round fish liver	Consumption and Sale
Grenlandsfjords, Langesundsfjord (84)	1997	Dioxins	fish, shellfish	Consumption and Sale
Tvedestrand (2)	2000	PCB	fish liver	Consumption
Arendal (9)	2000	PCB	fish liver	Consumption
Inner Kristiansandsfjord (29)	2000	Dioxins/PCB	fish, shellfish	Consumption and Sale
Farsund (42)	2000	PCB PAH	fish, mussels	Consumption
Fedafjord (13)	1995	PAH	mussels [2)]	Consumption
Flekkefjord (3)	2000	PCB	fish liver	Consumption
Karmsund	2000	PAH	shellfish	Consumption
Saudafjord (21)	1992	PAH	fish liver, mussels	Consumption
Sørfjord (80)	2000	Cd Pb Hg PCB	fish, shellfish	Consumption
Bergen area including Herdlefjord, Byfjord, Hjeltefjord, Grimstadfjord and Raunefjord (180)	1998	PCB	fish, shellfish	Consumption and Sale
Inner Årdalsfjord (8)	1995	PAH	mussels	Consumption
Inner Sunndalsfjord (15)	1993	PAH	fish liver, mussels	Consumption
Hommelvik (Trondheimsfjord) (5)	1985	PAH	mussels	Consumption
Inner Ranfjord (15)	1997	PAH Pb Hg	mussels	Consumption
Vefsnfjord (50)	1992	PAH	mussels	Consumption
Ramsund	2000	PCB	fish, shellfish	Consumption
Harstad (1)	2000	PCB heavy metals	fish liver, mussels	Consumption
Tromsø (17)	2000	PAH	mussels	Consumption
Hammerfest (2)	2000	PAH	mussels	Consumption
Honningsvåg (2)	2000	PAH	mussels	Consumption

[1)] Up to 1997 included only cod
[2)] Up to 1997 included fish

Study of the power of temporal trend monitoring was useful in assessing existing sampling strategies, however, modifications might be needed to account for local conditions (see Appendix O in Green *et al.* 2000).

The 1999 investigation also includes results on Norwegian Pollution Control Authority Pollution Indices (Appendix J.), and discussion of the results of biological effects methods including imposex and intersex (Chapter 1.4 and Chapter 1.5).

The JAMP issues to which these investigations are relevant are shown in Table 4.

Table 4. JAMP issues relating to the Norwegian JAMP (cf., SIME 1997, Annex 11).

Subject	JAMP issue	Question	Recent Norwegian contribution
Hg, Cd and Pb	JAMP issue 1.2.	What are the concentrations and fluxes in sediments and biota?	1996-1997: Levels in sediment (cf., Green *et al.* 2000) 1999: Levels and trends in biota (annual investigations since 1981, Chapter 1.3) 1999: INDEX for blue mussels from selected stations (annual investigations since 1995, cf. Chapter 1.3.8)
TBT	JAMP issue 1.3.	To what extent do biological effects occur in the vicinity of major shipping routes offshore installations, marinas and shipyards	1999: Levels and trends in mussels and snails (annual investigations since 1997, cf. Chapter 1.5)
PCBs	JAMP issue 1.7.	Do high concentrations pose a risk to the marine ecosystem	[as for JAMP issue 1.2]
PCBs	JAMP issue 1.8.	Do high concentrations of non-ortho and mono-ortho CBs in seafood pose a risk to human health?	1995: INDEX for blue mussels from selected stations (cf. Green 1997) 1996: Levels in cod (cf. Green *et al.* 2000)
PAHs	JAMP issue 1.10.	What are the concentrations in the maritime [1)] area?	1992: Levels in shellfish (Green *et al.* 1995) 1992-1993: Levels in fish for selected stations (Knutzen & Green 1995) 1996-1997: Levels in sediment (cf., Green *et al.* 2000) 1999: INDEX for blue mussels from selected stations (annual investigations since 1995, Chapter 1.3.8)
PAHs	JAMP issue 1.11.	Do PAHs affect fish and shellfish?	1998: Biological effects methods in cod (cf. Chapter 1.4)
Other synthetic organic compounds	JAMP issue 1.12.	How widespread are synthetic organic compounds within the maritime [1)] area?	1999: Levels and trends in biota (annual investigations since 1983 of selected organochlorines, cf. Chapter 1.3) 1996: Introductory investigation of organochlorines in cod livers (cf. Green *et al.* 2000)
Chlorinated dioxins and dibenzofurans	JAMP issue 1.15.	What concentrations occur and have the policy goals (for the relevant parts of the maritime [1)] area) been met?	1995: INDEX for blue mussels from selected stations (cf. Green 1997) 1996: Introductory investigation of organochlorines in cod livers (cf. Green *et al.* 2000)
Biological effects of pollutants	JAMP issue 1.17.	Where do pollutants cause deleterious biological effects?	1999: Southern Coast, planar PCBs, metals, PAHs in cod (annual investigations since 1997, cf. Chapter 1.4)
Chemicals used	JAMP issue 5.3.	In which areas do pesticides and antibiotics affect marine biota?	1999: Levels and trends in biota (cf. Chapter 1.3)
Ecosystem health	JAMP issue 6.1.	How can ecosystem health be assessed in order to determine the extent of human impact?	Results for the other issues are also relevant here

[1]) Not defined in original text

2. Technical Details

2.1 Compliance with guidelines/procedures

2.1.1 JAMP programme

Samples were collected and analysed, where practical, according to OSPAR guidelines (OSPAR 1990, 1997) and screened and submitted to ICES by agreed procedures (ICES 1996). The most important point of concern are those stations where insufficient number of fish were collected (cf. Appendix G.).

2.1.2 Overconcentrations and classification of environmental quality

This report focuses on the principle cases where *median* concentrations exceeded provisional "high background" ("normal"). The median concentration can be derived from the tables in Appendix H. or figures in Appendix I. , depending on the year and concentration basis in question. The provisional "high background" limits are summarised in Table 5. The factor by which concentrations exceeded “high background” is termed **overconcentration**. “High background” limits have not been set for all contaminants and species. It should be noted that there is in general a need for periodical review and supplement of this list of limits in the light of results from reference localities and introduction of new analytical methods, and/or units. Because of changes in the limits, assessments of overconcentrations for years prior to 1997 made in this report may not correspond to figures and assessments made in previous national comments.

In addition to the use of "high background", the Norwegian Pollution Control Authority’s (SFT’s) system for **classification of environmental quality** has been applied (Table 6).

No attempt has been made to compensate for differences in size groups or number of individuals of mussels or fish. The exception was with mercury in fish fillet where seven and seventeen data sets in this study showed significant differences between “small” and “large” fish (Appendix H.). In regards to mussels, there is some evidence that concentrations do not vary significantly among the three size groups employed for this study (i.e. 2-3, 3-4 and 4-5 cm) (WGSAEM 1993).

With respect to Purpose A (health risk assessment), the Norwegian Food Control Authority (SNT) is responsible for official commentary as to possible health risk due to consumption of seafood. Hence, the results of the JAMP pertaining to this purpose are presented only as a partial basis for evaluation.

Table 5. Provisional "high background levels" of selected contaminants, in **ppm** (**mg/kg) dry weight** (blue mussel) and **ppm (mg/kg wet weight)** (blue mussel and fish). The respective "high background" limits are from Knutzen & Skei (1990) with mostly minor adjustments (Knutzen & Green 1995; Molvær *et al.* 1997), except for dab where the suggested limit is based on JAMP-data (Knutzen & Green 1995). Especially uncertain values are marked with "?".

Cont.	Blue mussel [1]		Cod [1]		Flounder [1]		Dab [1]	
			liver	fillet	liver	fillet	liver	fillet
	ppm d.w.	ppm w.w.	ppm w.w.	ppm w.w.	ppm w.w.	ppm w.w.	ppm w.w.	ppm w.w.
Lead	3.0 [2]	0.6 [3]	0.1		0.3 ?		0.3 ?	
Cadmium	2.0 [2]	0.4 [3]	0.1		0.3 ?		0.3 ?	
Copper	10 [2]	2 [3]	20		30 ?		10 ?	
Mercury	0.2 [2]	0.04 [3]		0.1 [2]		0.1		0.1 ?
Zinc	200 [2]	40 [3]	30		60 ?		50 ?	
∑PCB-7 [8]	0.020 [3]	0.004 [2]	0.5 [2]	0.005	0.10 ?	0.005 ? [2]	0.5 ?	0.010 ?
CB-153	0.005 [3]	0.001 [4]	0.2 ? [5]		0.05 ? [7]		0.20 ? [7]	
ppDDE	0.010 [3]	0.002 [6]	0.2 [2]		0.03 ? [6]		0.1 ? [6]	
γ HCH	0.005 [3]	0.001 [6]	0.05 [2,6]		0.01 ? [6]		0.03 ? [6]	
HCB	0.0005 [3]	0.0001 [2]	0.02 [2]		0.005 ?		0.01 ?	
TCDDN	0.000001 [3]	0.0000002 [2]						

[1]) Respectively: *Mytilus edulis, Gadus morhua, Platichthys flesus* and *Limanda limanda*.
[2]) From the Norwegian Pollution Control Authority Environmental Class I ("good") (Molvær *et al.* 1997).
[3]) Conversion assuming 20% dry weight.
[4]) Approximately 25% of ΣPCB-7 (Knutzen & Green 1995)
[5]) 1.5-2 times 75% quartile (cf. Annex B in Knutzen & Green 1995)
[6]) Assumed equal to limit for ΣDDT or ΣHCH, respectively, from the Norwegian Pollution Control Authority Environmental Class I ("good") (Molvær *et al.* 1997). Hence, limits for ppDDE and γHCH are probably too high (lacking sufficient and reliable reference values)
[7]) Mean plus 2 times standard deviation (cf. Annex B in Knutzen & Green 1995)
[8]) Estimated as sum of 7 individual PCB compounds (CB-28, -52, -101, -118, -138, -153 and -180) and assumed to be ca. 50% and 70 % of total PCB for blue mussel and cod/flatfish, respectively.

Table 6. Extracts of the Norwegian Pollution Control Authority revised environmental classification system of contaminants in blue mussels and fish (from Molvær *et al.* 1997).

Contaminant			Classification (upper limit for classes I-IV)				
			I	II	III	IV	V
			"good"	*"fair"*	*"poor"*	*"bad"*	*"very bad"*
BLUE MUSSEL							
Lead	ppm	d.w.	3	15	40	100	>100
Cadmium	ppm	d.w.	2	5	20	40	>40
Copper	ppm	d.w.	10	30	100	200	>200
Mercury	ppm	d.w.	0.2	0.5	1.5	4	>4
Zinc	ppm	d.w.	200	400	1000	2500	>2500
TBT [1)]	ppm	d.w.	0.1	0.5	2	5	>5
∑PCB-7	ppb	w.w.	4	15	40	100	>100
∑DDT	ppb	w.w.	2	5	10	30	>30
∑HCH	ppb	w.w.	1	3	10	30	>30
HCB	ppb	w.w.	0.1	0.3	1	5	>5
$TE_{PCDF/D}$ [2)]	ppp	w.w.	0.2	0.5	1.5	3	>3
COD, fillet							
Mercury	ppm	w.w.	0.1	0.3	0.5	1	>1
COD, liver							
∑PCB-7	ppb	w.w.	500	1500	4000	10000	>10000
∑DDT	ppb	w.w.	200	500	1500	3000	>3000
∑HCH	ppb	w.w.	50	200	500	1000	>1000
HCB	ppb	w.w.	20	50	200	400	>400
$TE_{PCDF/D}$ [2)]	ppp	w.w.	15	40	100	300	>300

[1]) Tributyltin on a formula basis

[2]) TCDDN (cf. Appendix B.)

2.1.3 Comparison with previous data

A simple 3-model approach has been developed to study time trends for contaminants in biota based on *median* concentrations (ASMO 1994). A variation of this method was applied to mercury in fish fillet to distinguish trends in "large" and "small" individuals. The method was first used on a large-scale basis by the Ad Hoc Working Group on Monitoring that met in Copenhagen 8-12. November 1993 (MON 1993). At this meeting it was agreed to apply the method on contaminants in fish muscle and liver on a wet weight basis and contaminants in soft tissue of mussels on a dry weight basis. The results for this assessment are presented earlier (cf. ASMO 1994). The method has been applied to Norwegian data and results are shown in Appendix G. . The results can be presented as in Figure 21.

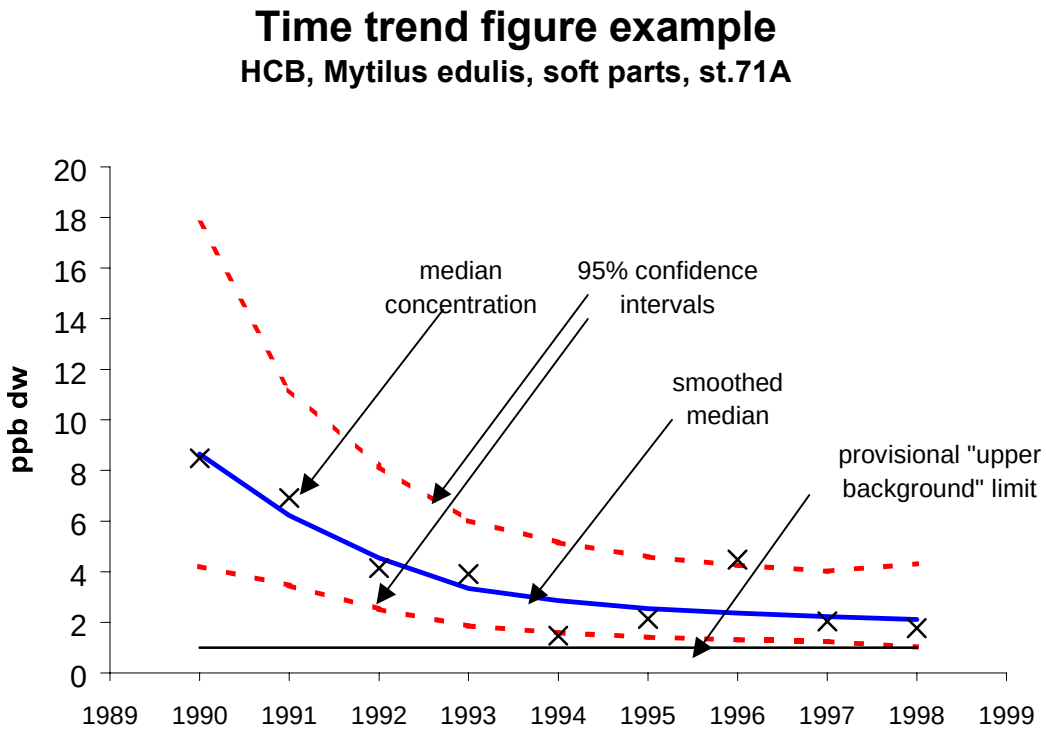


Figure 21. Example presentation and variation in contaminant concentration with time, indicating median concentrations, running mean of median values (Loess smoother), 95% confidence intervals. The provisional "high background level" is marked with a horizontal line and corresponds to values listed in Table 5 (see text).

The method of calculating the smoother is in accordance to the methods employed at Ad Hoc Working Group on Monitoring that met in Copenhagen 23-27. February 1998 (MON 1998). A Loess smoother is based on a running seven-year interval, a non-parametric curve fitted to median log-concentrations (Nicholson *et al.*1997). For statistical tests based on a fitted smoother to be valid the contaminants indices should be independent to a constant level of variance and the residuals for the fitted model should be lognormally distributed (cf. Nicholson *et al.* 1998).

The National Comments since 1994 have included two additional analyses. The first is that the upper 95% confidence interval for the last three sampling years is linearly projected for the next three years. This is in line with a proposal submitted earlier (Nicholson, *et al.* 1994) and is used to assess the likelihood of overconcentrations. The projected estimate is based on the results for the temporal trend analyses of at least 6 years of data.

The second is an estimate of the power of the temporal trend series expressed as the number of years to detect a 10% change per year with a 90% power (cf. Nicholson, *et al.*, 1997). The fewer the years the easier it is to detect a trend. The power is based on the percentage relative standard deviation (RLSD) estimated using the robust method described ASMO (1994) and Nicholson *et al.* (1998). The estimate was made for series with at least 3 years of data and covers the *entire* period monitored.

This fixed means of treating all the datasets may give misleading results especially where non-linear temporal changes are known to occur, such as for HCB in blue mussels from Langesundsfjord (Figure 4).

The statistical analysis was carried out on temporal trend data series for cadmium, copper, mercury, lead, zinc, the PCB congener CB153, ppDDE (ICES code DDEPP), γ-HCH (ICES code HCHG) and HCB. Assessment focused on individual compounds instead of "sum variables". CB153 was chosen because it is persistent and may act as an indicator for other congeners (Atuma *et al.* 1996). Furthermore, there is some evidence that CB153 may correlate with the sum of TCDD-equivalents from PCB (de Boer *et al.* 1993).

2.1.4 The effect of depuration and freezing on mussels

This was tested on samples collected in the Sørfjord and Hardangerfjord (cf., Appendix M.) The JAMP-method of pre-treatment of mussels (i.e., depuration and then cleaning) contrasted significantly to the Index-method (freezing then cleaning). Using the JAMP-method and based on a dryweight basis, cadmium concentrations were significantly higher (24%), whereas significant lower concentrations were found for lead (45%), zinc (14%), PCBs (CB101, -118, -138, -153 27-52%) and DDTs (50-64%). Lower concentrations indicated that these contaminants are associated with the particle load.

The results are not consistent with a previous study from this region that indicated no significant difference between the methods for mercury, cadmium, copper, lead and zinc (Green 1989). A study on mussels from the mouth of the Glomma River in Southern Norway showed the lead and copper were significantly lower in depurated samples (Green *et al.* 1996); however, no differences were found for PCBs or DDTs (on a lipid basis). The PCB concentrations found in the Glomma study were 3-4 times higher than Sørfjord/Hardangerfjord.

Mercury was the only contaminant common to all three studies that had consistent results; that there is no significant difference between the two methods.

The difference in methods has indicated an effect on the concentration of contaminants in mussels. However, with the exception of mercury, the results for Sørfjord/Hardangerfjord 1999 are inconsistent with two other studies in Norway. Revision of JAMP guidelines should take these results into consideration.

2.2 Information on Quality Assurance

NIVA has participated in all the QUASIMEME international intercalibration exercises, including Round 20 and 22 (2000). These exercises have included nearly all the contaminants analysed for JAMP. Quality assurance programme for NIVA is similar to the 1999 programme (cf. Green 1999). In addition, NIVA was accredited in 1993 in accordance with the EN45000 standard by the Norwegian Accreditation (reference P009). A summary of the quality assurance programme at NIVA is given in Appendix A. . A summary of the intercalibrations exercises that NIVA has participated in is given in Appendix C. .

2.3 Description of the Programme

The sampling for 1999 involved sampling of blue mussel at 45 stations and at least one flatfish species or cod was sampled at 16 stations. The Norwegian JAMP has been expanded since 1989 to include monitoring in more diffusely polluted areas. Though new stations are initially intended for annual monitoring (temporal trends), there has not always been sufficient funds to do this for every station. Sample/station reduction measures have been taken to reduce costs. Furthermore, sufficient samples have not always been practical to obtain. When this applies to mussels a new site in the vicinity is often chosen. As for fish, the quota of 25 individuals (±10%), indicated in Appendix F. as either 25 individuals or 5 bulked samples consisting of 5 fish per bulked sample, was met for all stations. Flounder was caught for the first time at this station. Appendix E. and Appendix F. gives an overview of the planned and realised sampling.

Concentrations of metals, chlorinated hydrocarbons (including pesticides) and polycyclic aromatic hydrocarbons in mussels and fish were determined at the Norwegian Institute for Water Research (JAMP code NIVA). An overview of the methods applied up to and including 1992 sample material has been presented by Green (1993, also JMG document 19/7 info 3). Only minor modifications have been made since. An overview of analyses applied from 1981 to 1998 (1999) for biological material is given in Appendix D. . Parameter abbreviations are given in Appendix B. .

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Appendix A.
Quality assurance programme

Accreditation

The laboratories at NIVA, both the chemical, microbiological and the ecotoxicological laboratories, were accredited in 1993 for quality assurance system by the National Measurement Service - Norwegian Accreditation and based on European Standard EN45000. NIVA has reference number P009.

Summary of quality control results

A summary of the results for the analyses of the SRM for sediment and biota are shown in Table A1 and A2, respectively.

Marine sediment standard reference material (SRM) MESS-2 and 1941 was used as control for determinations of metals and PCBs/PAHs, respectively.

Dogfish muscle (DORM-2) or dogfish liver (DOLT-2) was used as SRM for the control of the determination of metals (see Table A1). Mackerel oil (350) and mussel tissue (2974) was used as SRM for controls of PCBs and PAHs, respectively. In addition to SRM 2974, an internal standard was used for quality control.

The results were generally satisfactory, the mean was within 2 standard deviations of SRM-mean. Based on these findings, PCBs, DDE and naphthalenes in **sediment** may have been underestimated, whereas benzo(a)pyrene and benzo(ghi)perylene may have been overestimated. It should be noted that SRM values for PCBs, DDE and naphthalenes are listed as not certified. Based on the results for **biota** SRM, lead, benzo(a)pyrene and benzo(e)pyrene may have been underestimated and zinc overestimated. It should be noted that the SRM value for lead is close to the detection limit for this reporting lab.

See also results from intercalibrations exercises listed in Appendix C. .

NIVA has also participated in QUASIMEME exercises up to and including: Round 16 : Matrix QTM045MS for metals, QOR057MS for CBs/OCPs and QPH020MS - PAHs in sediment; and Matrix QTM041BT for metals, QOR057BT for CBs/OCPs and QPH010BT - PAHs in biota. The latest round would apply to the 1998 samples analysed in 1999. The results from this round were generally acceptable (z-scores between -2 and 2).

Table 7. Summary of the quality control results for the 1999 biota samples analysed 1999-2000. The Standard Reference Materials (SRM) were DORM-2* (dogfish muscle) for mussels and fish fillet, DOLT-2* (dogfish liver) for fish liver, 350** (mackerel oil) for mussels and fish liver and 2974*** (mussel tissue) for mussels. SRM was analysed in series with the JAMP-samples for analyses of metals (mg/kg w.w.), organic chlorines or PAH (µg/kg w.w.). Tissue types were: mussel softbody (SB), fish liver (LI) and fish fillet (MU). SRMs were measured several times (N) over a number of weeks (W).

Code	Contaminant	Tissue type	SRM type	SRM value ± confidence interval	N	W	Mean value	Standard deviation
Cd	**cadmium**	SB	DORM	0.043 ± 0.008	7	2	0.042	0.002
		LI	DOLT	20.80 ± 0.5	7	17	21.3	0.3
Cu	**copper**	SB	DORM	2.34 ± 0.16	6	2	2.20	0.18
		LI	DOLT	25.80 ± 1.1	12	17	26.8	1.6
Pb	**lead**	SB	DORM	0.065 ± 0.007	7	2	0.065	0.012
		LI	DOLT	0.22 ± 0.02	12	17	0.20	0.02
Hg	**mercury**	SB	DORM	4.64 ± 0.26	16	31	4.77	0.14
Zn	**zinc**	SB	DORM	25.6 ± 2.3	5	2	24.7	0.9
		LI	DOLT	85.8 ± 2.5	12	17	98.1	2.7
CB-28	**PCB congener CB-28**	(all)	350	22.5 ± 4	24	34	17.9	1.8
CB-52	**PCB congener CB-52**	(all)	350	62. ± 9	24	34	60	5.0
CB-101	**PCB congener CB-101**	(all)	350	164 ± 9	24	34	187	15
CB-118	**PCB congener CB-118**	(all)	350	142 ± 20	24	34	150	16
CB-153	**PCB congener CB-153**	(all)	350	317 ± 20	24	34	415	75
CB-180	**PCB congener CB-180**	(all)	350	73. ± 13	24	34	84	16
PA	**phenanthrene**	SB	2974	22.2 ± 2.5	6	27	14.1	2.0
ANT	**anthracene**	SB	2974	6.1 ± 1.7	6	27	2.9	1.0
FLU	**fluoranthene**	SB	2974	163.7 ± 10.3	6	27	153	13
PYR	**pyrene**	SB	2974	151.6 ± 8.0	6	27	144	14
BAA	**benzo[*a*]anthracene**	SB	2974	32.5 ± 4.8	6	27	28.4	8.0
BAP	**benzo[*a*]pyrene**	SB	2974	15.63 ± 0.80	6	27	14.4	5.5
BEP	**benzo[*e*]pyrene**	SB	2974	84.0 ± 3.2	6	27	69.3	8.0
PER	**perylene**	SB	2974	7.68 ± 2.3	6	27	4.5	1.6
ICDP	**indeno[1,2,3-*cd*]pyrene**	SB	2974	14.2 ± 2.8	6	27	12.2	1.5
BGHIP	**benzo[*ghi*]perylene**	SB	2974	22.0 ± 2.3	6	27	20.6	2.3

*) National Research Council Canada, Division of Chemistry, Marine Analytical Chemistry Standards
**) BCR, Community Bureau of Reference, Commission of the European Communities
***) National Institute of Standards & Technology (NIST)

Appendix B.
Abbreviations

Abbreviation[1]	English	*Norwegian*
ELEMENTS		
Al	aluminium	*aluminium*
As	arsenic	*arsen*
Cd	cadmium	*kadmium*
Co	cobalt	*kobolt*
Cr	chromium	*krom*
Cu	copper	*kobber*
Fe	iron	*jern*
Hg	mercury	*kvikksølv*
Li	lithium	*litium*
Mn	manganese	*mangan*
Ni	nickel	*nikkel*
Pb	lead	*bly*
Pb210	lead-210	*bly-210*
Se	selenium	*selen*
Ti	titanium	*titan*
Zn	zinc	*sink*
PAHs		
PAH	polycyclic aromatic hydrocarbons	*polysykliske aromatiske hydrokarboner*
ACNE	acenaphthene	*acenaften*
ACNLE	acenaphthylene	*acenaftylen*
ANT	anthracene	*antracen*
BAA [3]	benzo[*a*]anthracene	*benzo[a]antracen*
BAP [3]	benzo[*a*]pyrene	*benzo[a]pyren*
BBF [3]	benzo[*b*]fluoranthene	*benzo[b]fluoranten*
BBJKF [3]	benzo[*b,j,k*]fluoranthene	*benzo[b,j,k]fluoranten*
BBJKF [3]	benzo[b+j,k]fluoranthene	*benzo[b+j,k]fluoranten*
BBKF [3]	benzo[*b+k*]fluoranthene	*benzo[b+k]fluoranten*
BEP	benzo[*e*]pyrene	*benzo[e]pyren*
BGHIP	benzo[*ghi*]perylene	*benzo[ghi]perylen*
BIPN [2]	biphenyl	*bifenyl*
BJKF [3]	benzo[*j,k*]fluoranthene	*benzo[j,k]fluorantren*
BKF [3]	benzo[*k*]fluoranthene	*benzo[k]fluorantren*
CHR	chrysene	*chrysen*
CHRTR	chrysene+triphenylene	*chrysen+trifenylen*
COR	coronene	*coronen*
DBAHA [3]	dibenz[*a,h*]anthracene	*dibenz[a,h]anthracen*
DBA3A [3]	dibenz[*a,c/a,h*]anthracene	*dibenz[a,c/a,h]antracen*
DBP [3]	dibenzopyrenes	*dibenzopyren*
DBT	dibenzothiophene	*dibenzothiofen*
DBTC1	C_1-dibenzothiophenes	*C_1-dibenzotiofen*
DBTC2	C_2-dibenzothiophenes	*C_2-dibenzotiofen*
DBTC3	C_3-dibenzothiophenes	*C_3-dibenzotiofen*
FLE	fluorene	*fluoren*
FLU	fluoranthene	*fluoranten*

Abbreviation[1]	English	*Norwegian*
PAHs (cont.)		
ICDP [3]	indeno[*1,2,3-cd*]pyrene	*indeno[1,2,3-cd]pyren*
NAP [2]	naphthalene	*naftalen*
NAPC1 [2]	C_1-naphthalenes	*C_1-naftalen*
NAPC2 [2]	C_2-naphthalenes	*C_2-naftalen*
NAPC3 [2]	C_3-naphthalenes	*C_3-naftalen*
NAP1M [2]	1-methylnaphthalene	*1-metylnaftalen*
NAP2M [2]	2-methylnaphthalene	*2-metylnaftalen*
NAPD2 [2]	1,6-dimethylnaphthalene	*1,6-dimetylnaftalen*
NAPD3 [2]	1,5-dimethylnaphthalene	*1,5-dimetylnaftalen*
NAPDI [2]	2,6-dimethylnaphthalene	*2,6-dimetylnaftalen*
NAPT2 [2]	2,3,6-trimethylnaphthalene	*2,3,6-trimetylnaftalen*
NAPT3 [2]	1,2,4-trimethylnaphthalene	*1,2,4-trimetylnaftalen*
NAPT4 [2]	1,2,3-trimethylnaphthalene	*1,2,3-trimetylnaftalen*
NAPTM [2]	2,3,5-trimethylnaphthalene	*2,3,5-trimetylnaftalen*
NPD	Collective term for naphthalenes, phenanthrenes and dibenzothiophenes	*Sammebetegnelse for naftalen, fenantren og dibenzotiofens*
PA	phenanthrene	*fenantren*
PAC1	C_1-phenanthrenes	*C_1-fenantren*
PAC2	C_2-phenanthrenes	*C_2-fenantren*
PAM1	1-methylphenanthrene	*1-metylfenantren*
PAM2	2-methylphenanthrene	*2-metylfenantren*
PAMD1	3,6-dimethylphenanthrene	*3,6-dimetylfenantren*
PAMD2	9,10-dimethylphenanthrene	*9,10-dimetylfenantren*
PER	perylene	*perylen*
PYR	pyrene	*pyren*
DI-Σn	sum of "n" dicyclic "PAH"s (footnote 2)	*sum "n" disykliske "PAH" (fotnote 2)*
P-Σn	sum "n" PAH	*sum "n" PAH*
PK-Σn	sum carcinogen PAH's (footnote 3)	*sum kreftfremkallende PAH (fotnote 3)*
PAHΣΣ	DI-Σn + P-Σn etc.	*DI-Σn + P-Σn mm..*
SPAH	"total" PAH, specific compounds not quantified (outdated analytical method)	*"total" PAH, spesifikk forbindelser ikke kvantifisert (foreldret metode)*

Abbreviations (cont'd.)

Abbreviation[1]	English	*Norwegian*
PCBs		
PCB	polychlorinated biphenyls	*polyklorerte bifenyler*
CB	individual chlorobiphenyls (CB)	*enkelte klorobifenyl*
CB28	CB28 (IUPAC)	*CB28 (IUPAC)*
CB31	CB31 (IUPAC)	*CB31 (IUPAC)*
CB44	CB44 (IUPAC)	*CB44 (IUPAC)*
CB52	CB52 (IUPAC)	*CB52 (IUPAC)*
CB77 [4]	CB77 (IUPAC)	*CB77 (IUPAC)*
CB81 [4]	CB81 (IUPAC)	*CB81 (IUPAC)*
CB95	CB95 (IUPAC)	*CB95 (IUPAC)*
CB101	CB101 (IUPAC)	*CB101 (IUPAC)*
CB105	CB105 (IUPAC)	*CB105 (IUPAC)*
CB110	CB110 (IUPAC)	*CB110 (IUPAC)*
CB118	CB118 (IUPAC)	*CB118 (IUPAC)*
CB126 [4]	CB126 (IUPAC)	*CB126 (IUPAC)*
CB128	CB128 (IUPAC)	*CB128 (IUPAC)*
CB138	CB138 (IUPAC)	*CB138 (IUPAC)*
CB149	CB149 (IUPAC)	*CB149 (IUPAC)*
CB153	CB153 (IUPAC)	*CB153 (IUPAC)*
CB156	CB156 (IUPAC)	*CB156 (IUPAC)*
CB169 [4]	CB169 (IUPAC)	*CB169 (IUPAC)*
CB170	CB170 (IUPAC)	*CB170 (IUPAC)*
CB180	CB180 (IUPAC)	*CB180 (IUPAC)*
CB194	CB194 (IUPAC)	*CB194 (IUPAC)*
CB209	CB209 (IUPAC)	*CB209 (IUPAC)*
CB-Σ7	CB: 28+52+101+118+138+153+180	*CB: 28+52+101+118+138+153+180*
CB-ΣΣ	sum of CBs, includes CB-Σ7	*sum CBer, inkluderer CB-Σ7*
TECBW	Sum of CB-toxicity equivalents after WHO model, see **TEQ**	*Sum CB- toksitets ekvivalenter etter WHO modell, se **TEQ***
TECBS	Sum of CB-toxicity equivalents after SAFE model, see **TEQ**	*Sum CB-toksitets ekvivalenter etter SAFE modell, se **TEQ***

Abbreviations (cont'd.)

Abbreviation[1]	English	*Norwegian*
DIOXINs		
TCDD	2, 3, 7, 8-tetrachloro-dibenzo dioxin	*2, 3, 7, 8-tetrakloro-dibenzo dioksin*
CDDST	Sum of tetrachloro-dibenzo dioxins	*Sum tetrakloro-dibenzo dioksiner*
CDD1N	1, 2, 3, 7, 8-pentachloro-dibenzo dioxin	*1, 2, 3, 7, 8-pentakloro-dibenzo dioksin*
CDDSN	Sum of pentachloro-dibenzo dioxins	*Sum pentakloro-dibenzo dioksiner*
CDD4X	1, 2, 3, 4, 7, 8-hexachloro-dibenzo dioxin	*1, 2, 3, 4, 7, 8-heksakloro-dibenzo dioksin*
CDD6X	1, 2, 3, 6, 7, 8-hexachloro-dibenzo dioxin	*1, 2, 3, 6, 7, 8-heksakloro-dibenzo dioksin*
CDD9X	1, 2, 3, 7, 8, 9-hexachloro-dibenzo dioxin	*1, 2, 3, 7, 8, 9-heksakloro-dibenzo dioksin*
CDDSX	Sum of hexachloro-dibenzo dioxins	*Sum heksakloro-dibenzo dioksiner*
CDD6P	1, 2, 3, 4, 6, 7, 8-heptachloro-dibenzo dioxin	*1, 2, 3, 4, 6, 7, 8-heptakloro-dibenzo dioksin*
CDDSH	Sum of heptachloro-dibenzo dioxins	*Sum heptakloro-dibenzo dioksiner*
CDDO	Octachloro-dibenzo dioxin	*Oktakloro-dibenzo dioksin*
PCDD	Sum of polychlorinated dibenzo-p-dioxins	*Sum polyklorinaterte-dibenzo-p-dioksiner*
CDF2T	2, 3, 7, 8-tetrachloro-dibenzofuran	*2, 3, 7, 8-tetrakloro-dibenzofuran*
CDFST	Sum of tetrachloro-dibenzofurans	*Sum tetrakloro-dibenzofuraner*
CDFDN	1, 2, 3, 7, 8/1, 2, 3, 4, 8-pentachloro-dibenzofuran	*1, 2, 3, 7, 8/1, 2, 3, 4, 8-pentakloro-dibenzofuran*
CDF2N	2, 3, 4, 7, 8-pentachloro-dibenzofurans	*2, 3, 4, 7, 8-pentakloro-dibenzofuran*
CDFSN	Sum of pentachloro-dibenzofurans	*Sum pentakloro-dibenzofuraner*
CDFDX	1, 2, 3, 4, 7, 8/1, 2, 3, 4, 7, 9-hexachloro-dibenzofuran	*1, 2, 3, 4, 7, 8/1, 2, 3, 4, 7, 9-heksakloro-dibenzofuran*
CDF6X	1, 2, 3, 6, 7, 8-hexachloro-dibenzofuran	*1, 2, 3, 6, 7, 8-heksakloro-dibenzofuran*
CDF9X	1, 2, 3, 7, 8, 9-hexachloro-dibenzofuran	*1, 2, 3, 7, 8, 9-heksakloro-dibenzofuran*
CDF4X	2, 3, 4, 6, 7, 8-hexachloro-dibenzofuran	*2, 3, 4, 6, 7, 8-heksakloro-dibenzofuran*
CDFSX	Sum of hexachloro-dibenzofurans	*Sum heksakloro-dibenzofuraner*
CDF6P	1, 2, 3, 4, 6, 7, 8-heptachloro-dibenzofuran	*1, 2, 3, 4, 6, 7, 8-heptakloro-dibenzofuran*
CDF9P	1, 2, 3, 4, 7, 8, 9-heptachloro-dibenzofuran	*1, 2, 3, 4, 7, 8, 9-heptakloro-dibenzofuran*
CDFSP	Sum of heptachloro-dibenzofurans	*Sum heptakloro-dibenzofuraner*
CDFO	Octachloro-dibenzofurans	*Octakloro-dibenzofuran*
PCDF	Sum of polychlorinated dibenzo-furans	*Sum polyklorinated dibenzo-furaner*
CDDFS	Sum of PCDD and PCDF	*Sum PCDD og PCDF*
TCDDN	Sum of TCDD-toxicity equivalents after Nordic model, see **TEQ**	*Sum TCDD- toksitets ekvivalenter etter Nordisk modell, se **TEQ***
TCDDI	Sum of TCDD-toxicity equivalents after international model, see **TEQ**	*Sum TCDD-toksitets ekvivalenter etter internasjonale modell, se **TEQ***

Abbreviations (cont'd.)

Abbreviation[1]	English	*Norwegian*
PESTICIDES		
ALD	aldrin	*aldrin*
DIELD	dieldrin	*dieldrin*
ENDA	endrin	*endrin*
CCDAN	cis-chlordane (=α-chlordane)	*cis-klordan (=α-klordan)*
TCDAN	trans-chlordane (=γ-chlordane)	*trans-klordan (=γ-klordan)*
OCDAN	oxy-chlordane	*oksy-klordan*
TNONC	trans-nonachlor	*trans-nonaklor*
TCDAN	trans-chlordane	*trans-klordan*
OCS	octachlorostyrene	*oktaklorstyren*
QCB	pentachlorobenzene	*pentaklorbenzen*
DDD	ɔdiphenyldichloroethane	*diklordifenyldikloretan*
	1,1-dichloro-2,2-bis-(4-chlorophenyl)ethane	*1,1-dikloro-2,2-bis-(4-klorofenyl)etan*
DDE	dichlorodiphenyldichloroethylene (principle metabolite of DDT)	*diklordifenyldikloretylen (hovedmetabolitt av DDT)*
	1,1-dichloro-2,2-bis-(4-chlorophenyl)ethylene*	*1,1-dikloro-2,2-bis-(4-klorofenyl)etylen*
DDT	ɔdiphenyltrichloroethane	*diklordifenyltrikloretan*
	1,1,1-trichloro-2,2-bis-(4-chlorophenyl)ethane	*1,1,1-trikloro-2,2-bis-(4-klorofenyl)etan*
DDEOP	o,p'-DDE	*o,p'-DDE*
DDEPP	p,p'-DDE	*p,p'-DDE*
DDTOP	o,p'-DDT	*o,p'-DDT*
DDTPP	p,p'-DDT	*p,p'-DDT*
TDEPP	p,p'-DDD	*p,p'-DDD*
DDTEP	p,p'-DDE + p,p'-DDT	*p,p'-DDE + p,p'-DDT*
DD-nΣ	sum of DDT and metabolites, n = number of compounds	*sum DDT og metabolitter, n = antall forbindelser*
HCB	hexachlorobenzene	*heksaklorbenzen*
HCHG	Lindane	*Lindan*
	γ HCH = gamma hexachlorocyclohexane	*γ HCH = gamma heksaklorsykloheksan*
	(γ BHC = gamma benzenehexachloride, outdated synonym)	*(γ BHC = gamma benzenheksaklorid, foreldret betegnelse)*
HCHA	α HCH = alpha HCH	*α HCH = alpha HCH*
HCHB	β HCH = beta HCH	*β HCH = beta HCH*
HC-nΣ	sum of HCHs, n = count	*sum av HCHs, n = antall*
EOCl	extractable organically bound chlorine	*ekstraherbart organisk bundet klor*
EPOCl	extractable persistent organically bound chlorine	*ekstraherbart persistent organisk bundet klor*
NTOT	total organic nitrogen	*total organisk nitrogen*
CTOT	total organic carbon	*total organisk karbon*
CORG	organic carbon	*organisk karbon*
GSAMT	grain size	*kornfordeling*
MOCON	moisture content	*vanninnhold*

Abbreviations (cont'd.)

Abbreviation[1]	English	*Norwegian*
INSTITUTES		
IFEN	Institute for Energy Technology	*Institutt for energiteknikk*
FIER	Institute for Nutrition, Fisheries Directorate	*Fiskeridirektoratets Ernæringsinstitutt*
FORC	FORCE Institutes, Div. for Isotope Technique and Analysis [DK]	*FORCE Institutterne, Div. for Isotopteknik og Analyse [DK]*
IMRN	Institute of Marine Research (IMR)	*Havforskningsinstituttet*
NACE	Nordic Analytical Center	*Nordisk Analyse Center*
NILU	Norwegian Institute for Air Research	*Norsk institutt forluftforskning*
NIVA	Norwegian Institute for Water Research	*Norsk institutt for vannforskning*
SERI	Swedish Environmental Research Institute	*Institutionen för vatten- och luftvårdsforskning*
VETN	Norwegian Veterinary Institute	*Veterinærinstituttet*
SIIF	Fondation for Scientific and Industrial Research at the Norwegian Institute of Technology - SINTEF (a division, previously: Center for Industrial Research SI)	*Stiftelsen for industriell og teknisk forskning ved Norges tekniske høgskole- SINTEF (en avdeling, tidligere: Senter for industriforskning SI)*

1) After: ICES Environmental Data Reporting Formats. International Council for the Exploration of the Sea. July 1996 and supplementary codes related to non-ortho and mono-ortho PCB's and "dioxins" (ICES pers. comm.)

2) Indicates "PAH" compounds that are dicyclic and not truly PAH's typically identified during the analyses of PAH, include naphthalenes and "biphenyls".

3) Indicates PAH compounds potentially cancerogenic for humans according to IARC (1987), i.e., categories 2A+2B (possibly and probably carcinogenic).

4) Indicates non ortho- co-planer PCB compounds ie., those that lack Cl in positions 1, 1', 5, and 5'

*) The Pesticide Index, second edition. The Royal Society of Chemistry, 1991.

Other abbreviations *andre forkortelser*

	English	*Norwegian*
TEQ	"Toxicity equivalency factors" for the most toxic compounds within the following groups:	*"Toxisitetsekvivalentfaktorer" for de giftigste forbindelsene innen følgende grupper.*
	• polychlorinated dibenzo-p-dioxins and dibenzofurans (**PCDD/PCDFs**). Equivalents calculated after Nordic model (Ahlborg *et al.*, 1989) [1] or international model (Int./EPA, cf. Van den Berg *et al.*, 1998) [2]	• *polyklorerte dibenzo-p-dioksiner og dibenzofuraner (**PCDD/PCDF**). Ekvivalentberegning etter nordisk modell (Ahlborg et al., 1989) [1] eller etter internasjonal modell (Int./EPA, cf. Van den Berg et al. 1998) [2]*
	• non-ortho and mono-ortho substituted chlorobiphenyls after WHO model (Ahlborg *et al.*, 1994) [3] or Safe (1994, cf. NILU pers. comm.)	• *non-orto og mono-orto substituerte klorobifenyler etter WHO modell (Ahlborg et al., 1994) [3] eller Safe (1994, cf. NILU pers. medd.)*
ppm	parts per million, mg/kg	*deler pr. milliondeler, mg/kg*
ppb	parts per billion, µg/kg	*deler pr. milliarddeler, µg/kg*
ppp	parts per trillion, ng/kg	*deler pr. tusen-milliarddeler, ng/kg*
d.w.	dry weight basis	*tørrvekt basis*
w.w.	wet weight or fresh weight basis	*våtvekt eller friskvekt basis*

[1]) Ahlborg, U.G., 1989. Nordic risk assessment of PCDDs and PCDFs. Chemosphere 19:603-608.

[2]) Van den Berg, Birnbaum, L, Bosveld, A. T. C. and co-workers, 1998. Toxic equivalency factors (TEFs) for PCBs, PCDDs, PCDFs for humans and wildlife. Environ Hlth. Perspect. 106:775-792.

[3]) Ahlborg, U.G., Becking G.B., Birnbaum, L.S., Brouwer, A, Derks, H.J.G.M., Feely, M., Golor, G., Hanberg, A., Larsen, J.C., J.C., Liem, A.K.G., Safe, S.H., Schlatter, C., Wärn, F., Younes, M., Yrjänheikki, E., 1994. Toxic equivalency factors for dioxin-like PCBs. Report on a WHO-ECEH and IPSC consultation , December 1993. Chemosphere 28:1049-1067.

Appendix C.
Participation in intercalibration exercises

Participation in intercalibration exercises

General: The main contributor to JAMP in 1996 has been NIVA which has participated in all QUASIMEME exercises relevant to the parameter and tissues monitored

Sea water:

4H ICES/JMG Fifth Round Intercalibration on Trace Metals in Sea Water - Section 4, analysis for Hg - 1983 - (5/TM/SW:4).

4I JMG Sixth Intercalibration on Trace Metals in Estuarine Waters - 1986 - (6/TM/SW).

4Z Intercalibration exercise for SIIF/SERI (Cd) and NIVA/IAMK (IAMK=Chalmers Inst., Göteborg) - 1985.

Seabed sediment:

7E ICES, First Intercalibration Exercise on Trace metals in Marine Sediments - 1984 - (1/TM/MS).

8B ICES/OSPAR, First Intercomparison Exercise on Organochlorines (individual chlorobiphenyl congeners) in Marine Sediments - Phase 1, analysis of standard solutions - 1989 - (1/OC/MS:1).

8C ICES/OSPAR, First Intercomparison Exercise on Organochlorines (individual chlorobiphenyl congeners) in Marine Sediments - Phase 2, analysis of standard solutions - 1991 - (1/OC/MS:2).

8B ICES/IOC/OSPAR Intercomparison Programme on the Analysis of Chlorobiphenyls in Marine Media - Step 1 - (analysis of standard solutions) - 1989 - (1/OC/MS-1).

8C ICES/IOC/OSPAR Intercomparison Programme on the Analysis of Chlorobiphenyls in Marine Media - Step 2 - 1990 - (1/OC/MS-2).

8D ICES/IOC/OSPAR Intercomparison Programme on the Analysis of Chlorobiphenyls in Marine Media - Step 3a (1/OC/MS-3a) 1991.

8E ICES/IOC/OSPAR Intercomparison Programme on the Analysis of Chlorobiphenyls in Marine Media - Step 3b - (1/OC/MS-3b) 1992.

8F ICES/IOC/OSPAR Intercomparison Programme on the Analysis of Chlorobiphenyls in Marine Media - Step 4 - (1/OC/MS-4) 1993.

Marine biota:

1E ICES, Fifth Intercalibration Exercise on Trace Metals in Biological Tissues - 1978 - (5/TM/BT).

1F ICES, Sixth Intercalibration Exercise on Trace Metals (Cadmium and Lead only) in Biological Tissues - 1979 - (6/TM/BT).

1G ICES, Seventh Intercalibration Exercise on Trace Metals in Biological Tissues - Part A - 1983 - (7/TM/BT).

1H	ICES, Seventh Intercalibration Exercise on Trace Metals in Biological Tissues - Part B - 1985 - (7/TM/BT) (preliminary report 1987).
1Z VETN	Interlabcalibration exercise with VETN and SIIF 1983, mercury and cadmium in cod filet and liver.
1Z NIVA	Interlabcalibration exercise with VETN, NACE and NIVA 1986 (Hg, Cd, Cu, Pb and Zn in 6 samples).
2D	ICES Fourth Intercalibration Exercise on Organochlorines (mainly PCBs) in Biological Tissues (Sample No.5) - 1979 - (4/OC/BT).
2E	ICES Fifth Intercalibration Exercise on Organochlorines (PCBs only) in Biological Tissues - 1982 - (5/OC/BT).
2G	ICES/IOC/OSPAR Intercomparison Programme on the Analysis of Chlorobiphenyls in Marine Media - Step 1 - (analysis of standard solutions) - 1989 - (7/OC/BT-1).
2H	ICES/IOC/OSPAR Intercomparison Programme on the Analysis of Chlorobiphenyls in Marine Media - Step 2 - 1990 - (7/OC/BT-2).
2I	ICES/IOC/OSPAR Intercomparison Programme on the Analysis of Chlorobiphenyls in Marine Media - Step 3a - (7/OC/BT-3a) 1991.
2J	ICES/IOC/OSPAR Intercomparison Programme on the Analysis of Chlorobiphenyls in Marine Media - Step 3b - (7/OC/BT-3b) 1992.
2K	ICES/IOC/OSPAR Intercomparison Programme on the Analysis of Chlorobiphenyls in Marine Media - Step 4 - (7/OC/BT-4) 1993.
2Z VETN	Interlabcalibration exercise with VETN among others, 1983, PCB and HCB in cod liver.
2Z NACE	Interlabcalibration exercise with NACE, VETNand SIIF 1986 (PCB (all labs), DDE, OCS, HCB and DCB (NACE and VETN).

Appendix D.
Analytical overview

Sorted by:

- Contaminant, year, laboratory, intercalibration

Abbreviations are defined in Appendix B. and Appendix C.

Tissue				Fish liver					Fish fillet, Shrimp tail, Mussel, Other				
Contamin.	Mon. Lab. Year	Inter-calibr. +basis		Analys method code	Detect limit (ppb)	Total value count	Count below d.lim	N (<) above d.lim	Analys method code	Detect limit (ppb)	Total value count	Count below d.lim	N (<) above d.lim
ACNE	1992-NIVA		W	309	0.2	8			309	0.2	46		
	1995-NIVA		W						309	0.2	72		20
	1996-NIVA		W						309	0.2	65		19
	1997-NIVA		W						309	0.5	34		
	1998-NIVA		W						309	0.5	39		
	1999-NIVA		W						309	0.5	34		
ACNLE	1992-NIVA		W	309	0.2	8			309	0.2	46		
	1995-NIVA		W						309	0.2	72		49
	1996-NIVA		W						309	0.2	65		42
	1997-NIVA		W						309	0.5	34		
	1998-NIVA		W						309	0.5	39		
	1999-NIVA		W						309	0.5	34		
AG	1996-NIVA		W						999	miss	3		
ANT	1992-NIVA		W	309	0.2	8			309	0.2	45		
	1995-NIVA		W						309	0.2	72		28
	1996-NIVA		W						309	0.2	65		30
	1997-NIVA		W						309	0.5	35		
	1998-NIVA		W						309	0.5	39		
	1999-NIVA	EK	W						309	0.5	34		
AS	1996-NIVA		W						999	miss	3		
BAA	1992-NIVA		W	309	0.2	8			309	0.2	44		
	1995-NIVA		W						309	0.2	72		9
	1996-NIVA		W						309	0.2	65		8
	1997-NIVA		W						309	0.5	36		
	1998-NIVA		W						309	0.5	39		
	1999-NIVA	EK	W						309	0.5	34		
BAP	1992-NIVA		W	309	0.2	8			309	0.2	45		
	1995-NIVA		W						309	0.2	72		21
	1996-NIVA		W						309	0.2	65		26
	1997-NIVA	AL	W						309	0.5	36		
	1998-NIVA		W						309	0.5	39		
	1999-NIVA	EK	W						309	0.5	34		
BBF	1992-NIVA		W	309	0.2	8			309	0.2	45		
	1995-NIVA		W						309	0.2	59		9
	1996-NIVA		W						309	0.2	57		6
BBJKF	1995-NIVA		W						309	0.2	12		
	1996-NIVA		W						309	0.2	8		
	1997-NIVA		W						309	0.2	36		1
	1998-NIVA		W						309	0.2	39		
	1999-NIVA		W						309	0.2	34		
BEP	1992-NIVA		W	309	0.2	8			309	0.2	45		
	1995-NIVA		W						309	0.2	72		5
	1996-NIVA		W						309	0.2	65		6
	1997-NIVA		W						309	0.2	36		
	1998-NIVA		W						309	0.2	38		
	1999-NIVA	EK	W						309	0.2	34		
BGHIP	1992-NIVA		W	309	0.2	8			309	0.2	46		
	1995-NIVA		W						309	0.2	72		20
	1996-NIVA		W						309	0.2	65		10
	1997-NIVA		W						309	0.5	36		
	1998-NIVA		W						309	0.5	35		
	1999-NIVA	EK	W						309	0.5	34		
BIPN	1992-NIVA		W	309	0.2	8			309	0.2	46		
	1995-NIVA		W						309	0.2	72		52
	1996-NIVA		W						309	0.2	62		39
	1997-NIVA		W						309	0.5	34		
	1998-NIVA		W						309	0.5	39	1	
	1999-NIVA		W						309	0.5	34		

Tissue				Fish liver					Fish fillet, Shrimp tail, Mussel, Other				
Contamin.	Mon. Lab. Year	Inter-calibr. +basis		Analys method code	Detect limit (ppb)	Total value count	Count below d.lim	N (<) above d.lim	Analys method code	Detect limit (ppb)	Total value count	Count below d.lim	N (<) above d.lim
BJKF	1992-NIVA		W	309	0.2	8			309	0.2	45		
	1995-NIVA		W						309	0.2	24		21
	1996-NIVA		W						309	0.2	57		16
CB101	1987-SIIF		W						111	0.2	21	1	
	1988-SIIF		D						111	0.1	6		
	1988-SIIF		W						111	0.1	22		
	1989-NACE		W	510	20	93							
	1989-SIIF		W						111	0.1	36		
	1990-NIVA	2G	W	340	1	169	1		341	0.05	58		
	1990-SIIF	2G	W						111	0.4	41	6	
	1991-NIVA	2H	W	340	1	179		8	341	0.05	62		
	1991-SIIF	2H	W						111	0.2	35		1
	1992-NIVA	2J	W	340	5	192	3		341	0.1	140		
	1993-NIVA	2K	W	340	4	212	12		341	0.1	133		
	1994-NIVA	2Z	W	340	3	300	3		341	0.05	165	39	
	1995-NIVA		W	340	3	318	10		341	0.05	225	10	
	1996-NIVA		W	340	3	332	14		341	0.05	237	9	
	1997-NIVA		W	340	3	260	24						
	1997-NIVA	AJ	W						341	0.05	221	4	
	1998-NIVA		W	340	3	284	19	1	341	0.05	197	1	3
	1999-NIVA		W	340	3	245	3						
	1999-NIVA	EG	W						341	0.05	222		12
CB105	1991-NIVA	2H	W	340	1	87		1	341	0.05	47		
	1992-NIVA		W	340	5	192	3		341	0.1	140		
	1993-NIVA	QM	W	340	4	212	21		341	0.1	133		
	1994-NIVA	2Z	W	340	3	300	8		341	0.05	165	53	
	1995-NIVA		W	340	3	318	13		341	0.05	224	34	
	1996-NIVA		W	340	3	332	22		341	0.05	231	23	
	1997-NIVA		W	340	3	260	24		341	0.05	221	3	1
	1998-NIVA		W	340	3	284	31	19	341	0.05	201	11	16
	1999-NIVA		W	340	3	245	14						
	1999-NIVA	EG	W						341	0.05	222	4	59
CB118	1989-NACE		W	510	20	93							
	1989-SIIF		W						111	0.1	36		
	1990-NIVA	2G	W	340	1	169			341	0.05	58		
	1990-SIIF	2G	W						111	0.2	41	1	
	1991-NIVA	2H	W	340	1	179			341	0.05	62		
	1991-SIIF	2H	W						111	0.2	35		1
	1992-NIVA	2J	W	340	5	192	2		341	0.1	140		
	1993-NIVA	2K	W	340	4	212	10		341	0.1	133		
	1994-NIVA	2Z	W	340	3	300	2		341	0.05	165	25	
	1995-NIVA		W	340	3	318	2		341	0.05	225	2	
	1996-NIVA		W	340	3	332	6		341	0.05	237	4	
	1997-NIVA		W	340	3	260	5						
	1997-NIVA	AJ	W						341	0.05	221		
	1998-NIVA		W	340	3	284	6	1	341	0.05	203	3	1
	1999-NIVA		W	340	3	245							
	1999-NIVA	EG	W						341	0.05	222		6
CB126	1995-NILU		W						841	2E-05	6		
	1996-NILU		W						841	1E-04	18		
CB138	1988-SIIF		D						111	0.1	6		
	1988-SIIF		W						111	0.1	21		
	1989-NACE		W	510	20	93							
	1989-SIIF		W						111	0.1	36		
	1990-NIVA	2G	W	340	1	169			341	0.05	58		
	1990-SIIF	2G	W						111	0.3	41		
	1991-NIVA	2H	W	340	1	179			341	0.05	62		
	1991-SIIF	2H	W						111	0.3	35		1

Tissue				Fish liver					Fish fillet, Shrimp tail, Mussel, Other				
Contamin.	Mon. Lab. Year	Inter-calibr. +basis		Analys method code	Detect limit (ppb)	Total value count	Count below d.lim	N (<) above d.lim	Analys method code	Detect limit (ppb)	Total value count	Count below d.lim	N (<) above d.lim
	1992-NIVA	2J	W	340	5	192			341	0.1	137		
	1993-NIVA	QM	W	340	4	212	3		341	0.1	133		
	1994-NIVA	2Z	W	340	3	300			341	0.05	165	12	
	1995-NIVA		W	340	3	318	2		341	0.05	225		
	1996-NIVA		W	340	3	331	1		341	0.05	235		
	1997-NIVA		W	340	3	260	1						
	1997-NIVA	AJ	W						341	0.05	221		1
	1998-NIVA		W	340	3	284	3		341	0.05	203		
	1999-NIVA		W	340	3	245							
	1999-NIVA	EG	W						341	0.05	222		
CB153	1988-SIIF		D						111	0.1	6		
	1988-SIIF		W						111	0.1	22		
	1989-NACE		W	510	20	93							
	1989-SIIF		W						111	0.1	36		
	1990-NIVA	2G	W	340	1	169			341	0.05	58		
	1990-SIIF	2G	W						111	0.3	41		
	1991-NIVA	2H	W	340	1	179			341	0.05	62		
	1991-SIIF	2H	W						111	0.5	35		1
	1992-NIVA	2J	W	340	5	192			341	0.1	140		
	1993-NIVA	2K	W	340	4	212	3		341	0.1	133		
	1994-NIVA	2Z	W	340	3	300			341	0.05	165	9	
	1995-NIVA		W	340	3	318	1		341	0.05	225		
	1996-NIVA		W	340	3	332	1		341	0.05	237		
	1997-NIVA		W	340	3	260							
	1997-NIVA	AJ	W						341	0.05	221		
	1998-NIVA		W	340	3	284	1		341	0.05	203	1	1
	1999-NIVA		W	340	3	245							
	1999-NIVA	EG	W						341	0.05	222		
CB156	1991-NIVA	2H	W	340	1	87		15	341	0.05	47		5
	1992-NIVA		W	340	5	192	3		341	0.1	140		
	1993-NIVA	QM	W	340	4	212	31		341	0.1	133		
	1994-NIVA	2Z	W	340	3	300	24	1	341	0.05	162	70	
	1995-NIVA		W	340	3	317	27		341	0.05	225	67	
	1996-NIVA		W	340	3	332	48		341	0.05	237	62	
	1997-NIVA		W	340	3	260	46						
	1997-NIVA	AJ	W						341	0.05	221	9	10
	1998-NIVA		W	340	3	284	52	70	341	0.05	203	37	47
	1999-NIVA		W	340	3	245	35	2					
	1999-NIVA	EG	W						341	0.05	222	12	132
CB169	1995-NILU		W						841	2E-05	6		
	1996-NILU		W						841	1E-04	18	2	
CB180	1987-SIIF		W						111	0.2	21	6	
	1988-SIIF		D						111	0.1	6		
	1988-SIIF		W						111	0.1	22		
	1989-NACE		W	510	20	93	1						
	1989-SIIF		W						111	0.1	36		
	1990-NIVA	2G	W	340	1	169			341	0.05	58		
	1990-SIIF	2G	W						111	0.2	41	8	
	1991-NIVA	2H	W	340	1	179			341	0.05	62		
	1991-SIIF	2H	W						111	0.2	35		
	1992-NIVA	2J	W	340	5	192	3		341	0.1	140		
	1993-NIVA	2K	W	340	4	212	15		341	0.1	133		
	1994-NIVA	2Z	W	340	3	300	3		341	0.05	162	49	
	1995-NIVA		W	340	3	318	5		341	0.05	225	22	
	1996-NIVA		W	340	3	332	14		341	0.05	237	25	
	1997-NIVA		W	340	3	260	18						
	1997-NIVA	AJ	W						341	0.05	221	1	1
	1998-NIVA		W	340	3	284	20	14	341	0.05	203	18	44

Tissue				Fish liver					Fish fillet, Shrimp tail, Mussel, Other				
Contamin.	Mon. Lab. Year	Inter-calibr. +basis		Analys method code	Detect limit (ppb)	Total value count	Count below d.lim	N (<) above d.lim	Analys method code	Detect limit (ppb)	Total value count	Count below d.lim	N (<) above d.lim
	1999-NIVA		W	340	3	245	4	1					
	1999-NIVA	EG	W						341	0.05	222	2	76
CB209	1990-NIVA		W	340	2	169	24	11	341	0.05	58		
	1991-NIVA		W	340	2	179	11	88	341	0.05	62	5	7
	1992-NIVA		W	340	5	192	3		341	0.1	140		1
	1993-NIVA		W	340	4	212	46	14	341	0.1	133		
	1994-NIVA		W	340	3	300	29	24	341	0.05	165	91	
	1995-NIVA		W	340	3	318	36		341	0.05	225	92	5
	1996-NIVA		W	340	3	332	255		341	0.05	237	107	9
	1997-NIVA		W	340	3	260	196		341	0.05	221	30	14
	1998-NIVA		W	340	3	283	120	121	341	0.05	203	50	69
	1999-NIVA		W	340	3	242	162	17	341	0.05	222	19	171
CB28	1988-SIIF		D						111	0.1	6		
	1988-SIIF		W						111	0.1	22		
	1989-NACE		W	510	20	93							
	1989-SIIF		W						111	0.1	36		1
	1990-NIVA	2G	W	340	1	169	2	2	341	0.05	58		
	1990-SIIF	2G	W						111	0.2	41	7	
	1991-NIVA	2H	W	340	1	179	2	52	341	0.05	62	5	1
	1991-SIIF	2H	W						111	0.3	35		
	1992-NIVA	2J	W	340	5	192	3		341	0.1	137		
	1993-NIVA	2K	W	340	4	212	44	5	341	0.1	133		
	1994-NIVA	2Z	W	340	3	282	18	4	341	0.05	163	73	
	1995-NIVA		W	340	3	313	27		341	0.05	225	75	
	1996-NIVA		W	340	3	332	107		341	0.05	236	70	
	1997-NIVA		W	340	3	260	81						
	1997-NIVA	AJ	W						341	0.05	221	22	14
	1998-NIVA		W	340	3	284	96	99	341	0.05	201	33	46
	1999-NIVA		W	340	3	245	92	18					
	1999-NIVA	EG	W						341	0.05	222	14	140
CB52	1987-SIIF		W						111	0.2	20	1	
	1988-SIIF		D						111	0.1	6		
	1988-SIIF		W						111	0.1	22		
	1989-NACE		W	510	20	93							
	1989-SIIF		W						111	0.1	36		
	1990-NIVA	2G	W	340	1	169	2	6	341	0.05	58		
	1990-SIIF	2G	W						111	0.4	41	7	
	1991-NIVA	2H	W	340	1	179	1	37	341	0.05	62	5	1
	1991-SIIF	2H	W						111	0.3	35		
	1992-NIVA	2J	W	340	5	192	3		341	0.1	137		
	1993-NIVA	2K	W	340	4	212	40		341	0.1	133		
	1994-NIVA	2Z	W	340	3	300	9		341	0.05	165	64	
	1995-NIVA		W	340	3	312	19		341	0.05	214	28	
	1996-NIVA		W	340	3	332	49		341	0.05	235	31	
	1997-NIVA		W	340	3	260	116						
	1997-NIVA	AJ	W						341	0.05	221	25	10
	1998-NIVA		W	340	3	281	47	44	341	0.05	168	12	17
	1999-NIVA		W	340	3	245	49	11					
	1999-NIVA	EG	W						341	0.05	212	7	70
CB77	1995-NILU		W						841	2E-05	6		
	1996-NILU		W						841	1E-04	18		
CB81	1995-NILU		W						841	2E-05	6		
	1996-NILU		W						841	1E-04	18		
CD	1981-SIIF	1E	W	130	10	28			130	5	27		
	1981-SIIF	1F	W						130	10	7		
	1982-SIIF	1F	W						130	10	18		
	1982-VETN		W	230	10	54							
	1983-SIIF	1F	W						130	10	17		

Tissue				Fish liver					Fish fillet, Shrimp tail, Mussel, Other				
Contamin.	Mon. Lab. Year	Inter-calibr. +basis		Analys method code	Detect limit (ppb)	Total value count	Count below d.lim	N (<) above d.lim	Analys method code	Detect limit (ppb)	Total value count	Count below d.lim	N (<) above d.lim
	1983-VETN	1Z	W	230	10	46							
	1984-FIER	1H	W	402	1	23							
	1984-SIIF	1G	W						130	10	27		
	1984-VETN	1Z	W	230	10	66							
	1985-SIIF	1G	D						130	10	35		
	1985-VETN	1Z	W	230	10	45		3					
	1986-NIVA	1H	D	312	30	56	1		312	30	20		
	1987-FIER	1G	W	402	1	37							
	1987-NIVA	1H	D	312	30	57		4	312	30	37		
	1988-NIVA	1H	D	312	30	61	11	1	312	30	55		
	1989-NIVA	1H	D	312	30	135	11	8					
	1989-NIVA	1H	W						312	30	36		
	1990-NIVA	1H	W	312	10	189	9	2	312	30	77	5	
	1991-NIVA	1H	W	312	10	190	29	2	312	10	67		
	1992-NIVA	1H	W	312	10	191	4		312	10	111		
	1993-NIVA	1H	W	312	50	221	98		312	50	79		
	1994-NIVA	1Z	W	312	50	302	134		312	50	81		
	1995-NIVA		W	312	50	318	129		312	50	139	2	
	1996-NIVA	V1	W						312	50	125		
	1996-NIVA	V2	W	312	50	368	128						
	1997-NIVA		W	312	50	287	90						
	1997-NIVA	AH	W						312	50	107		
	1998-NIVA		W	312	50	285	101		312	50	93		
	1999-NIVA		W	312	50	233	79						
	1999-NIVA	EF	W						312	50	132	15	
CDD1N	1995-NILU		W						841	2E-05	6	1	1
	1996-NILU		W						841	1E-05	18		2
CDD4X	1995-NILU		W						841	2E-05	6	3	1
	1996-NILU		W						841	2E-05	18		1
CDD6P	1995-NILU		W						841	2E-05	6		
	1996-NILU		W						841	4E-05	18		
CDD6X	1995-NILU		W						841	2E-05	6		1
	1996-NILU		W						841	2E-05	18		1
CDD9X	1995-NILU		W						841	2E-05	6	2	1
	1996-NILU		W						841	2E-05	18		1
CDDO	1995-NILU		W						841	2E-05	6		
	1996-NILU		W						841	1E-04	18		
CDDSN	1995-NILU		W						841	2E-05	5		
	1996-NILU		W						841	1E-05	18		3
CDDSP	1995-NILU		W						841	2E-05	6		
	1996-NILU		W						841	4E-05	18		
CDDST	1995-NILU		W						841	2E-05	6		
	1996-NILU		W						841	1E-05	18		
CDDSX	1995-NILU		W						841	2E-05	5		
	1996-NILU		W						841	2E-05	18		2
CDF2N	1995-NILU		W						841	2E-05	6		
	1996-NILU		W						841	1E-05	18		1
CDF2T	1995-NILU		W						841	2E-05	6		
	1996-NILU		W						841	1E-05	18		
CDF4X	1995-NILU		W						841	2E-05	6		
	1996-NILU		W						841	2E-05	18		1
CDF6P	1995-NILU		W						841	2E-05	6		
	1996-NILU		W						841	4E-05	18	2	1
CDF6X	1995-NILU		W						841	2E-05	6		
	1996-NILU		W						841	2E-05	18		1
CDF9P	1995-NILU		W						841	2E-05	6	2	1
	1996-NILU		W						841	8E-05	17	3	1

Tissue				Fish liver					Fish fillet, Shrimp tail, Mussel, Other				
Contamin.	Mon. Lab. Year	Inter-calibr. +basis		Analys method code	Detect limit (ppb)	Total value count	Count below d.lim	N (<) above d.lim	Analys method code	Detect limit (ppb)	Total value count	Count below d.lim	N (<) above d.lim
CDF9X	1995-NILU		W						841	2E-05	6	3	1
	1996-NILU		W						841	2E-05	18		1
CDFDN	1995-NILU		W						841	2E-05	6		
	1996-NILU		W						841	1E-05	18		1
CDFDX	1995-NILU		W						841	2E-05	6		
	1996-NILU		W						841	2E-05	18		1
CDFO	1995-NILU		W						841	2E-05	6		1
	1996-NILU		W						841	1E-04	18	3	1
CDFSN	1995-NILU		W						841	2E-05	6		
	1996-NILU		W						841	1E-05	18		1
CDFSP	1995-NILU		W						841	2E-05	6		
	1996-NILU		W						841	8E-05	18	6	1
CDFST	1995-NILU		W						841	2E-05	6		
	1996-NILU		W						841	1E-05	18		
CDFSX	1995-NILU		W						841	2E-05	6		
	1996-NILU		W						841	2E-05	18		1
CHR	1992-NIVA		W	309	0.2	8			309	0.2	44		
	1995-NIVA		W						309	0.2	56		
	1996-NIVA		W						309	0.2	65		3
CHRTR	1995-NIVA		W						309	0.2	15		2
	1997-NIVA		W						309	0.5	36		
	1998-NIVA		W						309	0.5	39		
	1999-NIVA		W						309	0.5	34		
CO	1996-NIVA		W						999	miss	3		
COR	1992-NIVA		W	309	0.2	8			309	0.2	46		
CR	1992-NIVA		W						312	10	6		
	1996-NIVA		W						999	miss	3		
CU	1983-SIIF	1G	W						130	10	12		
	1984-SIIF	1G	W						130	10	27		
	1986-NIVA	1H	D	311	150	56			311	150	20		
	1987-FIER	1G	W	404	50	37							
	1987-NIVA	1H	D	311	150	57			311	150	37		
	1988-NIVA	1H	D	311	150	61			311	150	55		
	1989-NIVA	1H	D	311	150	135							
	1989-NIVA	1H	W						311	150	36		
	1990-NIVA	1H	W	311	150	189			311	150	77		
	1991-NIVA	1H	W	311	50	193	2		311	50	67		
	1992-NIVA	1H	W	311	10	191			311	10	111		
	1993-NIVA	1H	W	311	10	221			311	10	79		
	1994-NIVA	1Z	W	311	10	302			311	10	81		
	1995-NIVA		W	311	10	318			311	10	124		
	1996-NIVA	V1	W						311	10	113		
	1996-NIVA	V2	W	311	10	368							
	1997-NIVA		W	311	5000a	287	1						
	1997-NIVA	AH	W						311	10	96		
	1998-NIVA		W	311	10	285			311	10	51		
	1999-NIVA		W	311	10	233							
	1999-NIVA	EF	W						311	10	99		
DBA3A	1992-NIVA		W	309	0.2	8			309	0.2	46		
	1995-NIVA		W						309	0.2	71		48
	1996-NIVA		W						309	0.2	65		53
	1997-NIVA		W						309	0.5	36		
	1998-NIVA		W						309	0.5	39		
	1999-NIVA		W						309	0.5	34		
DBP	1992-NIVA		W	309	0.2	8			309	0.2	46		
DBT	1998-NIVA		W						309	0.5	39		
	1999-NIVA		W						309	0.5	34		

Tissue				Fish liver					Fish fillet, Shrimp tail, Mussel, Other				
Contamin.	Mon. Lab. Year	Inter-calibr. +basis		Analys method code	Detect limit (ppb)	Total value count	Count below d.lim	N (<) above d.lim	Analys method code	Detect limit (ppb)	Total value count	Count below d.lim	N (<) above d.lim
DBTC1	1995-NIVA		W						309	0.2	57		14
	1996-NIVA		W						309	0.2	65		9
DBTC2	1995-NIVA		W						309	0.2	56		9
	1996-NIVA		W						309	0.2	62		11
DBTC3	1995-NIVA		W						309	0.2	57		4
	1996-NIVA		W						309	0.2	65		5
DBTIN	1997-NIVA		D						320	5	8		
	1998-NIVA		D						320	5	15		
	1999-NIVA		D						320	5	13		
DBTIO	1997-NIVA		W						309	0.5	34		
DDEPP	1982-VETN		W	210	50	53							
	1983-VETN	2E	W	210	50	48			211a	50	48		
	1984-VETN	2E	W	210	50	66							
	1985-VETN	2E	W	210	50	45							
	1986-NACE	2Z	W	510	20	56							
	1987-NACE	2Z	W	510	40	53							
	1988-NACE	2Z	W	510	40	61							
	1989-NACE	2Z	W	510	20	93							
	1990-NIVA		W	340	1	169			341	0.05	58		
	1991-NIVA		W	340	1	179			341	0.05	62		
	1992-NIVA		W	340	5	192	2		341	0.1	140		
	1993-NIVA		W	340	4	212	3		341	0.1	133		
	1994-NIVA	2Z	W	340	4	300			341	0.1	165	27	
	1995-NIVA		W	340	4	318	2		341	0.1	225	30	
	1996-NIVA		W	340	4	332	2		341	0.1	237	47	
	1997-NIVA		W	340	4	260	3		341	0.1	221	1	
	1998-NIVA		W	340	4	284	6		341	0.1	203	4	
	1999-NIVA		W	340	4	245							
	1999-NIVA	EG	W						341	0.1	222	2	
DDTEP	1983-SIIF		W						111	0.5	12		
	1984-SIIF		W						111	0.5	24		1
	1985-SIIF		W						111	0.5	27	1	5
	1986-SIIF		W						111	0.5	21		
	1987-SIIF		W						111	0.5	21	1	
	1988-SIIF		D						111	0.5	6		
	1988-SIIF		W						111	0.5	22	1	
	1989-SIIF		W						111	0.5	36	1	
	1990-SIIF		W						111	0.2	41	1	
	1991-SIIF		W						111	0.3	35		
DDTPP	1986-NACE		W	510	40	56							
	1987-NACE		W	510	40	53							
	1988-NACE		W	510	40	61							
	1989-NACE		W	510	20	93							
	1995-NIVA		W						340	0.05	72		
	1996-NIVA		W	340	0.05	54		4	340	0.05	45		
	1997-NIVA		W	340	2	32							
	1997-NIVA	AJ	W						340	0.05	48		
	1998-NIVA		W	340	2	37	1	8	340	0.05	68		24
	1999-NIVA		W	340	2	29		4	340	0.05	93		7
DPTIN	1997-NIVA		D						320	5	8		
	1998-NIVA		D						320	5	15	9	
	1999-NIVA		D						320	5	13	12	
EOCL	1989-SIIF		W						605	170	5		
EPOCL	1986-NACE		W	610	800	56							
	1986-SIIF		W						605	5000	21	21	
	1987-NACE		W	610	800	53							
	1987-SIIF		W						605	40	20		
	1988-NACE		W	610	800	60							

Tissue				Fish liver					Fish fillet, Shrimp tail, Mussel, Other				
Contamin.	Mon. Lab. Year	Inter-calibr. +basis		Analys method code	Detect limit (ppb)	Total value count	Count below d.lim	N (<) above d.lim	Analys method code	Detect limit (ppb)	Total value count	Count below d.lim	N (<) above d.lim
	1988-SIIF		W						605	40	27		
	1989-NACE		W	610	800	89	1						
	1989-SIIF		W						605	40	35		
	1990-NIVA		W	615	40	117		3					
	1990-SIIF		W						605	40	41		
	1991-NIVA		W	615	40	116		12					
	1991-SIIF		W						605	130	35		
	1997-IFEN		W						607	50	6		
	1998-IFEN		W						607	1	6		
FLE	1992-NIVA		W	309	0.2	8			309	0.2	45		
	1995-NIVA		W						309	0.2	72		22
	1996-NIVA		W						309	0.2	65		6
	1997-NIVA	AL	W						309	0.5	34		
	1998-NIVA		W						309	0.5	39		
	1999-NIVA		W						309	0.5	34		
FLU	1992-NIVA		W	309	0.2	8			309	0.2	44		
	1995-NIVA		W						309	0.2	72		
	1996-NIVA		W						309	0.2	65		
	1997-NIVA	AL	W						309	0.2	36		
	1998-NIVA		W						309	0.2	39		
	1999-NIVA	EK	W						309	0.2	34		
HCB	1983-SIIF		W						111	0.5	12		
	1983-VETN	2Z	W	210	10	48			211a	10	48		
	1984-SIIF		W						111	0.2	24		1
	1984-VETN	2Z	W	210	10	66							
	1985-SIIF		W						111	0.2	30	6	2
	1985-VETN	2Z	W	210	10	45		4					
	1986-NACE	2Z	W	510	10	56							
	1986-SIIF	2Z	W						111	0.2	21	3	
	1987-NACE	2Z	W	510	40	53							
	1987-SIIF	2Z	W						111	0.2	21	4	
	1988-NACE	2Z	W	510	40	61							
	1988-SIIF	2Z	D						111	0.2	6		
	1988-SIIF	2Z	W						111	0.2	22	2	
	1989-NACE	2Z	W	510	20	93							
	1989-SIIF	2Z	W						111	0.05	36		
	1990-NIVA		W	340	1	169	2		341	0.05	58		
	1990-SIIF	2Z	W						111	0.05	41	3	
	1991-NIVA		W	340	1	179	4	13	341	0.05	62	5	
	1991-SIIF	2Z	W						111	0.1	35		
	1992-NIVA		W	340	5	189	3		341	0.1	140		
	1993-NIVA		W	340	4	212	31		341	0.1	133		
	1994-NIVA	2Z	W	340	3	300	24	1	341	0.05	165	33	
	1995-NIVA		W	340	3	317	37		341	0.05	225	30	
	1996-NIVA		W	340	3	332	52		341	0.05	237	37	
	1997-NIVA		W	340	2	260	39						
	1997-NIVA	AJ	W						341	0.05	221	7	
	1998-NIVA		W	340	2	284	48	13	341	0.05	203	67	2
	1999-NIVA		W	340	2	245	18						
	1999-NIVA	EG	W						341	0.05	222	18	8
HCHA	1990-NIVA		W	340	1	168			341	0.05	58		
	1991-NIVA		W	340	1	179	2	111	341	0.05	62	5	10
	1992-NIVA		W	340	5	192	3		341	0.1	140		
	1993-NIVA		W	340	4	212	45	22	341	0.1	133		
	1994-NIVA	2Z	W	340	3	296	32	3	341	0.05	165	85	
	1995-NIVA		W	340	3	318	45		341	0.05	225	98	
	1996-NIVA		W	340	3	332	111		341	0.05	231	100	
	1997-NIVA		W	340	0.5	260	2	10	341	0.05	221	20	11

Tissue				Fish liver					Fish fillet, Shrimp tail, Mussel, Other				
Contamin.	Mon. Lab. Year	Inter-calibr. +basis		Analys method code	Detect limit (ppb)	Total value count	Count below d.lim	N (<) above d.lim	Analys method code	Detect limit (ppb)	Total value count	Count below d.lim	N (<) above d.lim
	1998-NIVA		W	340	0.5	284	8	208	341	0.05	202	25	121
	1999-NIVA		W	340	0.5	245	17	75	341	0.05	222	23	147
HCHG	1986-NACE		W	510	30	56	1						
	1986-SIIF		W						111	3	21		
	1987-NACE		W	510	40	53							
	1987-SIIF		W						111	5	21		1
	1988-NACE		W	510	40	61							
	1989-NACE		W	510	20	93							
	1989-SIIF		W						111	50	36		
	1990-NIVA		W	340	1	169	1	9	341	0.05	58		
	1990-SIIF		W						111	0.1	41		
	1991-NIVA		W	340	1	179	3	18	341	0.05	62	5	1
	1991-SIIF		W						111	0.3	35		
	1992-NIVA		W	340	5	192	3		341	0.1	140		
	1993-NIVA		W	340	4	212	42	17	341	0.1	133		
	1994-NIVA	2Z	W	340	3	300	24	1	341	0.05	165	46	
	1995-NIVA		W	340	3	313	31		341	0.05	213	29	
	1996-NIVA		W	340	3	330	68		341	0.05	220	8	
	1997-NIVA		W	340	2	260	47						
	1997-NIVA	AJ	W						341	0.05	221	3	9
	1998-NIVA		W	340	2	284	25	63					
	1998-NIVA	AJ	W						341	0.05	203	10	23
	1999-NIVA		W	340	2	245	51	3	341	0.05	222	19	61
HG	1981-SIIF	1E	W	120	10	15		1	120	10	35		
	1982-SIIF	1E	W						120	10	18		
	1982-VETN		W	220	10	51			220	10	54		
	1983-SIIF	1E	W						120	10	17		
	1983-VETN	1Z	W						220	10	48		
	1984-FIER	1G	W						401	10	39		
	1984-SIIF	1G	W						120	10	27	6	
	1984-VETN	1Z	W						220	10	66		
	1985-SIIF	1G	D						120	10	30		
	1985-VETN	1Z	W						220	10	90		
	1986-NIVA	1H	D						310	10	74		
	1987-FIER	1G	W						401	10	38		
	1987-NIVA	1H	D						310	10	93		14
	1988-NIVA	1H	D						310	10	116		
	1989-NIVA	1H	D						310	100	134		
	1989-NIVA	1H	W						310	10	36	5	
	1990-NIVA	1H	W						310	10	266		
	1991-NIVA	1H	W						310	100a	264	126	
	1992-NIVA	1H	W						310	100a	303	122	
	1993-NIVA	1H	W						310	5	300		
	1994-NIVA	1Z	W						310	5	381		
	1995-NIVA		W						310	5	442	1	
	1996-NIVA	V1	W						310	5	481		
	1997-NIVA	AH	W						310	5	383		
	1998-NIVA		W						310	5	381	6	
	1999-NIVA		W	310	5	3							
	1999-NIVA	EF	W						310	5	382		
ICDP	1992-NIVA		W	309	0.2	8			309	0.2	46		
	1995-NIVA		W						309	0.2	72		29
	1996-NIVA		W						309	0.2	65		23
	1997-NIVA		W						309	0.5	36		
	1998-NIVA		W						309	0.5	37	2	
	1999-NIVA	EK	W						309	0.5	34		
MBTIN	1997-NIVA		D						320	5	8		
	1998-NIVA		D						320	5	15		

Tissue			Fish liver					Fish fillet, Shrimp tail, Mussel, Other				
Contamin.	Mon. Lab. Year	Inter-calibr. +basis	Analys method code	Detect limit (ppb)	Total value count	Count below d.lim	N (<) above d.lim	Analys method code	Detect limit (ppb)	Total value count	Count below d.lim	N (<) above d.lim
	1999-NIVA	D						320	5	13		
MN	1984-SIIF	W						132	40	27		
	1985-SIIF	D						132	40	35		
MPTIN	1997-NIVA	D						320	5	8		
	1998-NIVA	D						320	5	15	9	
	1999-NIVA	D						320	5	13	13	
NAP	1992-NIVA	W	309	0.2	8			309	0.2	46		
	1995-NIVA	W						309	0.2	70		21
	1996-NIVA	W						309	0.2	61		11
	1997-NIVA	W						309	0.2	34		1
	1998-NIVA	W						309	0.2	37		
	1999-NIVA	W						309	0.2	34		1
NAP1M	1992-NIVA	W	309	0.2	8			309	0.2	46		
	1995-NIVA	W						309	0.2	15		13
	1997-NIVA	W						309	0.5	34		
	1998-NIVA	W						309	0.5	37		
	1999-NIVA	W						309	0.5	34		
NAP2M	1992-NIVA	W	309	0.2	8			309	0.2	46		
	1995-NIVA	W						309	0.2	15		13
	1997-NIVA	W						309	0.5	34		
	1998-NIVA	W						309	0.5	37		
	1999-NIVA	W						309	0.5	34		
NAPC1	1995-NIVA	W						309	0.2	55		6
	1996-NIVA	W						309	0.2	61		
NAPC2	1995-NIVA	W						309	0.2	57		6
	1996-NIVA	W						309	0.2	60		
NAPC3	1995-NIVA	W						309	0.2	57		5
	1996-NIVA	W						309	0.2	60		
NAPD2	1997-NIVA	W						309	0.5	34		
	1998-NIVA	W						309	0.5	39		
	1999-NIVA	W						309	0.5	34		
NAPD3	1997-NIVA	W						309	0.5	34		
	1998-NIVA	W						309	0.5	39		
	1999-NIVA	W						309	0.5	34		
NAPDI	1992-NIVA	W	309	0.2	8			309	0.2	46		
	1995-NIVA	W						309	0.2	15		6
	1997-NIVA	W						309	0.5	34		
	1998-NIVA	W						309	0.5	39		
	1999-NIVA	W						309	0.5	34		
NAPT2	1997-NIVA	W						309	0.5	34		
	1998-NIVA	W						309	0.5	39		
	1999-NIVA	W						309	0.5	34		
NAPT3	1997-NIVA	W						309	0.5	34		
	1998-NIVA	W						309	0.5	39		
	1999-NIVA	W						309	0.5	34		
NAPT4	1997-NIVA	W						309	0.5	34		
	1998-NIVA	W						309	0.5	39		
	1999-NIVA	W						309	0.5	34		
NAPTM	1992-NIVA	W	309	0.2	8			309	0.2	46		
	1995-NIVA	W						309	0.2	15		11
	1997-NIVA	W						309	0.5	34		
	1998-NIVA	W						309	0.5	39		
	1999-NIVA	W						309	0.5	34		
NI	1983-SIIF	1G W						130	20	12		
	1992-NIVA	W						312	10	6		
	1996-NIVA	W						999	miss	3		
OCS	1990-NIVA	W	340	2	169	31	24	341	0.05	58		1

Tissue				Fish liver					Fish fillet, Shrimp tail, Mussel, Other				
Contamin.	Mon. Lab. Year	Inter-calibr. +basis		Analys method code	Detect limit (ppb)	Total value count	Count below d.lim	N (<) above d.lim	Analys method code	Detect limit (ppb)	Total value count	Count below d.lim	N (<) above d.lim
	1991-NIVA		W	340	2	179	14	81	341	0.05	62	5	8
	1992-NIVA		W	340	5	192	3		341	0.1	140		
	1993-NIVA		W	340	4	212	51	16	341	0.1	133		
	1994-NIVA		W	340	3	300	39	22	341	0.05	165	96	
	1995-NIVA		W	340	3	318	44		341	0.05	225	102	
	1996-NIVA		W	340	3	332	287		341	0.05	237	114	
	1997-NIVA		W	340	2	260	100		341	0.05	221	30	14
	1998-NIVA		W	340	2	277	132	101	341	0.05	203	182	1
	1999-NIVA		W	340	2	245	144	2	341	0.05	222	80	23
PA	1992-NIVA		W	309	0.2	8			309	0.2	45		
	1995-NIVA		W						309	0.2	72		
	1996-NIVA		W						309	0.2	65		
	1997-NIVA	AL	W						309	0.2	36		
	1998-NIVA		W						309	0.2	39		
	1999-NIVA	EK	W						309	0.2	34		
PAC1	1995-NIVA		W						309	0.2	57		1
	1996-NIVA		W						309	0.2	65		
PAC2	1995-NIVA		W						309	0.2	56		
	1996-NIVA		W						309	0.2	65		2
PAD10	1999-NIVA		W						309	0.2	34		21
PAD36	1999-NIVA		W						309	0.2	34		3
PAH	1987-NIVA		W	309	0.02	1							
PAM1	1992-NIVA		W	309	0.2	8			309	0.2	45		
	1995-NIVA		W						309	0.2	15		2
	1997-NIVA		W						309	0.5	36		
	1998-NIVA		W						309	0.5	39		
	1999-NIVA		W						309	0.5	34		
PAM2	1997-NIVA		W						309	0.5	36		
	1998-NIVA		W						309	0.5	39		
	1999-NIVA		W						309	0.5	34		
PAMD1	1997-NIVA		W						309	0.5	36		
	1998-NIVA		W						309	0.5	39		
PAMD2	1997-NIVA		W						309	0.5	36		
	1998-NIVA		W						309	0.5	39		
PB	1983-SIIF	1G	W						130	20	12		
	1984-SIIF	1G	W						130	20	27		2
	1985-SIIF	1G	D						130	20	35		
	1986-NIVA	1Z	D	312	150	56	4		312	150	20		
	1987-FIER	1G	W	403	10	37	1						
	1987-NIVA	1Z	D	312	150	57		12	312	150	37		
	1988-NIVA	1Z	D	312	150	61	17	3	312	150	55		
	1989-NIVA	1Z	D	312	150	135	9	9					
	1989-NIVA	1Z	W						312	150	36		
	1990-NIVA	1Z	W	312	50	187	3	1	312	150	77	3	
	1991-NIVA	1Z	W	312	50	193	14		312	50	67		
	1992-NIVA	1Z	W	312	50	191	119		312	50	111	2	
	1993-NIVA	1H	W	312	30	221	40		312	30	79		
	1994-NIVA	1Z	W	312	30	302	3		312	30	81		
	1995-NIVA		W	312	30	318	162	30	312	30	124		
	1996-NIVA	V1	W						312	30	110		
	1996-NIVA	V2	W	312	30	368		109					
	1997-NIVA		W	312	40	287	10	28	312	40	92		
	1998-NIVA		W	312	40	285	126	2	312	40	90		
	1999-NIVA		W	312	40	233	118	11					
	1999-NIVA	EF	W						312	40	129	10	
PCB	1981-SIIF	2D	W	110	10	27			110	10	35		
	1982-SIIF	2D	W						111	5	17		
	1982-VETN		W	210	50	53			211	50	54		

Tissue				Fish liver					Fish fillet, Shrimp tail, Mussel, Other				
Contamin.	Mon. Lab. Year	Inter-calibr. +basis		Analys method code	Detect limit (ppb)	Total value count	Count below d.lim	N (<) above d.lim	Analys method code	Detect limit (ppb)	Total value count	Count below d.lim	N (<) above d.lim
	1983-SIIF	2E	W						111	5	14		
	1983-VETN	2E	W						211	50	48		
	1983-VETN	2Z	W	210	50	48							
	1984-SIIF	2E	W						111	5	24		
	1984-VETN	2E	W						211	50	66		
	1984-VETN	2Z	W	210	50	66							
	1985-SIIF	2E	W						111	5	32		6
	1985-VETN	2E	W						211	50	90		1
	1985-VETN	2Z	W	210	50	45							
	1986-NACE	2Z	W	511a	40a	56			511	20	56		
	1986-SIIF	2E	W						111	5	21		
	1987-NACE	2Z	W	510	40	53			511	20	54		
	1987-NIVA		W	340	0.1	2							
	1987-SIIF	2E	W						111	5	21		
	1988-NACE	2Z	W	510	40	61			511	20	13		
	1988-SIIF	2E	D						111	5	6		
	1988-SIIF	2E	W						111	5	22	4	
	1989-NACE	2Z	W	510	20	93			511	20	17		
	1989-SIIF	2E	W						111	5	36	6	
	1990-SIIF	2E	W						111	5	41		
	1991-SIIF	2E	W						111	5	35		
PCC26	1996-NILU		W						842	0.001	6		
PCC32	1996-NILU		W						842	0.003	6		4
PCC50	1996-NILU		W						842	0.001	6		
PCC62	1996-NILU		W						842	0.025	6		6
PCDD	1995-NILU		W						841	2E-05	6		
	1996-NILU		W						841	1E-04	18		
PCDF	1995-NILU		W						841	2E-05	6		
	1996-NILU		W						841	1E-04	18		
PER	1992-NIVA		W	309	0.2	8			309	0.2	46		
	1995-NIVA		W						309	0.2	72		32
	1996-NIVA		W						309	0.2	65		40
	1997-NIVA		W						309	0.5	36		
	1998-NIVA		W						309	0.5	39		
	1999-NIVA	EK	W						309	0.5	34		
PYR	1992-NIVA		W	309	0.2	8			309	0.2	44		
	1995-NIVA		W						309	0.2	72		4
	1996-NIVA		W						309	0.2	65		1
	1997-NIVA	AL	W						309	0.2	36		
	1998-NIVA		W						309	0.2	39		
	1999-NIVA	EK	W						309	0.2	34		
QCB	1990-NIVA		W	340	2	169	33	39	341	0.05	58		
	1991-NIVA		W	340	2	178	13	97	341	0.05	57	5	7
	1992-NIVA		W	340	5	192	3		341	0.1	125		
	1993-NIVA		W	340	4	212	52	24	341	0.1	133		
	1994-NIVA		W	340	3	299	38	23	341	0.05	165	93	
	1995-NIVA		W	340	3	318	45		341	0.05	225	103	
	1996-NIVA		W	340	3	332	306		341	0.05	237	109	
	1997-NIVA		W	340	2	260	79		341	0.05	221	27	10
	1998-NIVA		W	340	2	284	121	101	341	0.05	203	171	1
	1999-NIVA		W	340	2	238	181	2	341	0.05	222	81	14
SE	1982-VETN		W	240	10	46			240	10	54		
TBTIN	1997-NIVA		D						320	5	8		
	1998-NIVA		D						320	5	15		
	1999-NIVA		D						320	5	13		
TCDD	1995-NILU		W						841	2E-05	6	1	
	1996-NILU		W						841	1E-05	18		

Tissue				Fish liver					Fish fillet, Shrimp tail, Mussel, Other				
Contamin.	Mon. Lab. Year	Inter-calibr. +basis		Analys method code	Detect limit (ppb)	Total value count	Count below d.lim	N (<) above d.lim	Analys method code	Detect limit (ppb)	Total value count	Count below d.lim	N (<) above d.lim
TDEPP	1991-NIVA		W	340	1	138		1	341	0.05	62		
	1992-NIVA		W	340	5	191	3		341	0.1	140		
	1993-NIVA		W	340	4	212	24	3	341	0.1	133		
	1994-NIVA	2Z	W	340	3	300	17	5	341	0.05	165	47	
	1995-NIVA		W	340	3	318	36		341	0.05	222	51	
	1996-NIVA		W	340	3	332	23		341	0.05	237	16	
	1997-NIVA		W	340	3	260	23						
	1997-NIVA	AJ	W						341	0.05	221	11	
	1998-NIVA		W	340	3	278	19	26	341	0.05	203	1	44
	1999-NIVA		W	340	3	245	5	1					
	1999-NIVA	EG	W						341	0.05	222	2	69
TPTIN	1997-NIVA		D						320	5	8		
	1998-NIVA		D						320	5	15		5
	1999-NIVA		D						320	5	13		
V	1996-NIVA		W						999	miss	3		
ZN	1983-SIIF	1G	W						131	400	12		
	1984-SIIF	1G	W						132	400	27		
	1985-SIIF	1G	D						132	400	35		
	1986-NIVA	1H	D	311	3000	56			311	3000	20		
	1987-FIER	1G	W	405	20	37							
	1987-NIVA	1H	D	311	3000	57			311	3000	37		
	1988-NIVA	1H	D	311	3000	61			311	3000	55		
	1989-NIVA	1H	D	311	3000	135		1					
	1989-NIVA	1H	W						311	3000	36		
	1990-NIVA	1H	W	311	3000	189			311	3000	77		
	1991-NIVA	1H	W	311	1000	193			311	1000	67		
	1992-NIVA	1H	W	311	1000	191			311	1000	111		
	1993-NIVA	1H	W	311	1000	221			311	1000	79		
	1994-NIVA	1Z	W	311	1000	302			311	1000	81		
	1995-NIVA		W	311	1000	318			311	1000	142		
	1996-NIVA	V1	W						311	1000	131		
	1996-NIVA	V2	W	311	1000	368							
	1997-NIVA		W	311	1000	287							
	1997-NIVA	AH	W						311	1000	110		
	1998-NIVA		W	311	1000	285			311	1000	51		
	1999-NIVA		W	311	1000	233							
	1999-NIVA	EF	W						311	1000	99		
Sum of counts						57072	6470	2083			49497	4057	2563

a(7) > ambigous value (Maximum value displayed)

Appendix E.
Overview of localities

Station positions are shown on maps in Appendix F. .

JAMP stations and programme 1999

Appendix E. 1. JAMP station positions and sampling overview for 1999. WSBOFR: W=water, S=sediment, B=blue mussel, O=other shellfish, F=flatfish, R=roundfish. second station position indicates previous location. NSTF=North Sea Task Force. Mussels were sampled from rock surfaces unless otherwise noted.

JAMP area	St.	Locality name	North latitude	East longitude	ICES position	1999 W	S	B	O	F	R	notes
26 OSLOFJORD AREA EAST, Hvaler and Singlefjorden												
26	01A	Sponvika	59°05.4'	11°12.5'	47G13							
			59°05.1'	11°13.9'	47G13							
26	02A	Fugleskjær	59°06.6'	10°59.3'	47G09							
			59°06.9'	10°59.0'	47G09							
26	03A	Tisler	58°59.0'	10°57.8'	46G07							C
			58°58.8'	10°57.5'	46G07							
26 OSLOFJORD AREA CENTRAL, Oslofjord proper												
26	30A	Gressholmen	59°52.8'	10°43.0'	48G07	+		+				
26	30A	Gressholmen (- 1996)	59°52.5'	10°43.0'	48G07							
26	30B	Oslo city area / Håøya	59°49'	10°33'	48G04							
			59°44'	10°32'	48G04						+	
26	30B	Oslo city area / Nesodden	59°52'	10°39'	48G04							
26	30F	Oslo city area / Håøya	59°47'	10°34'	48G04							
26	30X	West of Nesodden	59°48.5'	10°36'	48G04							
26	30G	Steilene area (Spro)	59°45.8'	10°34.5'	48G05							
26	30H	Steilene area (Storegrunn)	59°48.5'	10°33.5'	48G05							
26	40C	Steilene	59°49'	10°33'	48G05							
			59°49'	10°39'	48G05							
26	30S	Steilene	59°49.1'	10°33.8'	48G05							
26	31A	Solbergstrand	59°36.9'	10°39.4'	48G06	+		+				
26	31B	Solbergstrand (Filtvet, 1982)	59°37'	10°39'	47G07							
26	32A	Rødtangen	59°31.5'	10°25.6'	48G06							
26	33X	Sande, west side	59°31.7'	10°20.4'	48G06							
26	33B	Sande, east side	59°31.7'	10°21.0'	48G06					+		
26	35A	Mølen	59°29.2'	10°30.1'	47G04	+		+				
26	35C	Holmenstrand-Mølen	59°29'	10°27'	47G04							
26	35S	Mølen	59°30'	10°35'	47G04							
26	36A	Færder	59°01.6'	10°31.7'	47G06	+		+				
26	36B	Færder area	59°02'	10°27'	47G06							
			59°02'	10°32'	47G06						+	
26	36F	Færder area	59°04'	10°23'	47G06					+		
26	36S	Færder area (NSTF-54)	59°00.4'	10°41.6'	47G09							N
26 OSLOFJORD AREA WEST, outer Sandefjord-Langesundsfjord												
26	73A	Lyngholmen	59°02.6'	10°18.1'	47G03							C
26	74A	Oddeneskjær	58°57.3'	09°52.1'	46F97							C
26	71A	Bjørkøya (Risøyodden)	59°01.4'	09°45.4'	47F99	+		+				
ARENDAL AREA												
	76A	Risøy	58°43.6'	09°17.0'	46F92	+		+				C
	77A	Flostafjord	58°31.5'	08°56.9'	46F89							C
	77B	Borøy area	58°33'	09°01'	46F93							
	77F	Borøy area	58°33'	09°01'	46F93							
	77C	Borøy area	58°29'	09°10'	45F91							

Appendix E. (cont'd)

JAMP area	St.	Locality name	North latitude	East longitude	ICES position	1999 W	S	B	O	F	R	notes
ARENDAL AREA (cont.)												
	77S	Arendal area (NSTF-57)	58°24.2'	09°01.8'	45F91							N, C
	79A	Gjerdvoldsøyen, east	58°25.0'	08°45.3'	45F87							C
LISTA AREA												
	13A	Langøsund	57°59.8'	07°34.6'	44F74							C
	14A	Aavigen	58°02.2'	07°13.2'	45F73							C
	15A	Gåsøy (Ullerø area)	58°03.1'	06°53.3'	45F69	+		+				
	15B	Ullerø area	58°03'	06°43'	45F69						+	
	15F	Ullerø area	58°03'	06°43'	45F69					+		
	15S	Lista area (NSTF-39)	58°01.0'	06°34.3'	45F66							N, C
BØMLO AREA												
	224G	Heggjelen	59°25.2'	05°13.90'	47F51				+			
	226A	Karmsund bridge (east)	59°22.6'	05°17.91'	47F51			+				
	226G	Karmsund bridge (east)	59°22.6'	05°17.91'	47F51				+			
	227A	Melandholmen	59°20.0'	05°18.90'	47F51			+				
	227G	Melandholmen	59°20.0'	05°18.90'	47F51				+			
	220G	Smørstakk	59°15.2'	05°21.14'	47F55				+			
	221A	Stangeland	59°16.6'	05°19.70'	47F52			+				
	221G	Stangeland	59°16.6'	05°19.70'	47F52				+			
	22A	Espevær, west	59°35.2'	05°00.5'	48F59	+		+				C, 1
	22F	Borøyfjorden	59°43'	05°21'	48F55					+		
	22C	Bømlofjorden	59°34'	05°11'	48F53							
	22S	Bømlo (NSTF-36)	59°25.9'	04°50.2'	47F47							N
	23A	Austvik	59°52.2'	05°06.6'	48F51							
	23B	Karihavet area	59°55'	05°07'	48F51						+	
	24A	Vardøy	60°10.2'	05°00.8'	49F52							C
	24S	Sotra	60°15.1'	04°33.3'	49F45							N
62 HARDANGERFJORDEN												
62	69A	Lille Terøy	59°58.8'	05°45.4'	49F59	+		+				
62	69S	Kvinnheradsfjorden	60°01.3'	05°56.1'	49F59							
62	67B	Strandebarm	60°16'	06°02'	49F62					+	+	
62	67S	Strandebarm	60°13.5'	06°05.1'	49F62							
62	65A	Vikingneset	60°14.5'	06°09.6'	49F62	+		+				
62	63A	Ranaskjær	60°25.1'	06°24.5'	49F64	+		+				
62	63S	Ranaskjær	60°23.6'	06°27.1'	49F64							
63 SØRFJORD												
63	51A	Byrkjenes	60°05.1'	06°33.1'	49F66							
63	52A	Eitrheimsneset	60°05.8'	06°32.2'	49F66	+		+				3
63	52S	Tyssedal	60°06.9'	06°32.9'	49F66							
63	53B	Inner Sørfjord	60°10'	06°34'	49F65					+	+	
63	56A	Kvalnes	60°13.4'	06°36.1'	49F65	+		+				
63	56S	Kvalnes	60°13.7'	06°35.6'	49F65							
63	57A	Krossanes	60°23.2'	06°41.2'	49F67	+		+				
63	57S	Krossanes	60°23.1'	06°40.7'	49F67							
	56A-1	Kvalnes, north	60°13.6'	06°36.45'	49F66			+				8
	56A-2	Kjeken at Helland	60°20.58'	06°39.50'	49F66			+				8
	57A-1	Urdhem	60°22.17'	06°40.65'	49F66			+				8
ÅLESUND AREA												
	25A	Hinnøy	61°22.2'	04°52.8'	51F47							5
	26A	Hamnen	61°52.7'	05°13.6'	52F51							5
	27A	Grinden	62°12.2'	05°25.4'	53F55							1
	27X	Kvame area	62°12.3'	05°22.2'	53F55							
	27S	Stattlandet (east of)	62°09.3'	05°21.3'	53F56							
	28A	Eiksundet	62°14.9'	05°54.5'	53F58							1
		Eiksundet (1992)	62°14.9'	05°54.5'	53F58							1

Appendix E. (cont'd)

JAMP area	St.	Locality name	North latitude	East longitude	ICES position	1999 W	S	B	O	F	R	notes
65 ORKDALSFJORDEN												
65	80A	Østmerknes	63°27.5'	10°27.5'	56G04							
65	81A	Biologisk station	63°26.5'	10°21.4'	56G04							
65	82A	Flakk	63°27.1'	10°12.6'	56G01							
65	82S	Flakk	63°27.5'	10°11.8'	56G01							
65	83A	Frøsetskjær	63°25.5'	10°07.8'	56G01							
65	84A	Trossavika	63°20.8'	09°57.8'	55F97							
65	84B	Trossavika	63°20.8'	09°57.8'	55F97							
65	84S	Trossavika	63°21.7'	09°57.4'	55F97							
		(1987)	63°21.2'	09°57.2'	55F97							
65	89S	Thamshavn (indre Orkdal)	63°19.7'	09°52.3'	55F98							
		(1987)	63°19.8'	09°52.5'	55F98							
65	90S	Outer Orkdalsfjord	63°27.4'	10°03.0'	56G01							
		(1987)	63°27.4'	10°04.3'	56G01							
65	85A	Geitastrand	63°21.9'	09°56.3'	55F97							
65	86A	Geitnes	63°26.6'	09°59.2'	55F97							
65	87A	Ingdalsbukt	63°27.8'	09°54.8'	55F97							
65	88A	Rødberg	63°27.2'	10°00.0'	55G01							
FROAN AREA												
	91A	Nerdvika	63°21.2'	08°09.6'	55F81							3
		Fosflua (1992)	63°23.8'	08°17.6'	55F81							4
	92A	Stokken	64°02.2'	10°01.1'	57G03							5
		(-1996)	64°04.6'	10°00.7'	57G03							4
	92B	Stokken area	64°09.9'	09°53.0'	57F99							
	92F	Stokken area	64°09.9'	09°53.0'	57F99							
	93S	Raudøya (northeast of)	64°22.7'	10°27.8'	57G04							
	93A	Låven (Sætervik)	64°23.7'	10°29.0'	57G04							4
		Låven (Sætervik, 1992))	64°23.5'	10°28.0'	57G04							4
HELGELAND AREA												
	94A	Landfast	65°38.4'	12°00.5'	60G23							1
	96A	Breiviken	66°17.6'	12°50.5'	61G28							1
	95S	Rodø (east of)	66°41.8'	13°09.9'	62G32							
	95A	Flatskjær	66°42.6'	13°15.8'	62G32							4
LOFOTEN AREA												
	97A	Klakholmen	67°39.9'	14°44.6'	64G49							4
	99A	Brunvær	68°00.3'	15°05.6'	65G53							4
	98B	Lille Molla	68°12.0'	14°48.0'	65G48						+	
	98F	Lille Molla	68°12.0'	14°48.0'	65G48					+		
	98S	Skrova (south of)	68°07.0'	14°41.0'	65G49							
	98A	Husvågen (1997)	68°15.4'	14°40.6'	65G46	+		+				5
		(1992)	68°09.4'	14°39.3'	65G46							1
	98X	Skrova	68°10.5'	14°40.2'	65G48							7
	99S	Lundøy (north of)	68°05.8'	15°10.1'	65G53							

Appendix E. (cont'd)

JAMP area	St.	Locality name	North latitude	East longitude	ICES position	1999 W	S	B	O	F	R	notes
FINNSNES-SKJERVØY AREA												
	41S	Andfjord	68°56.3'	17°05.2'	66G71							
	41A	Fensneset, Grytøya	68°56.9'	16°38.5'	66G64							3
	42S	Tromsø area	69°60.4'	18°06.8'	68G83							
	42A	Tennskjær, Malangen	69°28.6'	18°18.0'	67G81							3
	43S	Kvænangen	70°03.3'	21°07.9'	69H13							
	43A	Lyngneset, Langjforden	70°06.2'	20°32.8'	69H06							2
	43B	Kvænangen	70°09.0'	21°22.0'	69H16							
	43F	Kvænangen	70°09.0'	21°22.0'	69H16							
HAMMERFEST-HONNINGSVÅG AREA												
	44S	Sørøya, south	70°25.9'	22°31.8'	69H24							
	44A	Elenheimsundet	70°30.8'	22°14.8'	70H23							1, 6
	45S	Hammerfest area	70°42.9'	24°26.6'	70H45							
	45A	Ytre Sauhamnneset	70°45.8'	24°19.2'	70H42							
	46S	Porsangen area	70°52.9'	26°11.9'	70H61							
	46A	Smineset in Altesula	70°58.4'	25°48.1'	70H57							3, 6
	46B	Hammerfest area	70°50.0'	23°44.0'	70H37							
	46F	Honningsvåg area	00°00.0'	00°00.0'								
	47S	Laksefjord	70°55.0'	26°55.1'	70H67							
	47A	Kifjordeneset	70°52.9'	27°22.2'	70H74							
VARANGER PENINSULA AREA												
	48S	Tanafjord	70°52.5'	28°38.5'	70H84							
	48A	Trollfjorden i Tanafjord	70°41.6'	28°33.3'	70H85							
	49S	Syltefjord	70°33.9'	30°19.9'	70J03							
	49A	Nordfjorden, Syltefjord	70°33.1'	30°05.2'	70J03							
	10S	Varangerfjord	69°56.1'	30°06.7'	68J01							
	10A	Skagodden	70°04.2'	30°09.8'	69J03	+		+				2
	10B	Varangerfjorden	69°54.5'	29°30.0'	68H97						+	
	10F	Varangerfjorden	69°55.0'	29°51.5'	68H97					*		
	11A	Sildkroneset, Bøkfjorden	69°47.2'	30°11.1'	68J02							
	11X	Brashavn	69°53.9'	29°44.7'	68J02	+		+				4

notes:

+ - samples collected
* - planned but innsufficient material
x - collected but not analysed
N - official NSTF station
C - at or near SFT's coastal monitoring programme station
1 - mussels collected from buoy and/or buoy anchor lines
2 - mussels collected from sand/gravel bottom
3 - mussels collected from iron/cement pilings
4 - mussels collected from metal navigation buoys
5 - mussels collected from floating dock
6 - mussels collected from wooden docks
7 - mussels collected from rocks under ferry terminal
8- extra sample frozen directly without depuration prior to cleaning (se section 2.1.4)

Appendix F.
Map of stations

Station positions 1981-1999
(cf. Appendix G. and Appendix J.)

Appendix F. (cont.) Map of stations

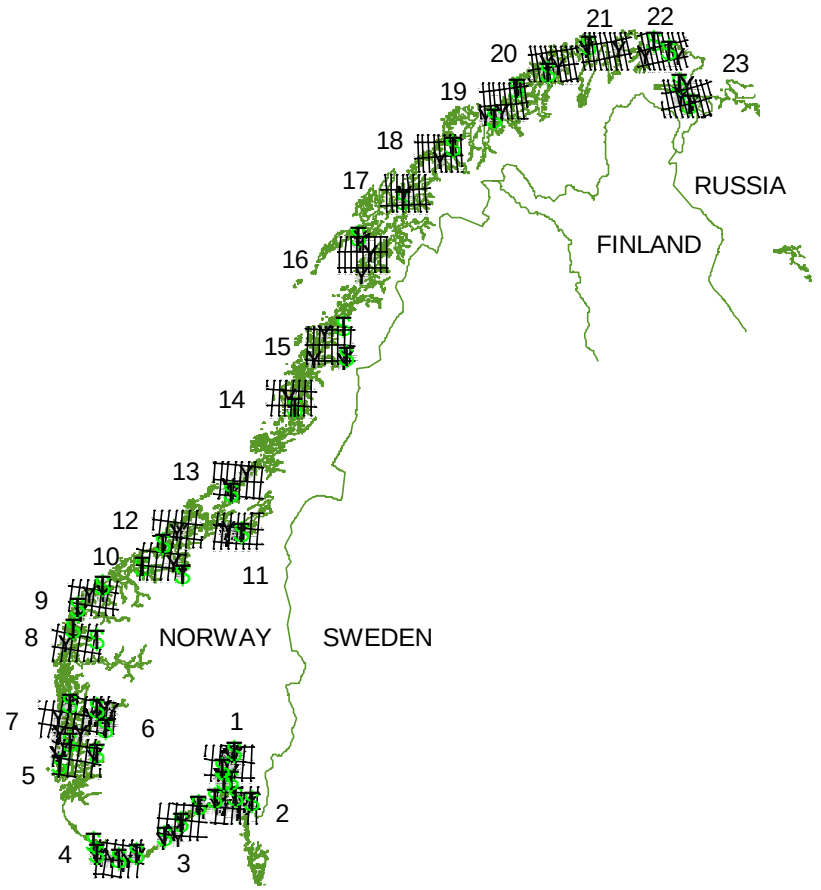
NOTES

For a few station the positions of sampling has varied in order to collect sufficient material (e.g., st. 36B and 98A) or investigate local geographical variations (e.g., in the inner Oslofjord and Sørfjord). Hence, the same station name may appear more than once on a map.

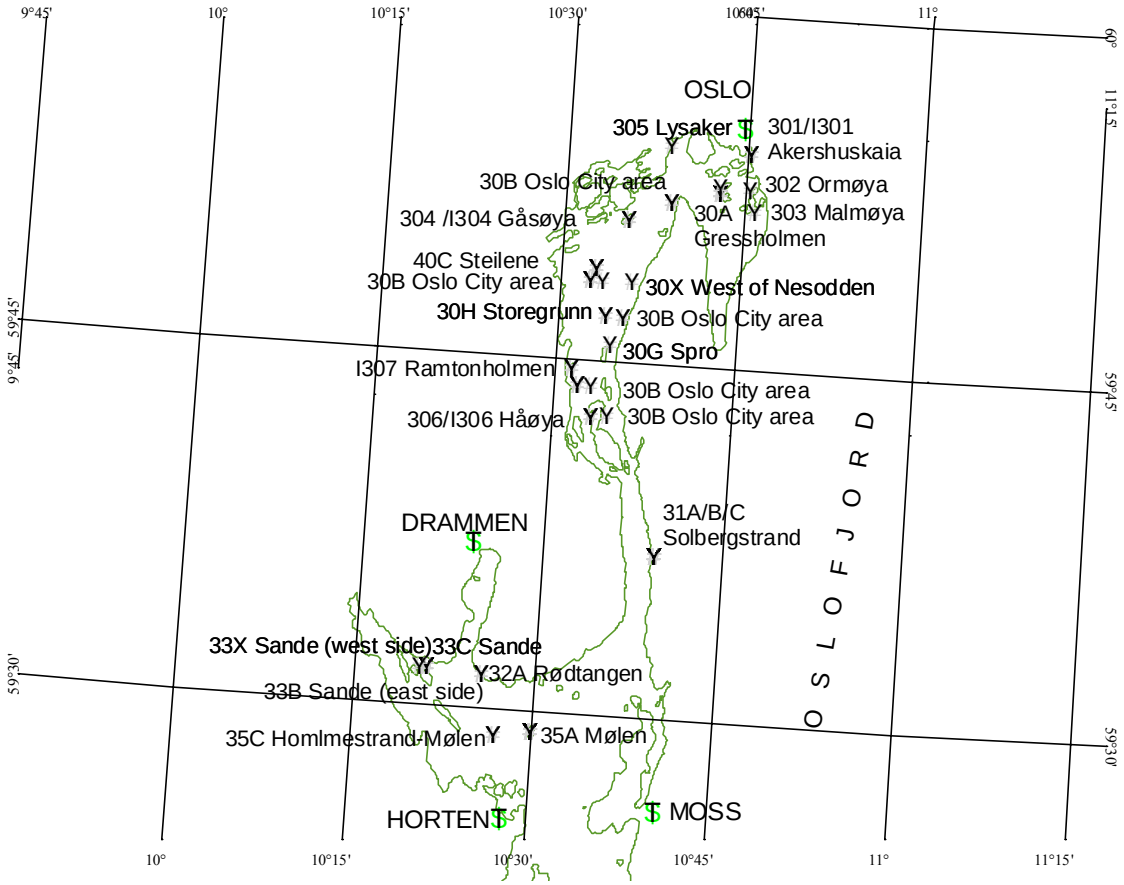
The letter A following the station identification number indicates that blue mussels were sampled. The letter B indicates sampling for cod and the letter F indicates sampling for flatfish. This system for fish is not consistent for some older stations (30, 33, 52 and 67) where only the letter B is used indicating that either cod or flatfish or both were sampled.

The letter "I" preceding the station identification number indicates an INDEX station for evaluating a "pollution" index. The letter R indicates a station for evaluating a "reference" index. Only blue mussels are used for these indices. The indices are based on a selection of JAMP and INDEX stations (cf. Green *et al.* 2000).

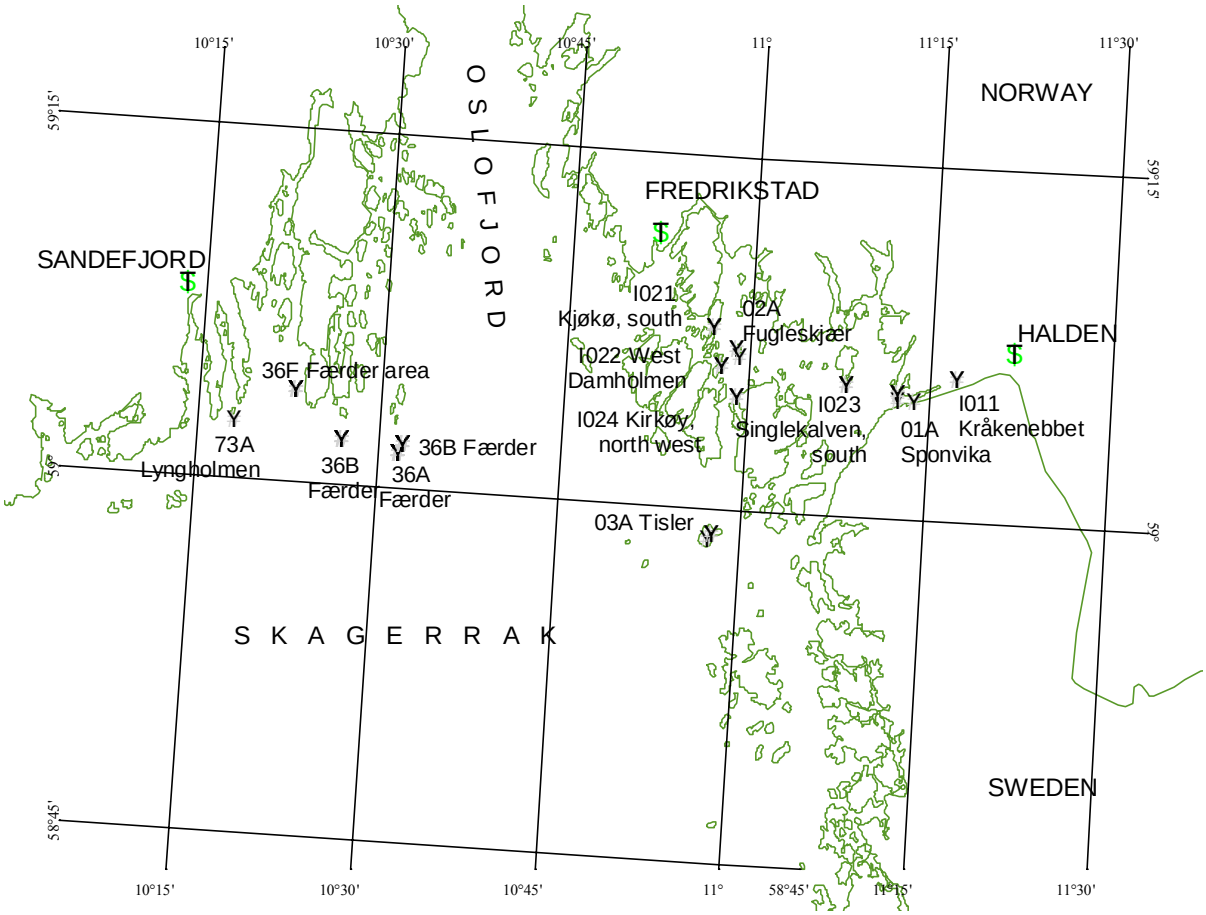
The maps are generated using ArcView GIS version 3.1.



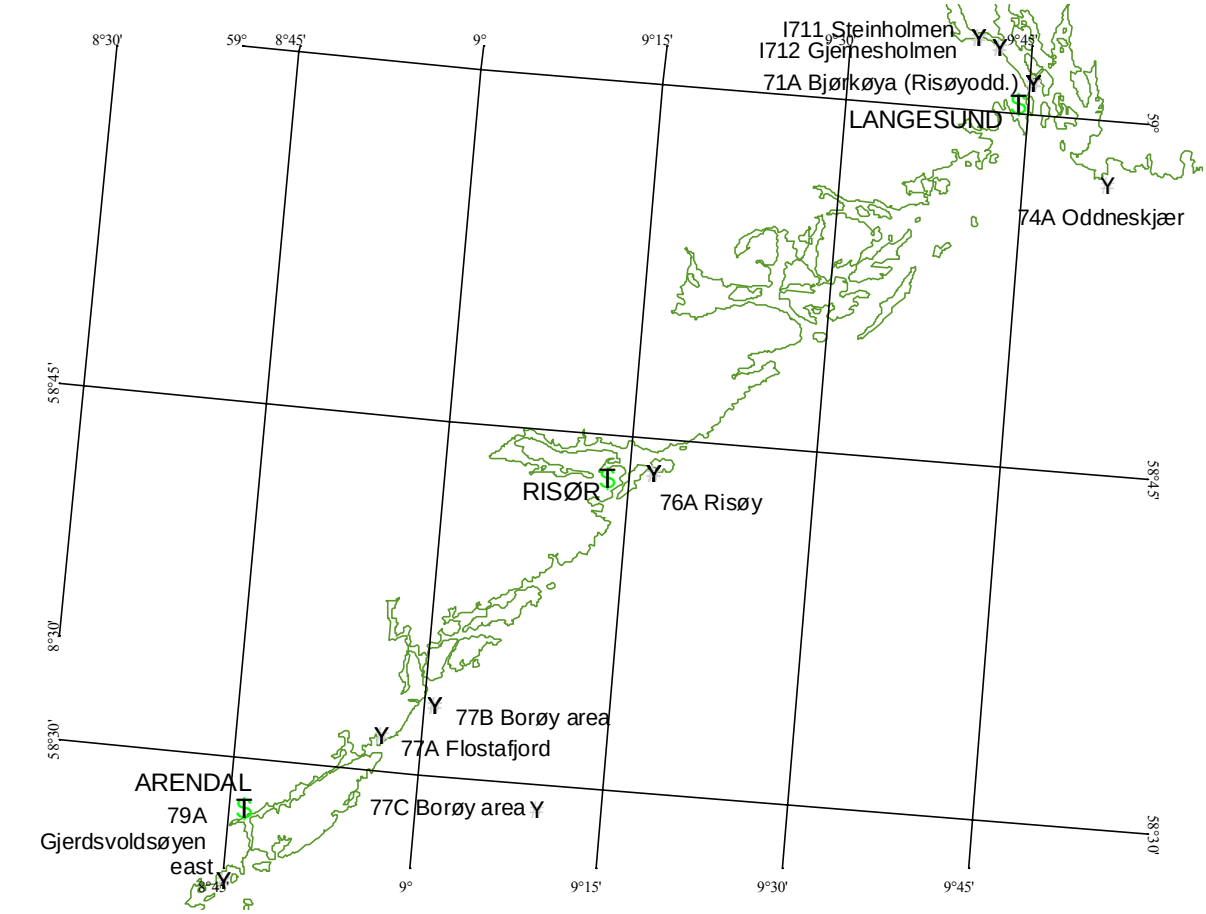
JAMP stations in Norway. Numbers refer to detail maps below.



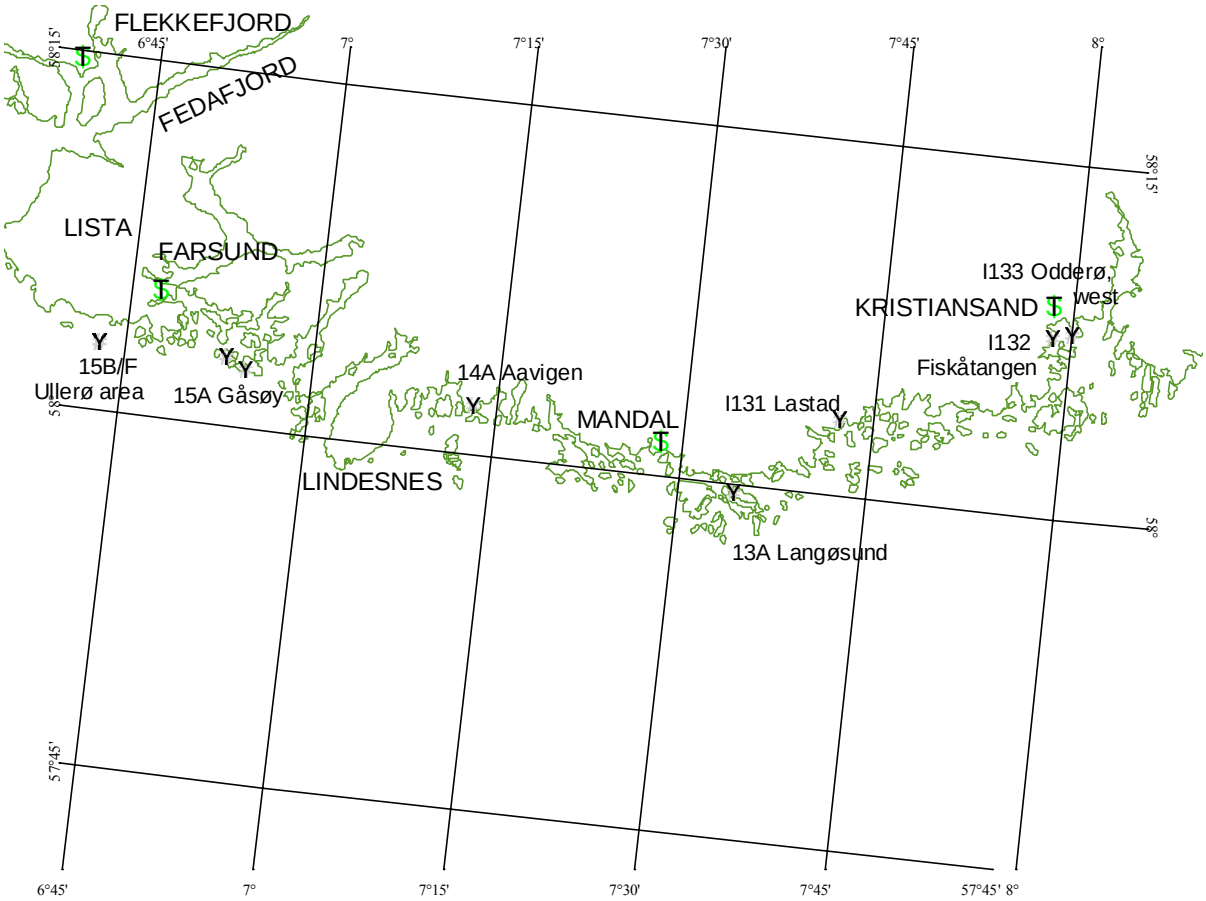
MAP 1


10°15'
10°30'
10°45'
11°
11°15'
11°30'
59°15'
59°
58°45'
OSLOFJORD
NORWAY
FREDRIKSTAD
SANDEFJORD
I021
Kjøkø, south
02A
Fugleskjær
HALDEN
I022 West
Damholmen
36F Færder area
I024 Kirkøy,
north west
I023
Singlekalven,
south
I011
Kråkenebbet
01A
Sponvika
73A
Lyngholmen
36B
Færder
36B Færder
36A
Færder
03A Tisler
SKAGERRAK
SWEDEN

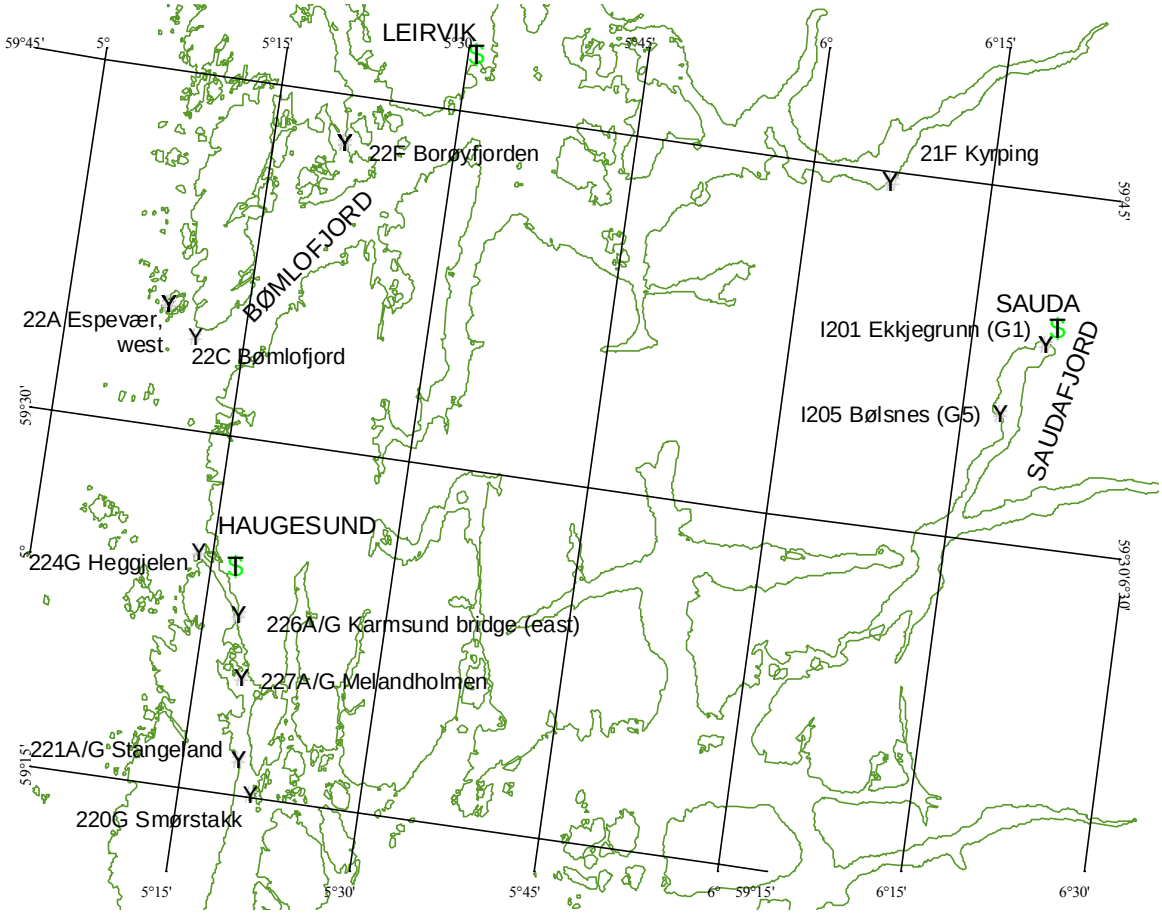
MAP 2


8°30'
59°
8°45'
9°
9°15'
9°30'
9°45'
58°45'
58°30'
I711 Steinholmen
I712 Gjemesholmen
71A Bjørkøya (Risøyodd.)
LANGESUND
74A Oddneskjær
RISØR
76A Risøy
77B Borøy area
77A Flostafjord
ARENDAL
79A
Gjerdsvoldsøyen
east
77C Borøy area

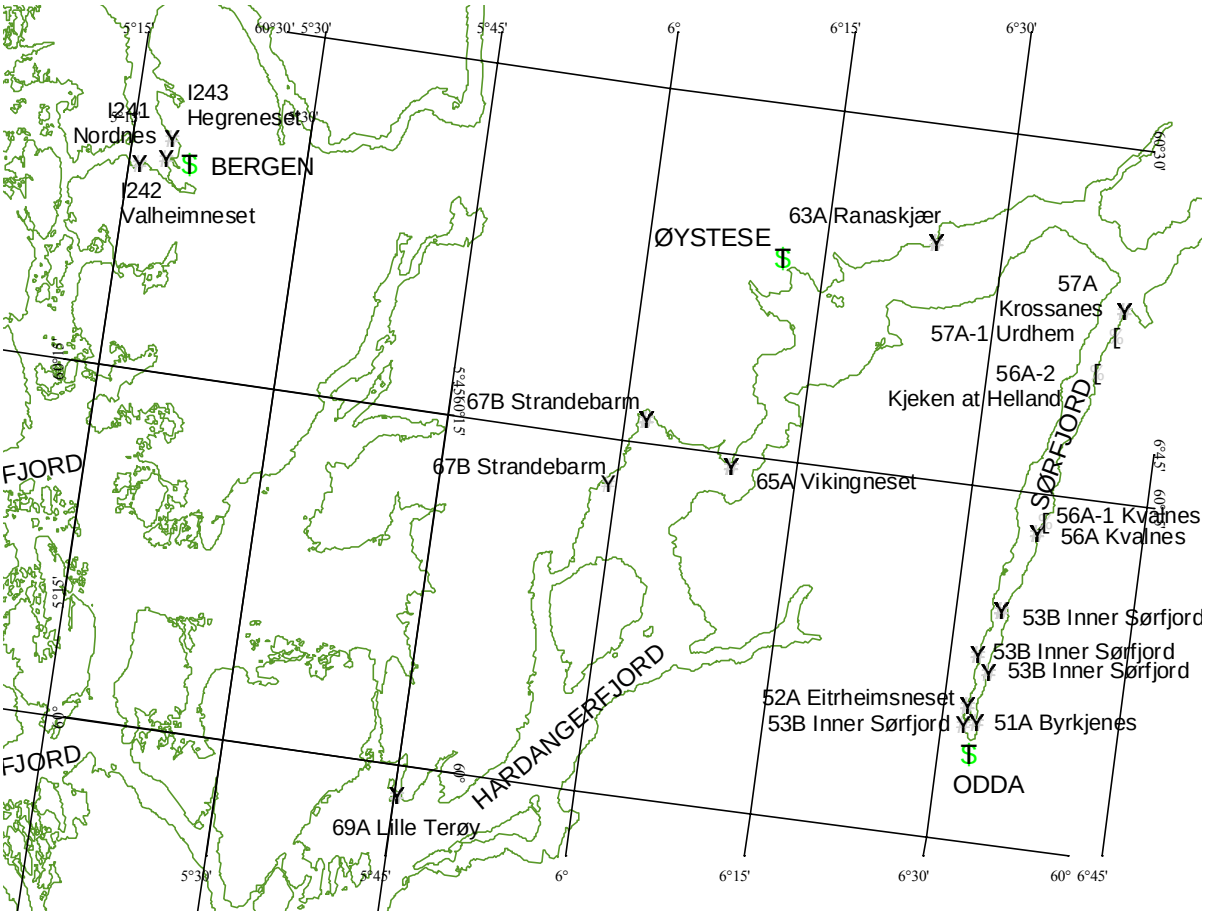
MAP 3


FLEKKEFJORD
FEDAFJORD
LISTA
FARSUND
15B/F
Ullerø area
15A Gåsøy
14A Aavigen
MANDAL
LINDESNES
I131 Lastad
I133 Odderø, west
KRISTIANSAND
I132 Fiskåtangen
13A Langøsund
6°45'
7°
7°15'
7°30'
7°45'
8°
58°15'
58°
57°45'

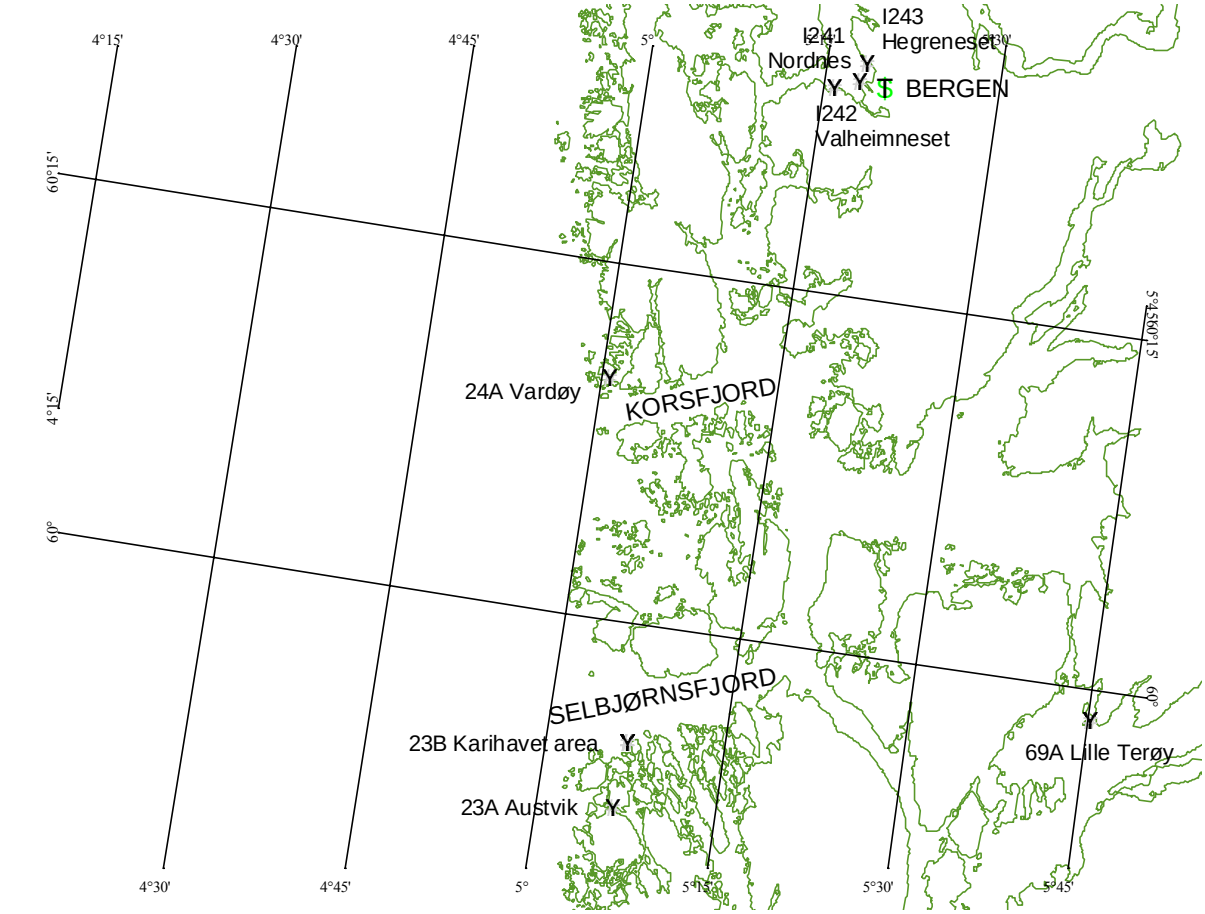
MAP 4


LEIRVIK
22F Borøyfjorden
21F Kyrping
BØMLOFJORD
22A Espevær, west
22C Bømlofjord
SAUDA
I201 Ekkjegrunn (G1)
I205 Bølsnes (G5)
SAUDAFJORD
HAUGESUND
224G Heggjelen
226A/G Karmsund bridge (east)
227A/G Melandholmen
221A/G Stangeland
220G Smørstakk
59°45'
59°30'
59°15'
5°
5°15'
5°30'
5°45'
6°
6°15'
6°30'

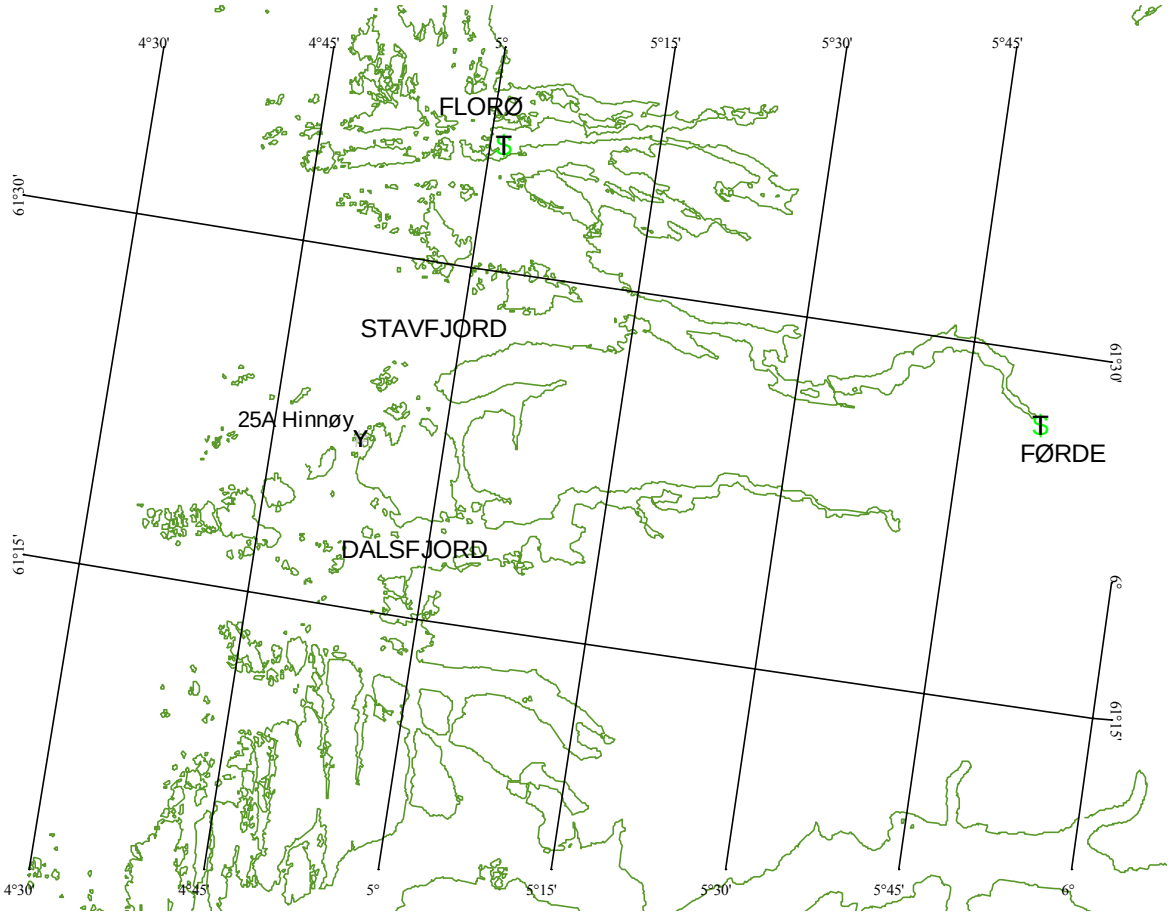
MAP 5


I241
I243
Hegreneset
Nordnes
BERGEN
I242
Valheimneset
ØYSTESE
63A Ranaskjær
57A
Krossanes
57A-1 Urdhem
56A-2
Kjeken at Helland
SØRFJORD
67B Strandebarm
67B Strandebarm
65A Vikingneset
56A-1 Kvalnes
56A Kvalnes
53B Inner Sørfjord
53B Inner Sørfjord
53B Inner Sørfjord
52A Eitrheimsneset
53B Inner Sørfjord
51A Byrkjenes
ODDA
HARDANGERFJORD
69A Lille Terøy
5°15'
5°30'
5°45'
6°
6°15'
6°30'
60°30'
60°15'
60°
59°45'

MAP 6


I241
I243
Hegreneset
Nordnes
BERGEN
I242
Valheimneset
24A Vardøy
KORSFJORD
SELBJØRNSFJORD
23B Karihavet area
23A Austvik
69A Lille Terøy
4°15'
4°30'
4°45'
5°
5°15'
5°30'
5°45'
60°30'
60°15'
60°
59°45'

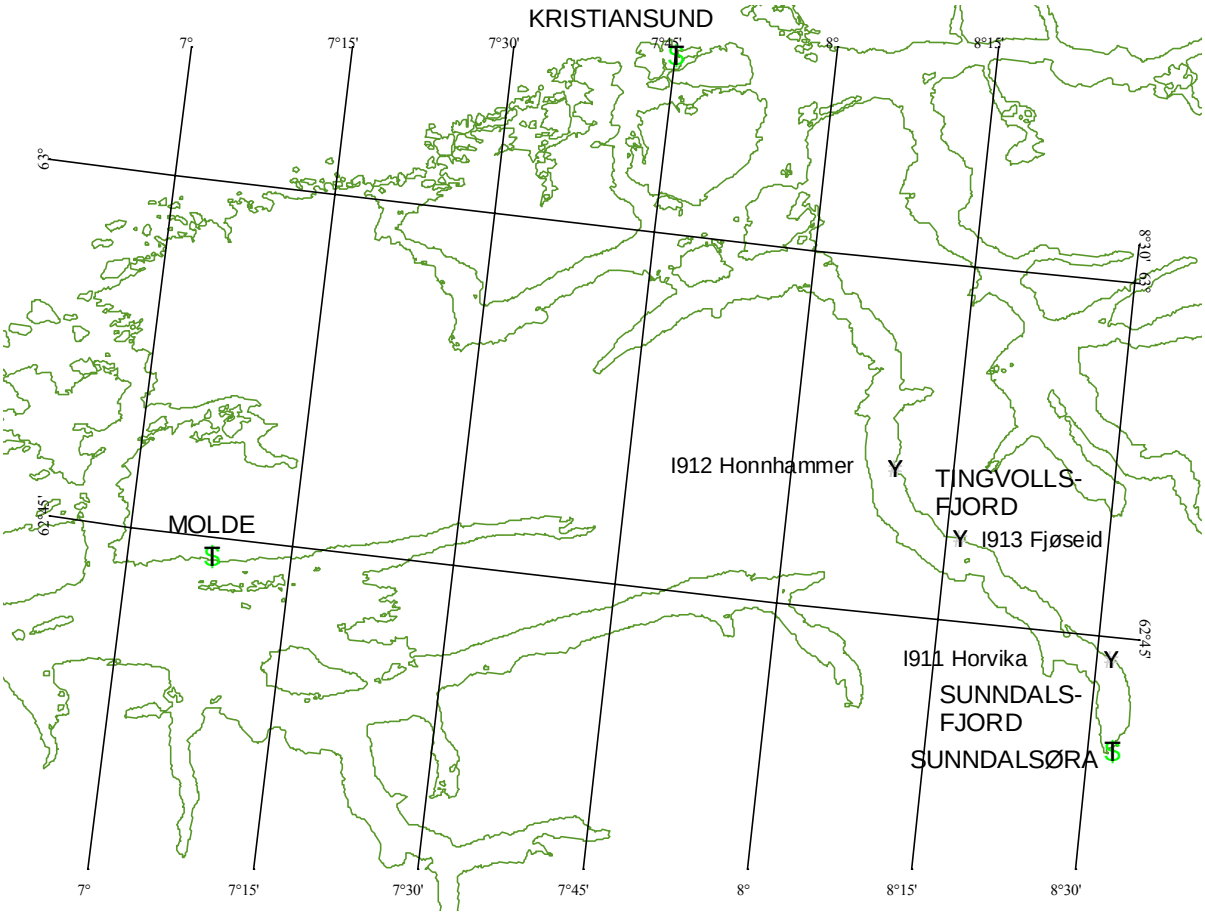
MAP 7


4°30'
4°45'
5°
5°15'
5°30'
5°45'
6°
61°30'
61°15'
FLORØ
STAVFJORD
25A Hinnøy
FØRDE
DALSFJORD

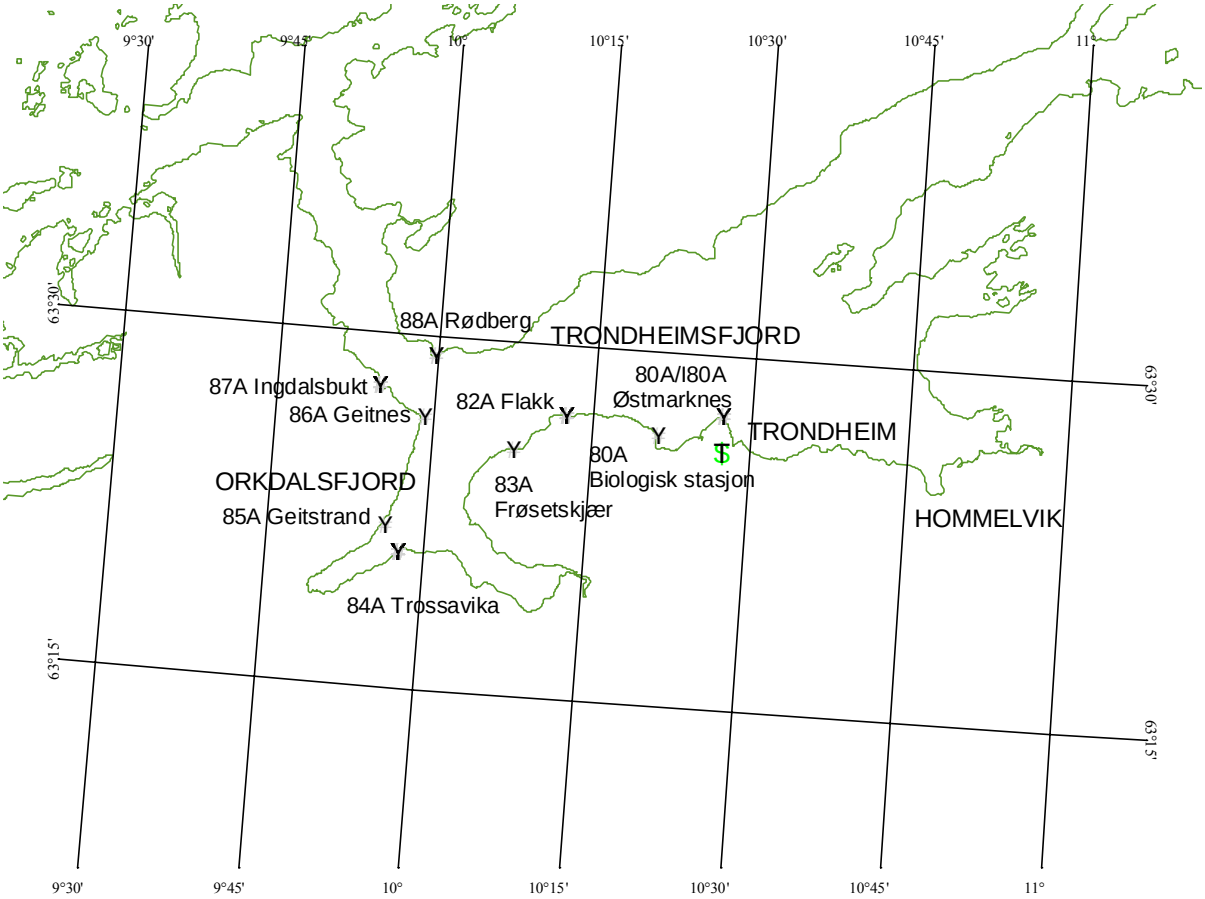
MAP 8


4°45'
5°
5°15'
5°30'
5°45'
6°
62°15'
62°
ULTSTEINVIK
27A Grinden
28A Eiksundet
VARTDALSFJORD
STADLANDET
VANYLVS-
FJORD
MÅLØY
26A Hamnen

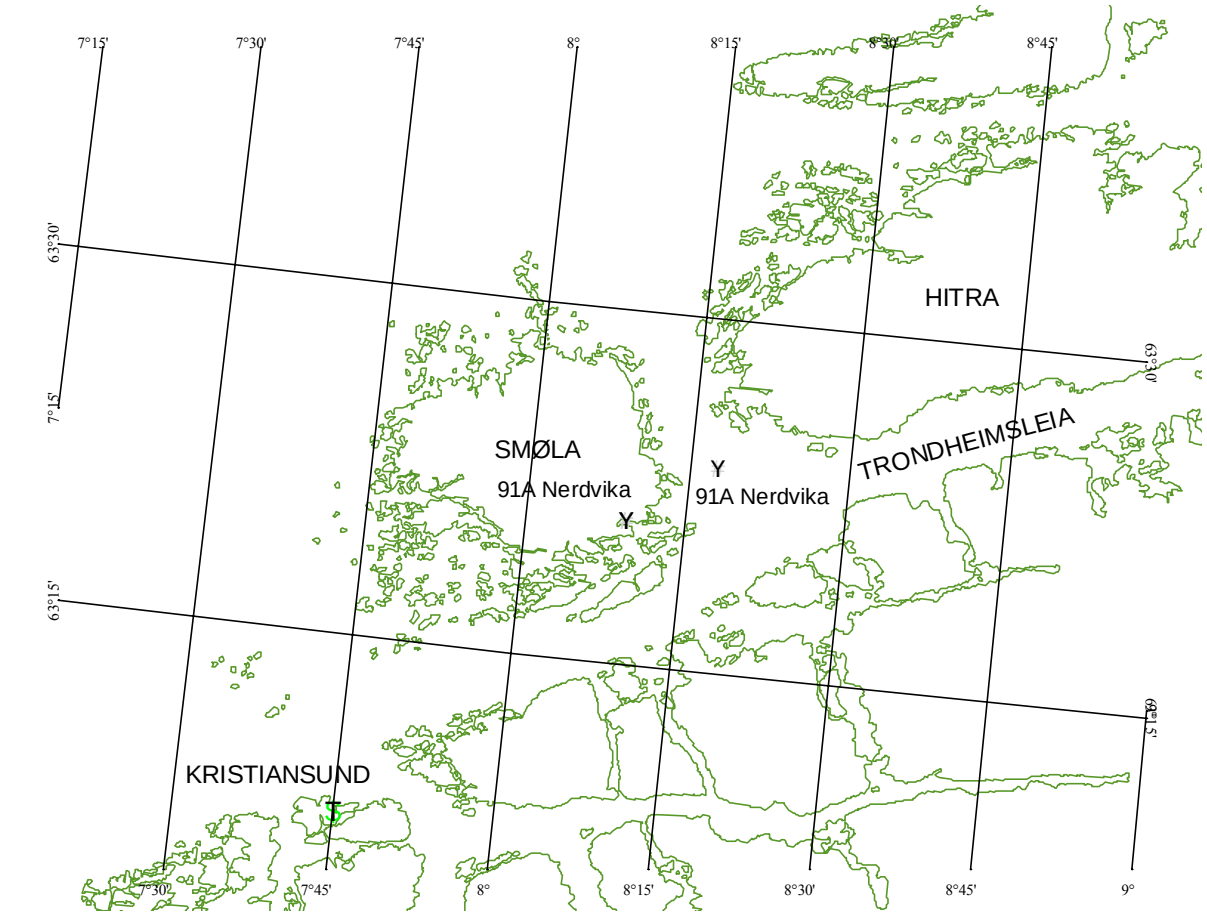
MAP 9


KRISTIANSUND
MOLDE
I912 Honnhammer
TINGVOLLS-
FJORD
I913 Fjøseid
I911 Horvika
SUNNDALS-
FJORD
SUNNDALSØRA
7°
7°15'
7°30'
7°45'
8°
8°15'
8°30'
63°
62°45'

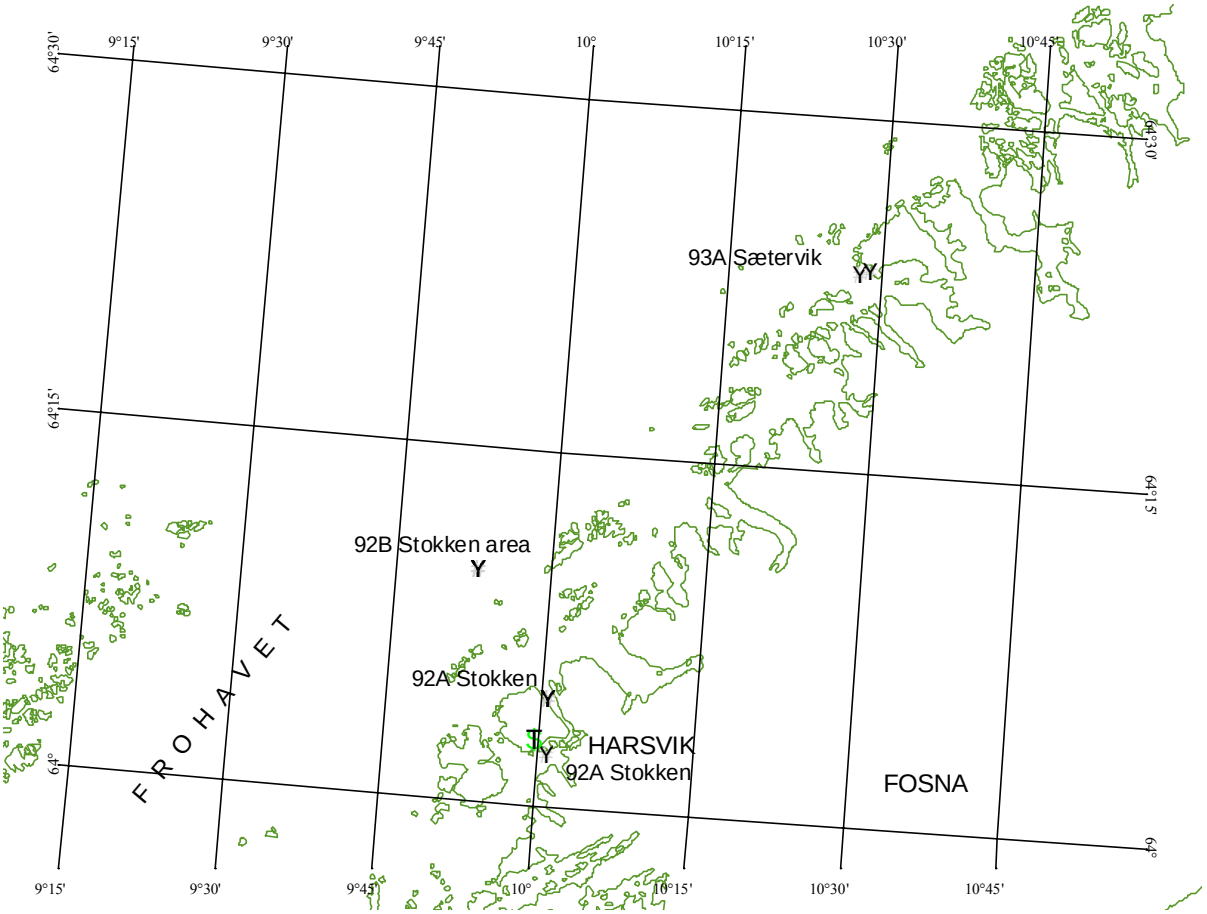
MAP 10


88A Rødberg
TRONDHEIMSFJORD
87A Ingdalsbukt
86A Geitnes
82A Flakk
80A/I80A
Østmarknes
TRONDHEIM
80A
Biologisk stasjon
ORKDALSFJORD
83A
Frøsetskjær
85A Geitstrand
HOMMELVIK
84A Trossavika
9°30'
9°45'
10°
10°15'
10°30'
10°45'
11°
63°30'
63°15'

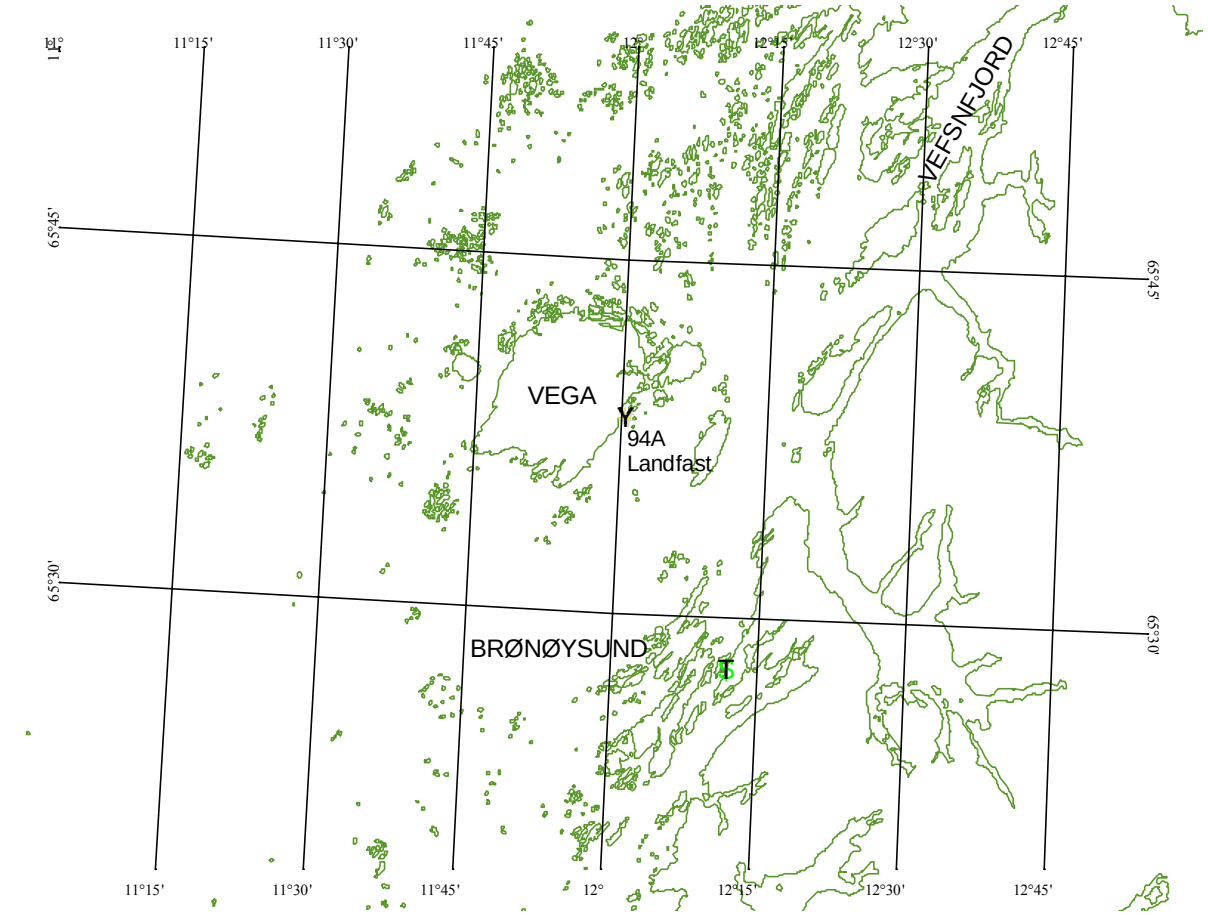
MAP 11


7°15'
7°30'
7°45'
8°
8°15'
8°30'
8°45'
63°30'
63°15'
HITRA
SMØLA
91A Nerdvika
91A Nerdvika
TRONDHEIMSLEIA
KRISTIANSUND
7°30'
7°45'
8°
8°15'
8°30'
8°45'
9°

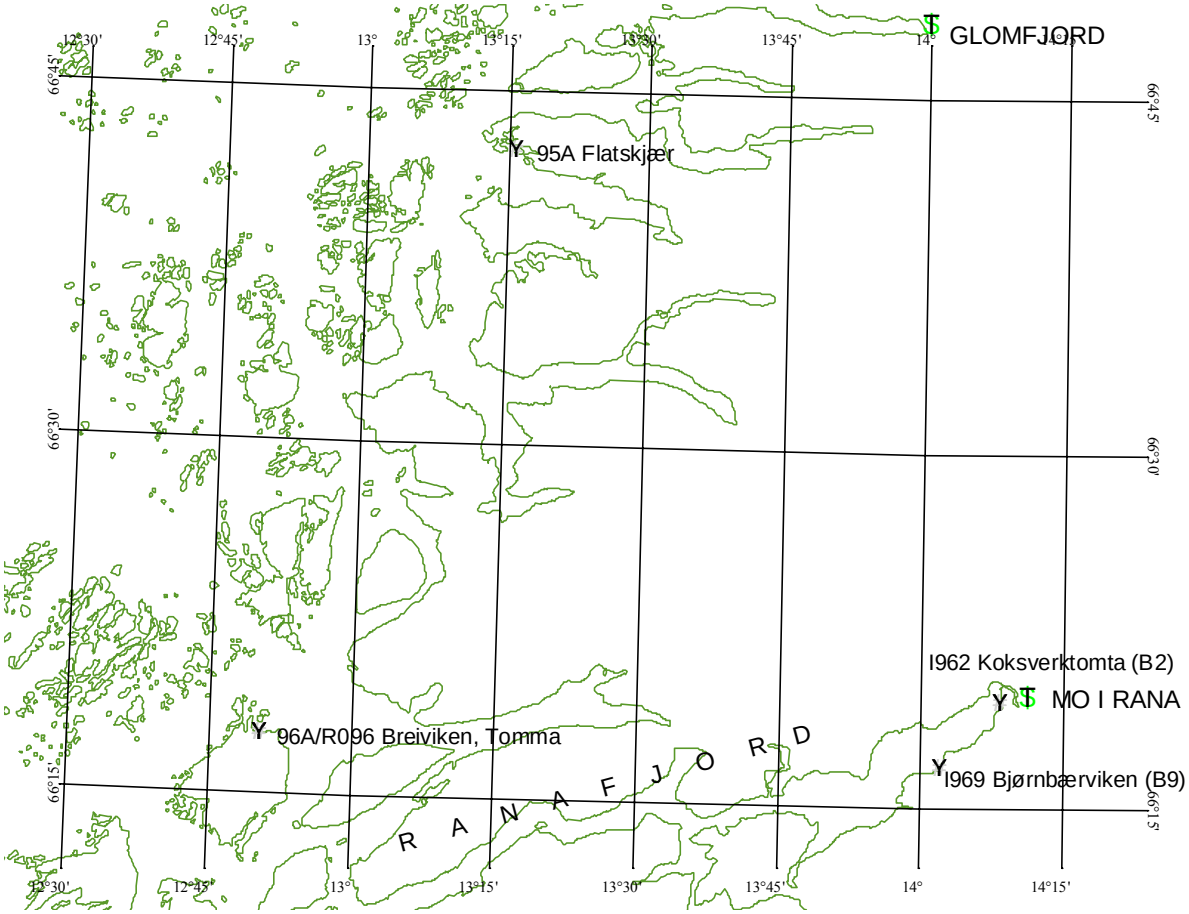
MAP 12


9°15'
9°30'
9°45'
10°
10°15'
10°30'
10°45'
64°30'
64°15'
64°
93A Sætervik
92B Stokken area
92A Stokken
HARSVIK
92A Stokken
FOSNA
FROHAVET
9°15'
9°30'
9°45'
10°
10°15'
10°30'
10°45'

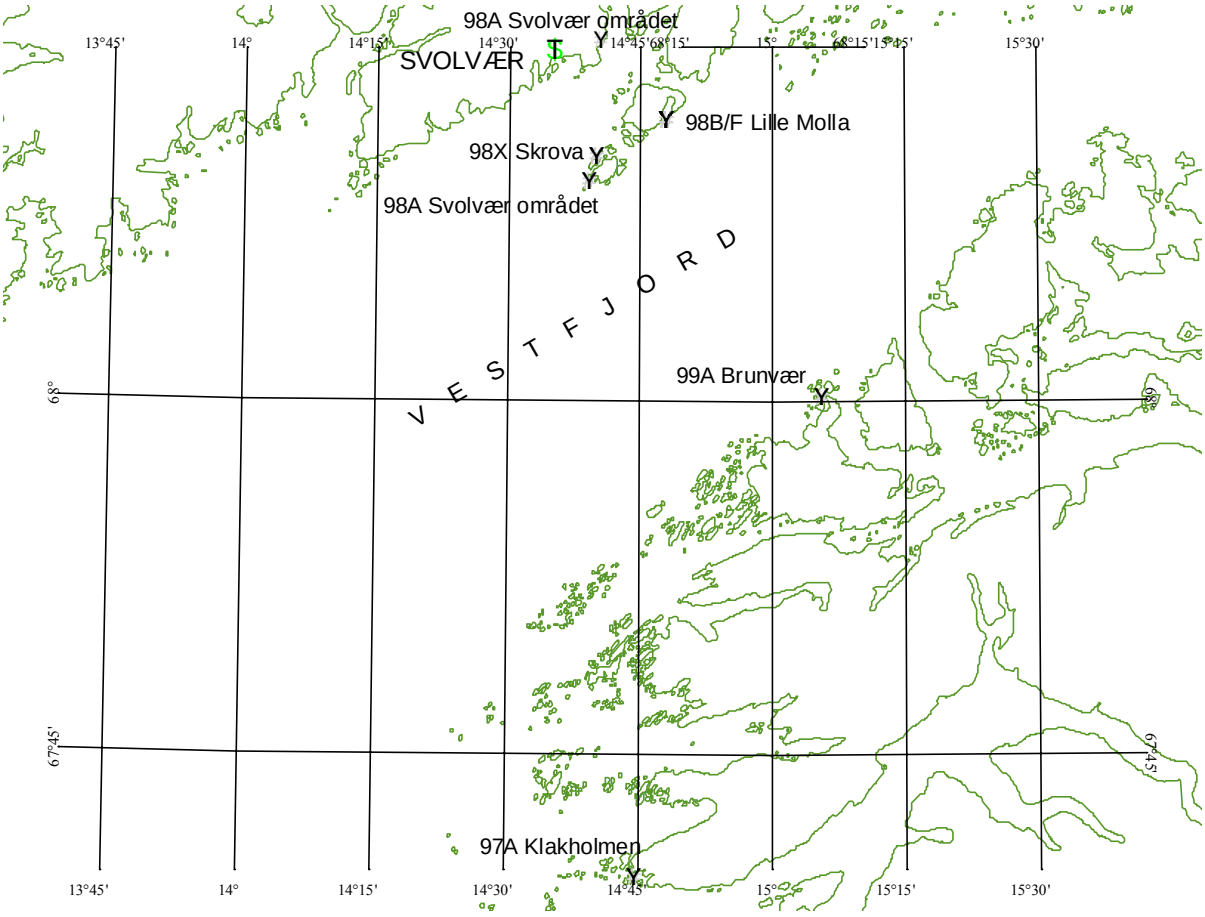
MAP 13


VEFSNFJORD
VEGA
94A
Landfast
BRØNNØYSUND
11°15'
11°30'
11°45'
12°
12°15'
12°30'
12°45'
65°45'
65°30'

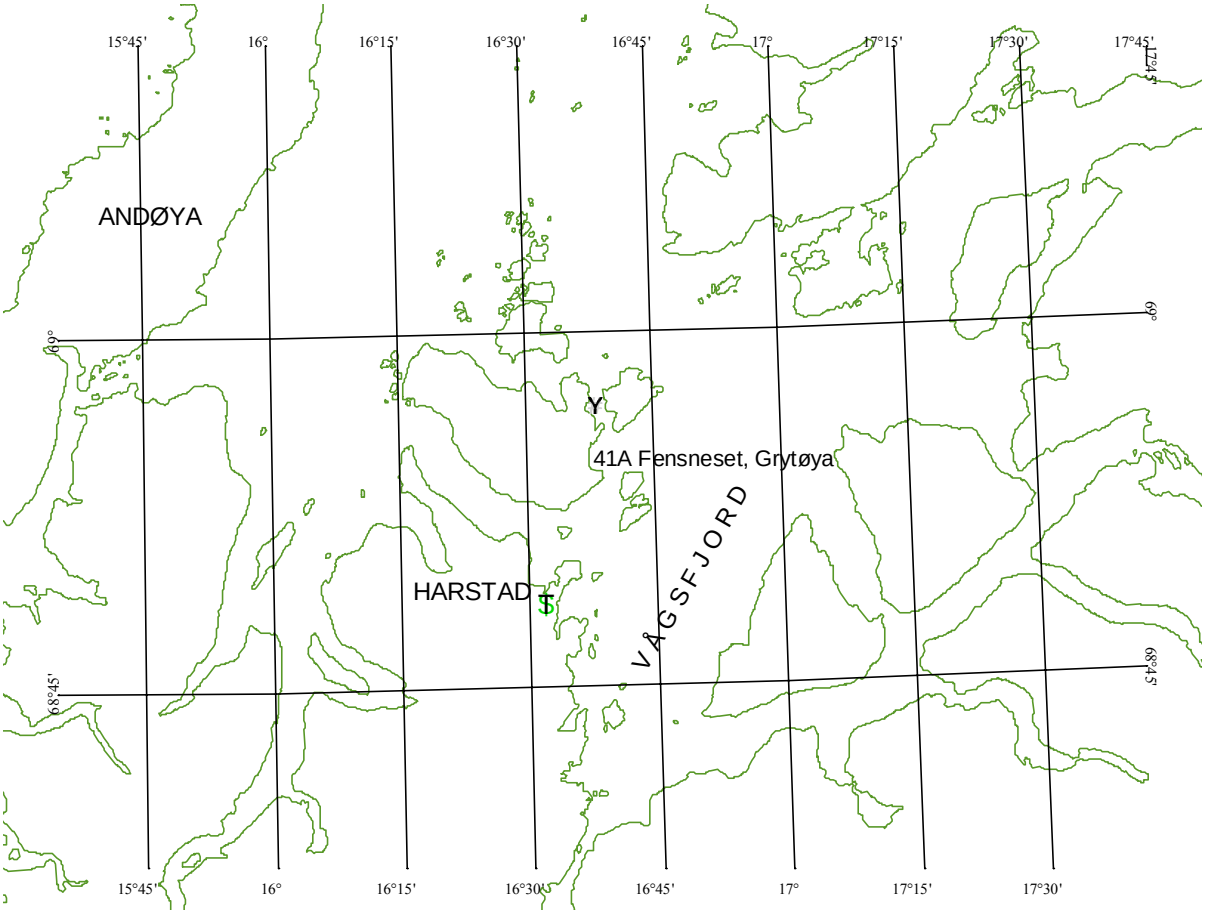
MAP 14


GLOMFJORD
95A Flatskjær
I962 Koksverktomta (B2)
MO I RANA
96A/R096 Breiviken, Tomma
I969 Bjørnbærviken (B9)
RANAFJORD
12°30'
12°45'
13°
13°15'
13°30'
13°45'
14°
14°15'
66°45'
66°30'
66°15'

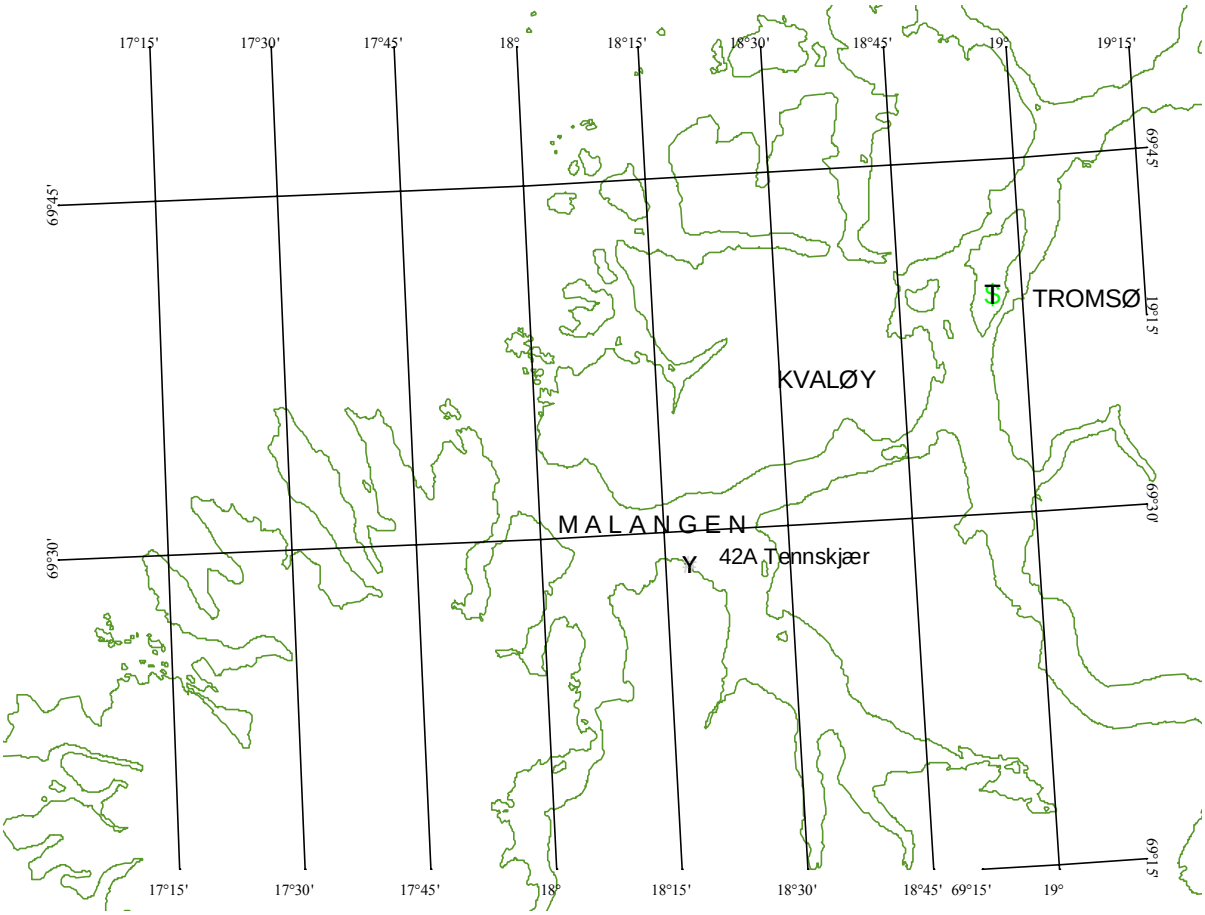
MAP 15


98A Svolvær området
SVOLVÆR
98B/F Lille Molla
98X Skrova
98A Svolvær området
VESTFJORD
99A Brunvær
97A Klakholmen
13°45'
14°
14°15'
14°30'
14°45'
15°
15°15'
15°30'
68°
67°45'

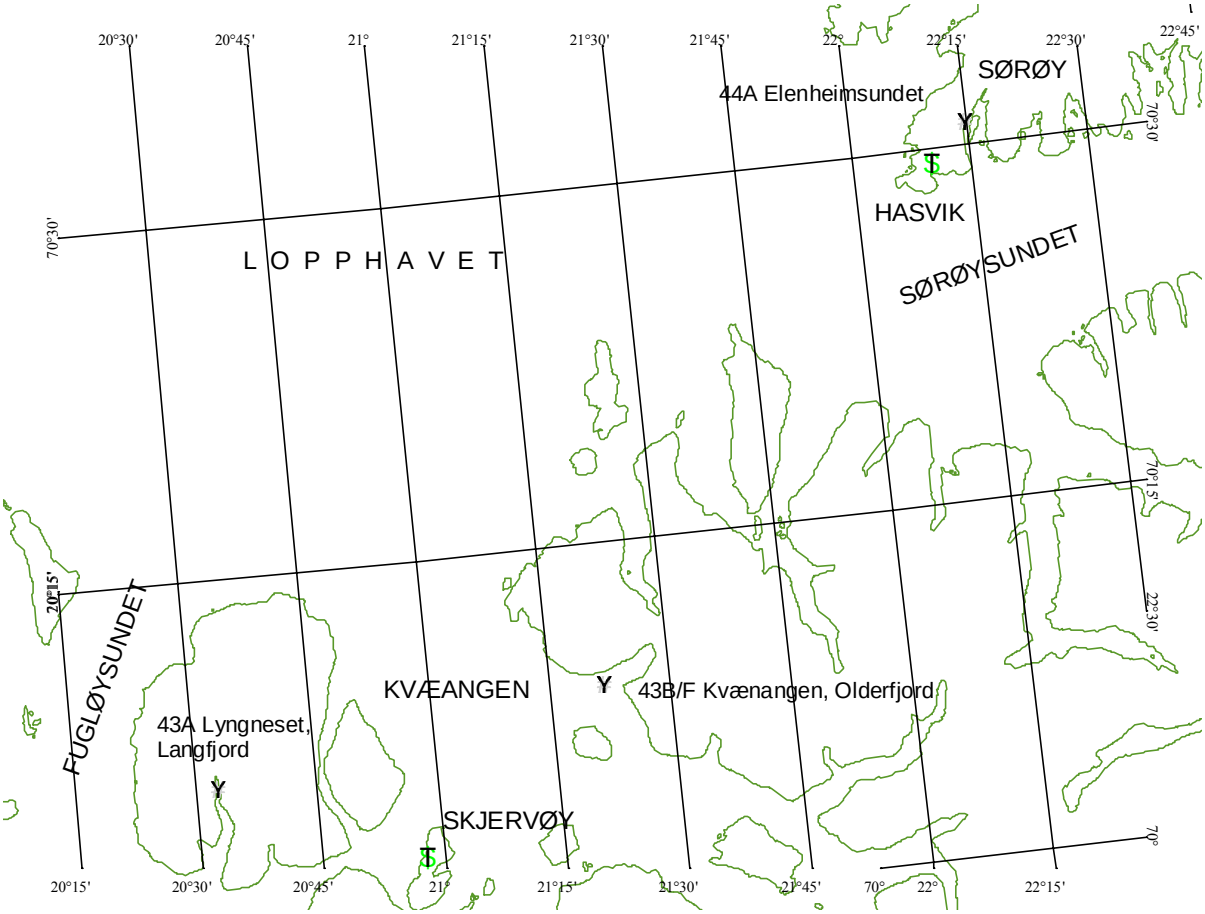
MAP 16


ANDØYA
41A Fensneset, Grytøya
HARSTAD
VÅGSFJORD
15°45'
16°
16°15'
16°30'
16°45'
17°
17°15'
17°30'
17°45'
69°
68°45'

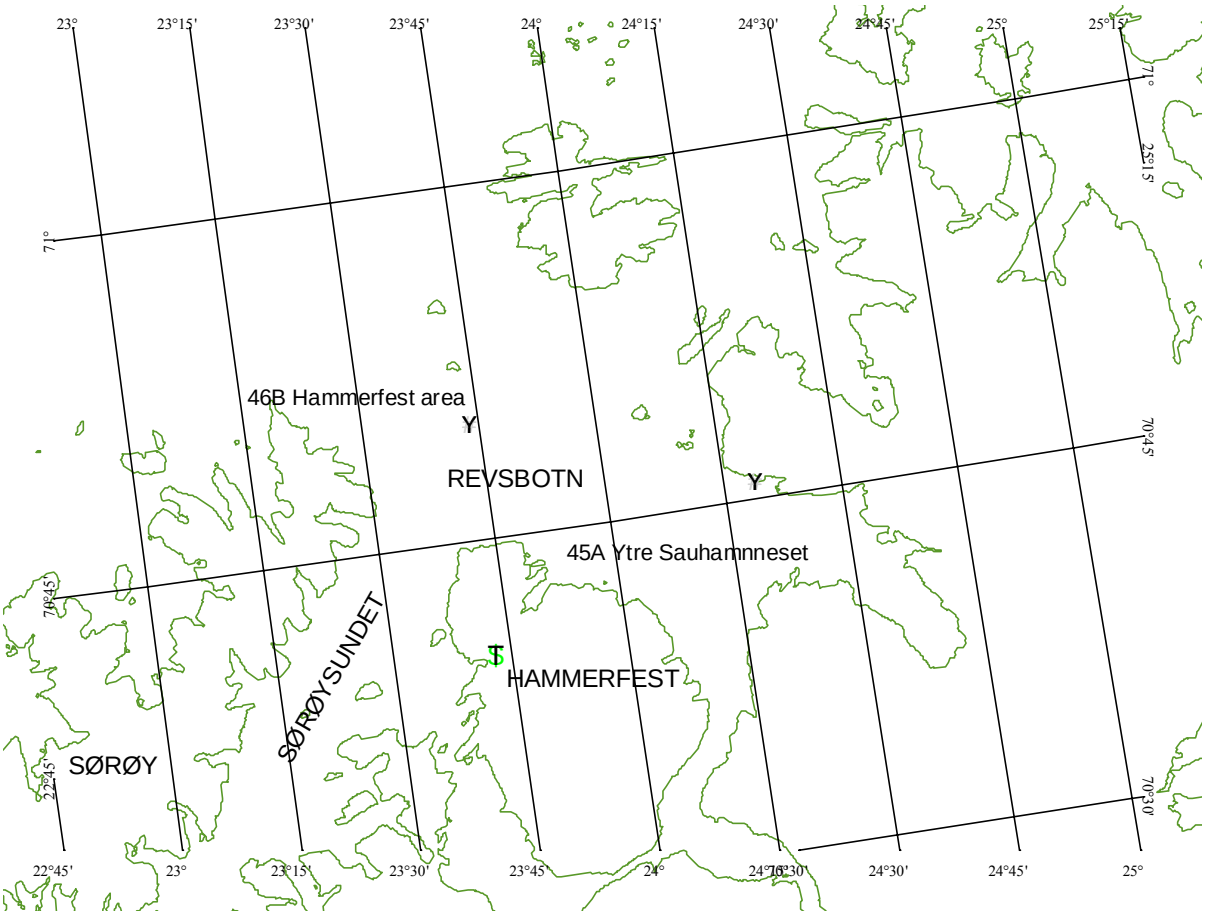
MAP 17


17°15'
17°30'
17°45'
18°
18°15'
18°30'
18°45'
19°
19°15'
69°45'
69°30'
69°15'
TROMSØ
KVALØY
MALANGEN
42A Tennskjær

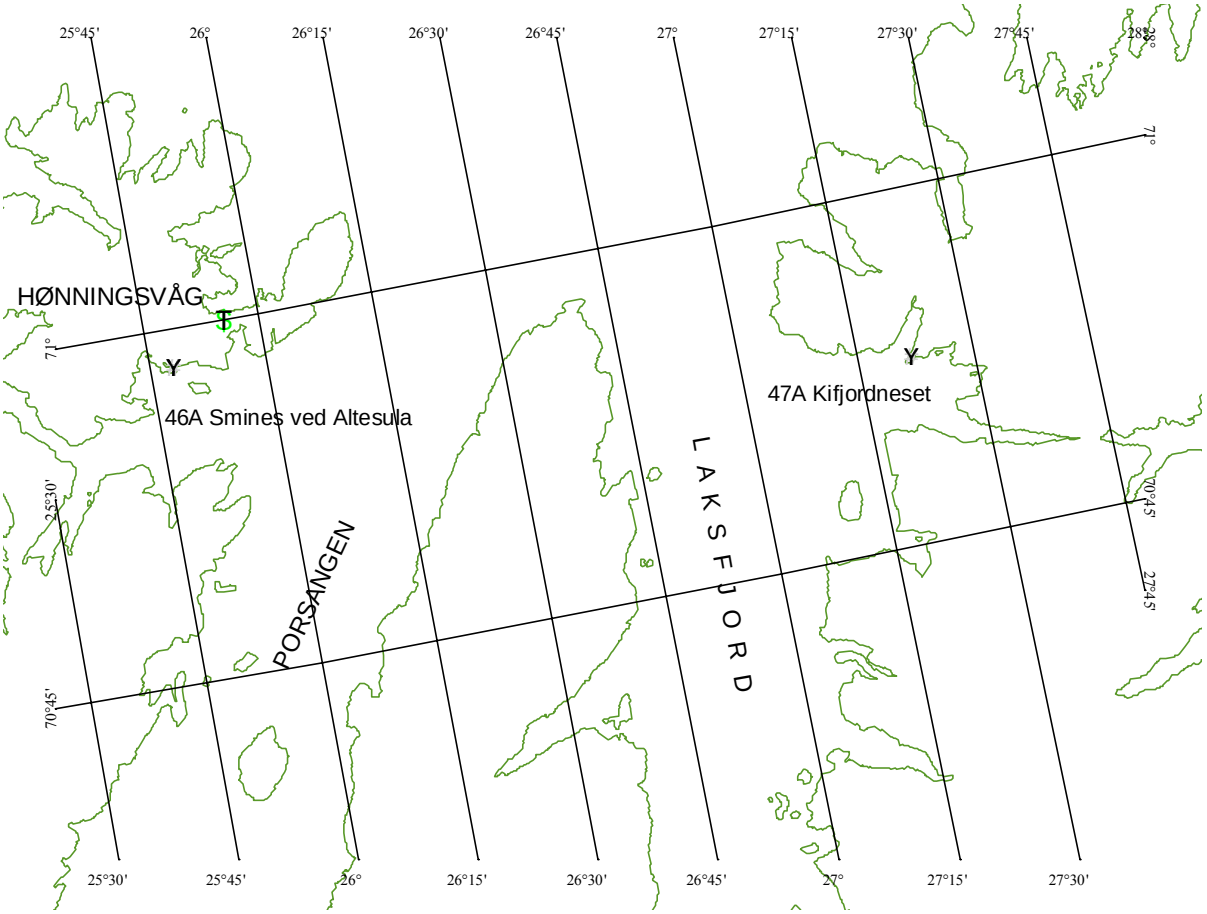
MAP 18


20°30'
20°45'
21°
21°15'
21°30'
21°45'
22°
22°15'
22°30'
22°45'
70°30'
70°15'
70°
20°15'
SØRØY
44A Elenheimsundet
HASVIK
LOPPHAVET
SØRØYSUNDET
FUGLØYSUNDET
KVÆANGEN
43B/F Kvænangen, Olderfjord
43A Lyngneset, Langfjord
SKJERVØY

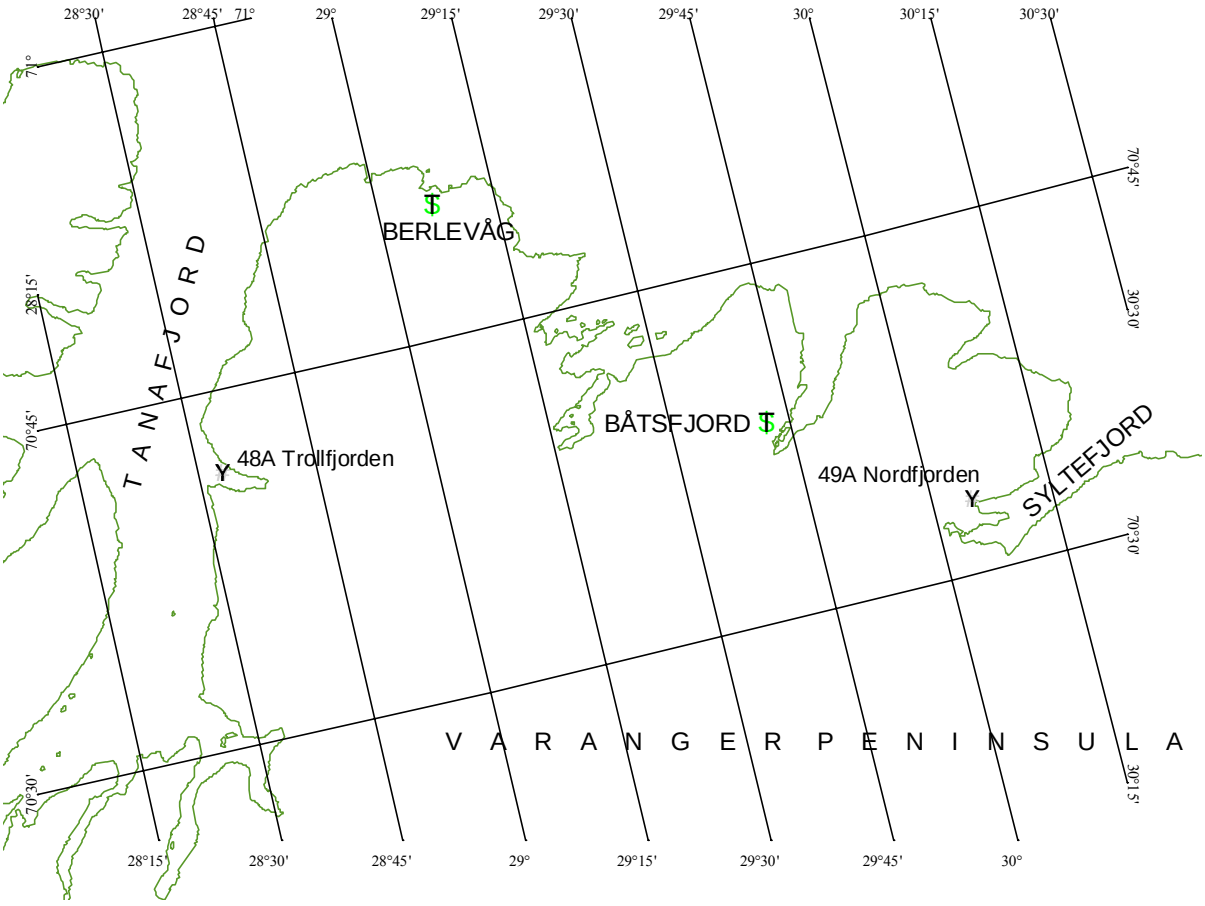
MAP 19


46B Hammerfest area
REVSBOTN
45A Ytre Sauhamnneset
HAMMERFEST
SØRØYSUNDET
SØRØY

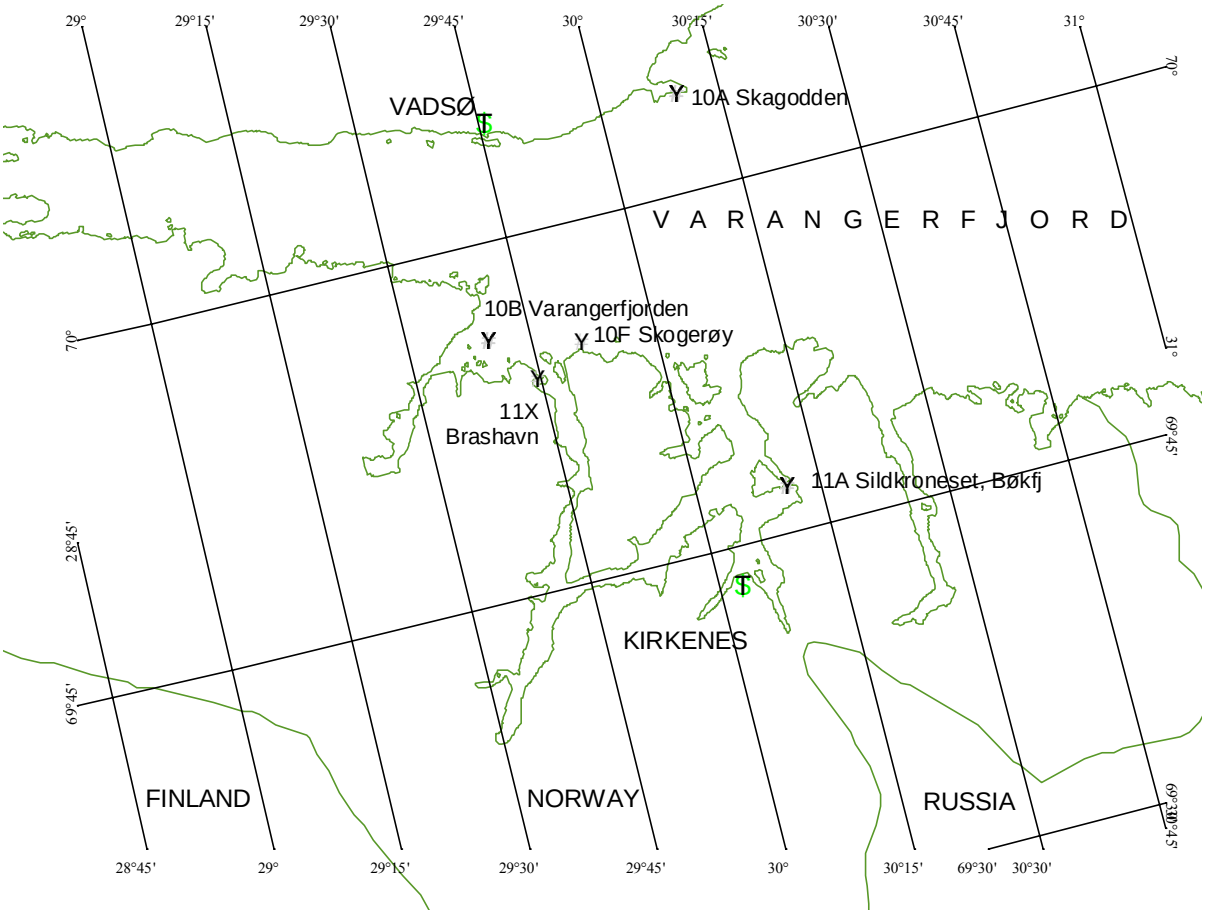
MAP 20


HØNNINGSVÅG
46A Smines ved Altesula
47A Kifjordneset
PORSANGEN
LAKSFJORD

MAP 21


BERLEVÅG
TANAFJORD
48A Trollfjorden
BÅTSFJORD
49A Nordfjorden
SYLTEFJORD
V A R A N G E R P E N I N S U L A

MAP 22


VADSØ
10A Skagodden
V A R A N G E R F J O R D
10B Varangerfjorden
10F Skogerøy
11X
Brashavn
11A Sildkroneset, Bøkfj
KIRKENES
FINLAND
NORWAY
RUSSIA

MAP 23

Appendix G.
Overview of materials and analyses 1999

Station positions are shown on maps in Appendix F. .

Appendix G. 1. Sampling and analyses for 1999, L-liver, F-fillet. (See Appendix G. 2 for descriptions of codes for analysis (M0, M1, M3, M4, M5, C2, C4, A1, G1), fish (P, F, D, L, M, C) and counts). Analytical overview for liver (-L) or fillet (-F) tissue is distinguished.

JAMP area	STATION	WATER	SEDIMENT				MUSSEL/			OTHER		FISH							
												FLAT- (P,F,D,M)				COD- (C)			
		M0	M1	C4	A1	G1	M3	C2	A1	M3	C2	-L -F	M4 M5	C2 C2	A1 A1	-L -F	M4 M5	C2 C2	A1 A1
26	**OSLOFJORD AREA CENTRAL**, Oslofjord proper																		
26	30A Gressholmen	1	.	.	.	.	3	3	.	.	.	.	.	.	.	.	.	.	.
26	30B Oslo city Area / Håøya	.	.	.	.	.	.	.	.	.	.	.	.	.	.	C-L	25	25	.
		.	.	.	.	.	.	.	.	.	.	.	.	.	.	C-F	25	5B	.
26	31A Solbergstrand	1	.	.	.	.	3	3	.	.	.	.	.	.	.	.	.	.	.
26	33B Sande, east side	.	.	.	.	.	.	.	.	.	.	F-L	5B	5B	.	.	.	.	.
		.	.	.	.	.	.	.	.	.	.	F-F	5B	5B	.	.	.	.	.
26	35A Mølen	1	.	.	.	.	3	3	.	.	.	.	.	.	.	.	.	.	.
26	36A Færder	1	.	.	.	.	3	3	.	.	.	.	.	.	.	.	.	.	.
26	36B Færder area	.	.	.	.	.	.	.	.	.	.	.	.	.	.	C-L	25	25	.
		.	.	.	.	.	.	.	.	.	.	.	.	.	.	C-F	25	5B	.
20	36F Færder area	.	.	.	.	.	.	.	.	.	.	D-L	5B	5B	.	.	.	.	.
		.	.	.	.	.	.	.	.	.	.	D-F	5B	5B	.	.	.	.	.
26	**OSLOFJORD AREA WEST**, outer Sandefjord-Langesundsfjord																		
26	71A Bjørkøya	1	.	.	.	.	3	3	.	.	.	.	.	.	.	.	.	.	.
	ARENDAL AREA																		
	76A Risøy	1	.	.	.	.	3	3	.	.	.	.	.	.	.	.	.	.	.
	LISTA AREA																		
	15A Ullerø area	1	.	.	.	.	3	3	.	.	.	.	.	.	.	.	.	.	.
	15B Ullerø area	.	.	.	.	.	.	.	.	.	.	.	.	.	.	C-L	25	25	.
		.	.	.	.	.	.	.	.	.	.	.	.	.	.	C-F	25	5B	.
	15F Ullerø area	.	.	.	.	.	.	.	.	.	.	D-L	5B	5B	.	.	.	.	.
		.	.	.	.	.	.	.	.	.	.	D-F	5B	5B	.	.	.	.	.
	BØMLO-SOTRA AREA																		
	21F Kyrping (Åkrafjord 1999)	.	.	.	.	.	.	.	.	.	.	P-L	5B	5B	.	.	.	.	.
		.	.	.	.	.	.	.	.	.	.	P-F	5B	5B	.	.	.	.	.
	22A Espevær, west	1	.	.	.	.	3	3	.	.	.	.	.	.	.	.	.	.	.
	23B Karihavet	.	.	.	.	.	.	.	.	.	.	.	.	.	.	C-L	25	25	.
		.	.	.	.	.	.	.	.	.	.	.	.	.	.	C-F	25	5B	.
62	**HARDANGERFJORDEN**																		
62	69A Lille Terøy	1	.	.	.	.	3[1]	3[1]	.	.	.	.	.	.	.	.	.	.	.
62	67B Strandebarm											ML	5B	5B	.	C-L	25	25	.
		.	.	.	.	.	.	.	.	.	.	MF	5B	5B	.	C-F	25	5B	.
62	65A Vikingneset	1	.	.	.	.	3[1]	3[1]	.	.	.	.	.	.	.	.	.	.	.
62	63A Ranaskjær	1	.	.	.	.	3[1]	3[1]	.	.	.	.	.	.	.	.	.	.	.
63	**SØRFJORDEN**																		
63	52A Eitrheimsneset	1	.	.	.	.	3[1]	3[1]	.	.	.	.	.	.	.	.	.	.	.
63	53B Inner Sørfjord	.	.	.	.	.	.	.	.	.	.	P-L	5B	5B	.	C-L	25	25	.
		.	.	.	.	.	.	.	.	.	.	P-F	5B	5B	.	C-F	25	5B	.
63	56A Kvalnes	1	.	.	.	.	3[1]	3[1]	.	.	.	.	.	.	.	.	.	.	.
63	57A Krossanes	1	.	.	.	.	3[1]	3[1]	.	.	.	.	.	.	.	.	.	.	.

Appendix G. 1 (cont.)

JAMP area	STATION	WATER	SEDIMENT				MUSSEL/			OTHER		FISH							
												FLAT- (P,F,D,M)				COD- (C)			
		M0	M1	C4	A1	G1	M3	C2	A1			-L -F	M4 M5	C2 C2	A1 A1	-L -F	M4 M5	C2 C2	A1 A1
	LOFOTEN AREA																		
98A	Husvågen (1997)	1	.	.	.	.	3	3	.	.	.	.	.	.	.	.	.	.	.
98B	Lille Molla	.	.	.	.	.	.	.	.	.	.	.	.	.	.	C-L	25	25	.
		.	.	.	.	.	.	.	.	.	.	.	.	.	.	C-F	25	5B	.
98F	Lille Molla	.	.	.	.	.	.	.	.	.	.	D-L	5B	5B	.	.	.	.	.
		.	.	.	.	.	.	.	.	.	.	D-F	5B	5B	.	.	.	.	.
	VARANGER PENINSULA AREA																		
10A	Skagodden	1	.	.	.	.	3	3	.	.	.	.	.	.	.	.	.	.	.
10B	Varangerfjorden	.	.	.	.	.	.	.	.	.	.	.	.	.	.	C-L	25	25	.
		.	.	.	.	.	.	.	.	.	.	.	.	.	.	C-F	25	5B	.
10F	Varangerfjorden	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
11X	Brashavn (1997)	1	.	.	.	.	3	3	.	.	.	.	.	.	.	.	.	.	.

NOTES:
[1]) Parallel samples collected for analysis that were frozen directly and not depurated prior to cleaning

Appendix G. 2: Key to analysis codes and sample counts used in Appendix G. 1.

ANALYSIS CODES:

Code	Analyses
M0	suspended matter
M1	Hg, Cd, Cu, Pb, Zn, Li (normalising element) total organic carbon (TOC)
M3	Hg, Cd, Cu, Pb, Zn
M4	Cd Cu Pb Zn (for fish liver)
M5	Hg (for fish fillet)
C1	CB-28,-52,-101,-105,-118,-138,-153,-156,-180, 209, 5-CB, OCS, a+gHCH, HCB, DDE, DDD, EPOCl (optional), dry weight percent
C2	CB-28,-52,-101,-105,-118,-138,-153,-156,-180, 209, 5-CB, OCS, a+gHCH, HCB, DDE, DDD, EPOCl (optional), fat and dry weight percent
A1	PAH
G1	Sediment core geological dating

SAMPLE COUNT CODES:

Medium	Count	Explanation
SEAWATER	1	sample for suspended matter determination
SEDIMENT	17	17 samples for metal analyses; two cores each with samples from 0-1, 1-2, 2-4, 4-6, 6-10, 10-15, 15-20 cm and deepest 5 cm slice plus one core with sample from 0-1 cm.
	4	4 samples for PCB or PAH analyses; two each cores with samples from 0-1cm and deepest 5cm slice.
	3	3 samples for metal analyses; three cores each with samples from 0-1cm.
MUSSEL	3/6	3 size groups (2-3, 3-4, 4-5 cm) each a bulk of ca.50 individuals and/or 1 size group (3-4 or 4-5 cm), 3 parallel samples each a bulk of 20 individuals.
	1/2	1 size group (2-3 or 3-4 cm), 2 parallel samples each a bulk of 50 individuals.
SHRIMP	2	2 samples of 100 individuals (edible size)
FISH		The number of individual fish or bulk samples of fish (-B) for analyses is shown. Bulk samples of fish consist of 5 fish. The five longest fish make up one bulk sample, the next five longest fish make up the another bulk sample and so on. The letter following the number indicates the fish type: D=dab, F=flounder, L=lemon sole, M=megrim, P=plaice, W=witch and C=cod.

Appendix H.
Temporal trend analyses of contaminants in biota 1981-1999

Sorted by contaminant, species and area/station:

Cadmium (Cd)
Copper (Cu)
Mercury (Hg)
Lead (Pb)
Zinc (Zn)
CB-153
DDEPP (ppDDE)
γHCH (HCHG)
HCB

MYTI EDU - Blue Mussel (*Mytilus edulis***)**
GADU MOR - Atlantic cod (*Gadus morhua***)**
LEPI WHI - Megrim (*Lepidorhombus whiff-iagonis***)**
LIMA LIM - Dab (*Limanda limanda***)**
PLAT FLE - Flounder (*Platichthys flesus***)**
(s) - Small fish
(l) - Large fish
SB - Soft body tissue
LI - Liver tissue
MU - Muscle tissue

OC	**Overconcentration expressed as quotient of median of last year and "high background" ("?" missing background value)**	
TRND	**trend**	
	D-	**Significant linear trend, downward**
	U-	**Significant linear trend, upward**
	--	**No significant trend**
	-?	**No significant linear trend, systematic non-linear trend can not be tested because of insufficient data (<6 years)**
	-Y	**No significant linear trend, but a systematic non-linear trend**
	DY or UY	**Significant linear trend (downward or upward) and a significant non-linear trend. This is considered the same as "-Y"**
	SIZE length effect (mercury in fillet)	
	L	**Significant difference in concentration levels but pattern of variation same**
	D	**As "L" but pattern of variation significantly different**
	-	**No significant difference between "small" and "large" fish**
U95+3	**Projected upper 95% confidence interval in three years expressed as quotient of value and "high background" ("?" if missing background or if number of years is less than seven)**	
POWER	**Estimated number of years to detect a hypothetical situation of 10% trend a year with a 90% power**	

Annual median concentration of Cd (ppm)

St	Species	Tissue	Base	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	ANALYSIS OC	TRND	UP95+3	POWER
30A	MYTI EDU	SB	d.wt				1.1	0.81	1.4	0.6	0.61	0.74	0.77	0.77	1.1	1.3	1.2	0.78	0.8	0.86	1.3	1.2	no	--	1.2	11
31A	MYTI EDU	SB	d.wt			1.4	1.3	0.89	1.9	0.4	0.43	0.41	0.72	0.73	0.91	0.93	0.78	1.3	0.79	0.85	1.1	1.2	no	--	1.3	13
35A	MYTI EDU	SB	d.wt			1.3	0.95	1.2	1.3	0.52	0.66	0.65	0.93	1.1	1.3	1.1	0.96	0.89	0.77	0.97	1.1	1.5	no	--	1.5	10
36A	MYTI EDU	SB	d.wt			0.85	1.2	0.84	1.4	0.59	0.56	0.5	0.41	1.2	1.1	0.9	1.2	1.2	1.6	1.8	0.97	1	no	--	no	12
71A	MYTI EDU	SB	d.wt			2.5	2	1.4	2	0.98	2.1	2	0.97	1.1	1.7	1.9	2	2.3	1.5	2.4	1.5	1.8	no	--	1.4	12
76A	MYTI EDU	SB	d.wt										0.64	0.86	0.96	1.1			1.2	1.2	1.2	1.3	no	UY	no	6
15A	MYTI EDU	SB	d.wt										0.5	0.83		1.2	0.79	1.4	1.2	1.1	1	0.84	no	--	no	10
51A	MYTI EDU	SB	d.wt							43	58							37	25	5.4	10	35	17.3	--	32.5	21
52A	MYTI EDU	SB	d.wt									94	10	80	43	15	8.7	20	18	13	9.1	11	5.7	--	21.2	21
56A	MYTI EDU	SB	d.wt							56	54	98	45	69	52	60	11	31	20	29	8.7	26	12.9	--	23.7	17
57A	MYTI EDU	SB	d.wt							21	43	37	26	33	32	15	12	12	8.5	14	5	14	6.8	D-	9.3	14
63A	MYTI EDU	SB	d.wt							47	10	19	30	35	18	7.8	4.2	8.2	5.4	6.6	4.4	6.9	3.4	D-	8.5	17
65A	MYTI EDU	SB	d.wt							15	6	8.3	15	24	5.1	7.7	3	5.4	3.5	4.3	1.7	3.8	1.9	--	3.2	17
69A	MYTI EDU	SB	d.wt												4.3	2.4	2.1	2.9	3.2	3.5	1.6	3.8	1.9	--	3.6	14
22A	MYTI EDU	SB	d.wt										0.53	1.1	1.1	0.84	1	1.4	1.1	1	0.85	1.3	no	--	no	11
82A	MYTI EDU	SB	d.wt				1.4	1.2	2.3	0.99	0.4	1.3		1.2	1.2	1.1		0.98	1.2				no	--	1.5	15
84A	MYTI EDU	SB	d.wt				1.4	1.9	2.4	2.1	0.96	1.2		1.8	2.1	1.6		1.6	1.3				no	--	1.3	12
87A	MYTI EDU	SB	d.wt				0.97	1	1.9	0.77	0.69	0.76		0.87	0.98	0.93		1.1	1.3				no	--	1.5	12
91A	MYTI EDU	SB	d.wt												1.7	1.3	1.8						no	-?	?	11
92A	MYTI EDU	SB	d.wt												1.1	0.54	0.94	0.74	0.69	0.72			no	--	no	11
98A	MYTI EDU	SB	d.wt												1.1	1.1				0.85	1.6	2.2	1.1	-?	?	13
98X	MYTI EDU	SB	d.wt														0.71	0.69	0.78				no	-?	?	6
41A	MYTI EDU	SB	d.wt														1.9	2.9	1.6	1.9			no	-?	?	12
43A	MYTI EDU	SB	d.wt														3.5	4.3		3.9			1.9	-?	?	8
44A	MYTI EDU	SB	d.wt														1.7	2.7	2	1.5			no	-?	?	12
46A	MYTI EDU	SB	d.wt														2.7	2.1	2.7				1.4	-?	?	10
48A	MYTI EDU	SB	d.wt														1.4	1.3	1.4				no	-?	?	<=5
10A	MYTI EDU	SB	d.wt														1.7	1.7	2.3	1.1	2.3	1.6	no	--	4.1	12
11A	MYTI EDU	SB	d.wt														1.3	1.3	1.1	1.6			no	-?	?	9
30B	GADU MOR	LI	w.wt				0.01	0.05	0.062	0.071	0.022	0.027	0.035	0.027	0.1	0.064	0.063	0.049	0.045	0.045	0.11	0.17	1.7	--	8.3	17
36B	GADU MOR	LI	w.wt	0.078	0.06	0.22	0.07	0.05	0.14	0.061	0.031	0.028	0.023	0.01	0.021	0.034	0.021	0.042	0.033	0.074	0.036	0.065	no	DY	2.4	16
15B	GADU MOR	LI	w.wt										0.026	0.009	0.025	0.016	0.014	0.016	0.024	0.031	0.03	0.026	no	--	1	14
53B	GADU MOR	LI	w.wt						0.66		0.058	0.093	0.045	0.15	0.21	0.038		0.007	0.18	0.14	0.23	0.73	7.3	--	551.8	>25
67B	GADU MOR	LI	w.wt							0.14	0.052	0.047	0.069	0.077	0.051	0.11	0.099	0.033	0.11	0.28	0.018	0.071	no	--	2.2	22
23B	GADU MOR	LI	w.wt										0.022	0.024	0.02	0.025	0.015	0.026	0.014	0.029	0.025	0.033	no	--	no	11
84B	GADU MOR	LI	w.wt				0.13	0.095	0.069		0.029												no	D?	?	6
92B	GADU MOR	LI	w.wt													0.036	0.029	0.022	0.066				no	-?	?	16
98B	GADU MOR	LI	w.wt												0.069	0.15	0.025	0.11	0.33	0.064	0.047	0.039	no	--	1.6	23
43B	GADU MOR	LI	w.wt														0.17	0.18	0.097				no	-?	?	12
10B	GADU MOR	LI	w.wt														0.23	0.19	0.095	0.13	0.12	0.14	1.4	--	2.9	11
33B	PLAT FLE	LI	w.wt			0.19		0.19	0.18	0.25	0.061	0.11	0.23	0.2	0.16	0.18	0.087	0.091	0.11	0.11	0.11	0.13	no	--	no	14
53B	PLAT FLE	LI	w.wt								2.2	1.5	1.5	1.7	1.8	0.79		0.13	2.5	0.89	1.5	2.6	8.5	--	124.8	22
36F	LIMA LIM	LI	w.wt										0.11	0.11	0.23	0.29	0.14	0.15	0.14	0.12	0.2	0.23	no	--	1.8	12
15F	LIMA LIM	LI	w.wt													0.099	0.14	0.13	0.15	0.076	0.18	0.19	no	--	1.7	13
22F	LIMA LIM	LI	w.wt										0.095	0.091	0.13		0.17	0.12					no	-?	?	9
98F	LIMA LIM	LI	w.wt														0.98	0.18	0.23				no	-?	?	21
67B	LEPI WHI	LI	w.wt			0.18				0.18	0.11	0.066	0.2	0.085	0.1	0.12	0.3	0.26	0.2	0.097	0.033	0.051	m	--	m	15

Annual median concentration of CU (ppm)

St	Species	Tissue	Base	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	ANALYSIS OC	TRND	UP95+3	POWER
30A	MYTI EDU	SB	d.wt				4.6		7.5	5	5.5	6	10	10	5.8	6.7	8.6	6.9	7.7	9.5	7.7	8	no	--	1.4	10
31A	MYTI EDU	SB	d.wt			7	6.6			4.4	4.5	4.5	9	11	5.5	5.7	6.2	7.3	6.6	6.1	8.1	7.5	no	--	1.4	11
35A	MYTI EDU	SB	d.wt			6.3	3.6		8.1	4.9	4.6	5.3	8	10	6.6	6.3	6.6	6.4	6.9	6.8	7.2	7.1	no	--	1.2	11
36A	MYTI EDU	SB	d.wt			6.3	3.6		6.1	4.5	4.9	4.3	5.5	9.2	5.2	5.5	5.6	7.7	9.1	6.9	6.8	6.2	no	--	no	10
71A	MYTI EDU	SB	d.wt			8.5	5.2			6.1	8.4	7	8.3	10	7.4	7.9	7.2	8.1	7.7	9.4	7.5	7.6	no	--	1.1	9
76A	MYTI EDU	SB	d.wt										8.5	11	5.6	5.6			6.6	7.8	9.1	10	1	--	2.3	10
15A	MYTI EDU	SB	d.wt										5.7	7.2		5.5	5.3	5.3	7.3	6.1	7.6	7.3	no	--	1.3	8
51A	MYTI EDU	SB	d.wt							7.1	6.1							10	10	7.4		8.2	no	--	no	9
52A	MYTI EDU	SB	d.wt									8.4	7.5	72	9.3	8.4	7	7	6.3	7.7	6.5	5.5	no	--	2.4	20
56A	MYTI EDU	SB	d.wt							8.1	7.9	8.8	5.4	7.5	7.4	9.1	6.4	7.7	6.6	7.8	7.2	8.2	no	--	1.2	8
57A	MYTI EDU	SB	d.wt							8.2	6.3	6	6.2	7.3	6.6	6.8	6.4	5.6	5.5	7	6.9	6.4	no	--	no	7
63A	MYTI EDU	SB	d.wt							9.8	6.2	5.1	6.8	11	6.3	6.1	6.7	6.8	6.6	6.1	5.6	5.1	no	--	no	10
65A	MYTI EDU	SB	d.wt							8	4.9	5.2	12	8.1	5.5	6	5.1	5.7	5.8	5.6	5.1	5	no	--	no	11
69A	MYTI EDU	SB	d.wt												6.2	5.3	5.4	6.3	7.3	5.6	5.2	7.2	no	--	no	8
22A	MYTI EDU	SB	d.wt										6.3	6.7	5.4	5.8	6.3	6.8	9.3	4.2	8.6	7.5	no	--	1.4	11
82A	MYTI EDU	SB	d.wt				6.4			4.7	5.8	7.5		12	6.9	9.6		7.4	7.9				no	--	1.2	10
84A	MYTI EDU	SB	d.wt				10		97	57	39	27		17	22	24		9.5	7.2				no	--	1.7	20
87A	MYTI EDU	SB	d.wt				4.6			20	8.3	5.9		7.3	6.3	6.9		7.6	7.5				no	--	2.3	15
91A	MYTI EDU	SB	d.wt												6.6	6.4	8.4						no	-?	?	7
92A	MYTI EDU	SB	d.wt												6.7	6	7.6	6.3	7.5	6.4			no	--	no	7
98A	MYTI EDU	SB	d.wt												8.9	6.6				5.5	5.3	5.9	no	-?	?	8
98X	MYTI EDU	SB	d.wt														9	8.9	7.7				no	-?	?	<=5
41A	MYTI EDU	SB	d.wt														6.8	8.2	7.6	4.8			no	-?	?	10
43A	MYTI EDU	SB	d.wt														7.8	9.3		6.3			no	-?	?	9
44A	MYTI EDU	SB	d.wt														6.6	9.6	7.8	6.9			no	-?	?	10
46A	MYTI EDU	SB	d.wt														6.6	7.4	8				no	-?	?	<=5
48A	MYTI EDU	SB	d.wt														6.6	7.7	7.1				no	-?	?	7
10A	MYTI EDU	SB	d.wt														7.3	11	7.8	5.7	7.9	6.9	no	--	1.7	10
11A	MYTI EDU	SB	d.wt														9.9	9.7	12	8.3			no	-?	?	8
30B	GADU MOR	LI	w.wt						7	28	5.1	4.2	4.5	3.7	8.5	6.8	8.1	5.1	5.1	7	9.3	12	no	--	2.5	16
36B	GADU MOR	LI	w.wt						14	20	7	12	11	8.7	9.6	7.4	11	8	9.8	14	10	14	no	--	1.5	11
15B	GADU MOR	LI	w.wt										11	1.6	5.8	2.3	1.7	3.6	9	5.9	5.5	3.8	no	--	1.3	19
53B	GADU MOR	LI	w.wt						12		7.1	5.9	2.4	3.3	4.7	6		5.4	6.3	8.2	15	9.6	no	UY	1.9	12
67B	GADU MOR	LI	w.wt							8	6.9	14	8.9	8.8	5.2	8	9.7	4.5	7.2	19	10	9.6	no	--	1.9	14
23B	GADU MOR	LI	w.wt										8.2	11	5.8	7.1	7.1	10	8.8	9.1	7.4	13	no	--	1.1	11
92B	GADU MOR	LI	w.wt													7.8	6.1	7.4	7				no	-?	?	7
98B	GADU MOR	LI	w.wt												5.9	8.2	3.8	2.3	6.2	3.9	5.9	6.8	no	--	1.2	14
43B	GADU MOR	LI	w.wt														6	5.6	5.4				no	-?	?	<=5
10B	GADU MOR	LI	w.wt														9.9	7.8	4.3	5.3	4.3	3.5	no	D-	no	9
33B	PLAT FLE	LI	w.wt						22	35	16	34	20	19	16	18	18	13	14	15	15	17	no	--	no	11
53B	PLAT FLE	LI	w.wt								14	9	8.2	19	11	17		8.3	15	8.4	19	14	no	--	1.3	14
36F	LIMA LIM	LI	w.wt										13	5.3	8.5	8.1	7.3	8.9	7.1	9.6	7.6	14	1.4	--	2.9	12
15F	LIMA LIM	LI	w.wt											2.8		4.1	3	5.9	9.1	1.9	9	10	1	--	5.5	18
22F	LIMA LIM	LI	w.wt										9.8	6.7	3.4		2.2	3.5					no	-?	?	14
98F	LIMA LIM	LI	w.wt														3.5	5	5.7				no	-?	?	6
67B	LEPI WHI	LI	w.wt							15	14	19	11	14	13	12	14	20	20	13	9.4	11	m	--	m	10

Annual median concentration of HG (ppm)

St	Species	Tissue	Base	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	ANALYSIS OC	TRND	UP95+3	POWER
30A	MYTI EDU	SB	d.wt				0.11	0.07	0.14	0.05	0.13	0.04	0.06	0.05	0.05	0.07	0.08	0.05	0.07	0.06	0.07	0.11	no	--	1.3	13
31A	MYTI EDU	SB	d.wt			0.07	0.16	0.08	0.12	0.05	0.09	0.02	0.06	0.04	0.05	0.04	0.05	0.06	0.04	0.05	0.07	0.08	no	--	1.2	14
35A	MYTI EDU	SB	d.wt			0.09	0.07	0.08	0.17	0.05	0.18	0.05	0.06	0.05	0.05	0.05	0.06	0.03	0.03	0.03	0.06	0.10	no	--	1.5	14
36A	MYTI EDU	SB	d.wt			0.05	0.04	0.08	0.14	0.05	0.14	0.03	0.04	0.04	0.03	0.03	0.04	0.03	0.04	0.07	0.03	0.04	no	--	no	15
71A	MYTI EDU	SB	d.wt			0.39	0.24	0.21	0.24	0.12	0.34	0.24	0.18	0.14	0.17	0.14	0.21	0.20	0.22	0.31	0.11	0.15	no	--	1.1	13
76A	MYTI EDU	SB	d.wt										0.07	0.06	0.05	0.02			0.05	0.08	0.06	0.10	no	--	2.4	15
15A	MYTI EDU	SB	d.wt										0.05	0.05		0.02	0.05	0.02	0.04	0.05	0.05	0.04	no	--	no	14
51A	MYTI EDU	SB	d.wt							0.24	0.25							1.51	0.90	0.17	0.57	2.89	14.5	--	156.4	>25
52A	MYTI EDU	SB	d.wt									2.35	0.32	3.01	0.97	0.37	0.28	0.43	0.17	0.26	0.25	0.58	2.9	--	13.6	21
56A	MYTI EDU	SB	d.wt							0.53	0.37	1.09	0.71	1.54	0.93	1.22	0.35	0.67	0.36	0.52	0.28	0.91	4.6	--	9	16
57A	MYTI EDU	SB	d.wt							0.17	0.21	0.26	0.41	0.75	0.57	0.34	0.35	0.26	0.15	0.31	0.16	0.46	2.3	--	4	13
63A	MYTI EDU	SB	d.wt							0.31	0.14	0.17	0.39	0.46	0.29	0.14	0.19	0.25	0.17	0.20	0.22	0.26	1.3	--	3.3	14
65A	MYTI EDU	SB	d.wt							0.10	0.15	0.10	0.31	0.32	0.12	0.11	0.13	0.14	0.11	0.13	0.07	0.14	no	--	1.1	14
69A	MYTI EDU	SB	d.wt												0.10	0.02	0.08	0.07	0.10	0.11	0.07	0.16	no	--	3.3	17
22A	MYTI EDU	SB	d.wt										0.05	0.07	0.11	0.04	0.06	0.06	0.07	0.06	0.04	0.07	no	--	no	12
82A	MYTI EDU	SB	d.wt				0.05	0.11	0.17	0.08	0.12	0.06		0.07	0.05	0.07		0.04	0.06				no	--	no	13
84A	MYTI EDU	SB	d.wt				0.07	0.11	0.15	0.08	0.24	0.05		0.06	0.09	0.05		0.05	0.04				no	--	no	15
87A	MYTI EDU	SB	d.wt				0.17		0.15	0.05	0.26	0.04		0.05	0.05	0.04		0.04	0.06				no	--	no	17
91A	MYTI EDU	SB	d.wt												0.05	0.07	0.09						no	-?	?	<=5
92A	MYTI EDU	SB	d.wt												0.05	0.03	0.05	0.04	0.02	0.06			no	--	1.5	14
98A	MYTI EDU	SB	d.wt												0.08	0.08				0.10	0.15	0.24	1.2	-?	?	11
98X	MYTI EDU	SB	d.wt														0.33	0.34	0.32				1.6	-?	?	<=5
41A	MYTI EDU	SB	d.wt														0.06	0.06	0.06	0.08			no	-?	?	8
43A	MYTI EDU	SB	d.wt														0.08	0.09		0.10			no	-?	?	<=5
44A	MYTI EDU	SB	d.wt														0.05	0.05	0.05	0.05			no	-?	?	6
46A	MYTI EDU	SB	d.wt														0.03	0.06	0.05				no	-?	?	10
48A	MYTI EDU	SB	d.wt														0.07	0.06	0.05				no	-?	?	<=5
10A	MYTI EDU	SB	d.wt														0.05	0.04	0.05	0.06	0.05	0.06	no	--	no	6
11A	MYTI EDU	SB	d.wt														0.18	0.14	0.08	0.14			no	-?	?	13

Annual median concentration of HG (ppm)

St	Species	Tissue	Base	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	ANALYSIS OC	TRND	UP95+3	POWER
30B	GADU MOR (s)	MU	w.wt				0.125	0.089	0.079	0.04	0.059	0.121	0.12	0.09	0.11	0.122	0.102	0.08	0.108	0.131	0.117	0.153	1.5	--L	3.3	11
30B	GADU MOR (l)	MU	w.wt				0.155	0.09	0.074	0.038	0.147	0.166	0.13	0.108	0.15	0.155	0.129	0.119	0.142	0.19	0.232	0.351	3.5	U-L	12.7	13
36B	GADU MOR (s)	MU	w.wt	0.069	0.08	0.11	0.075	0.08	0.061	0.032	0.053	0.069	0.06	0.06	0.059	0.067	0.054	0.076	0.067	0.089	0.078	0.06	no	--L	1.1	10
36B	GADU MOR (l)	MU	w.wt	0.079	0.16	0.18	0.195	0.12	0.112	0.039	0.083	0.074	0.115	0.1	0.08	0.083	0.06	0.095	0.07	0.157	0.088	0.186	1.9	--L	5.1	13
15B	GADU MOR (s)	MU	w.wt										0.065	0.04	0.026	0.018	0.045	0.044	0.059	0.076	0.044	0.023	no	--L	no	14
15B	GADU MOR (l)	MU	w.wt										0.12	0.07	0.063	0.039	0.081	0.046	0.087	0.108	0.09	0.027	no	--L	no	15
53B	GADU MOR (s)	MU	w.wt						0.223		0.105	0.16	0.184	0.204	0.36	0.09		0.054	0.229	0.128	0.151	0.175	1.8	---	8.1	17
53B	GADU MOR (l)	MU	w.wt						0.196		0.105	0.203	0.17	0.269	0.396	0.141		0.09	0.277	0.243	0.298	0.285	2.9	---	13.7	15
67B	GADU MOR (s)	MU	w.wt							0.1	0.085	0.09	0.079	0.1	0.085	0.093	0.12	0.071	0.073	0.117	0.051	0.058	no	---	no	10
67B	GADU MOR (l)	MU	w.wt							0.17	0.085	0.102	0.255	0.13	0.141	0.083	0.106	0.072	0.089	0.16	0.068	0.06	no	---	1.3	14
23B	GADU MOR (s)	MU	w.wt										0.065	0.07	0.06	0.042	0.052	0.069	0.06	0.073	0.075	0.061	no	--L	1.1	9
23B	GADU MOR (l)	MU	w.wt										0.17	0.11	0.084	0.098	0.074	0.109	0.057	0.105	0.116	0.113	1.1	--L	2.6	11
84B	GADU MOR (s)	MU	w.wt				0.035	0.04	0.025		0.044												no	-?-	?	12
84B	GADU MOR (l)	MU	w.wt				0.06	0.04	0.025		0.044												no	-?-	?	14
92B	GADU MOR (s)	MU	w.wt													0.046	0.079	0.08	0.077				no	-?-	?	10
92B	GADU MOR (l)	MU	w.wt													0.058	0.091	0.074	0.117				1.2	-?-	?	10
98B	GADU MOR (s)	MU	w.wt												0.067	0.054	0.069	0.069	0.04	0.095	0.066	0.047	no	---	1.1	12
98B	GADU MOR (l)	MU	w.wt												0.065	0.064	0.069	0.086	0.037	0.128	0.09	0.043	no	---	1.6	15
43B	GADU MOR (s)	MU	w.wt														0.065	0.054	0.047				no	-?-	?	<=5
43B	GADU MOR (l)	MU	w.wt														0.05	0.059	0.057				no	-?-	?	6
10B	GADU MOR (s)	MU	w.wt														0.044	0.034	0.029	0.011	0.014	0.017	no	D--	no	13
10B	GADU MOR (l)	MU	w.wt														0.056	0.053	0.04	0.02	0.019	0.032	no	---	1.4	13
33B	PLAT FLE (s)	MU	w.wt			0.11		0.09	0.077	0.019	0.069		0.175	0.088	0.116	0.092	0.069	0.053	0.048	0.076	0.038	0.046	no	---	no	16
33B	PLAT FLE (l)	MU	w.wt			0.139		0.1	0.077	0.024	0.069		0.195	0.135	0.196	0.103	0.088	0.049	0.06	0.087	0.07	0.119	1.2	---	3.6	16
53B	PLAT FLE (s)	MU	w.wt								0.111	0.074	0.139	0.154	0.141	0.071		0.035	0.165	0.13	0.165	0.249	2.5	---	16.1	16
53B	PLAT FLE (l)	MU	w.wt								0.111	0.128	0.09	0.124	0.1	0.116		0.036	0.208	0.221	0.257	0.157	1.6	---	13.1	17
36F	LIMA LIM (s)	MU	w.wt										0.045	0.071	0.066	0.07	0.05	0.054	0.049	0.031	0.062	0.038	no	--L	no	11
36F	LIMA LIM (l)	MU	w.wt										0.098	0.074	0.133	0.101	0.076	0.1	0.066	0.091	0.092	0.068	no	--L	1.2	10
15F	LIMA LIM (s)	MU	w.wt											0.09		0.038	0.037	0.025	0.037	0.048	0.042	0.029	no	--L	no	13
15F	LIMA LIM (l)	MU	w.wt											0.15		0.034	0.036	0.056	0.108	0.073	0.088	0.068	no	--L	3.7	17
22F	LIMA LIM (s)	MU	w.wt										0.084	0.04	0.207		0.045	0.063					no	-?-	?	20
22F	LIMA LIM (l)	MU	w.wt										0.174	0.152	0.282		0.223	0.372					3.7	-?-	?	11
67B	LEPI WHI (s)	MU	w.wt			0.235				0.35	0.329	0.21	0.343	0.075	0.174	0.187	0.305	0.364	0.398	0.172	0.066	0.11	m	--L	m	16
67B	LEPI WHI (l)	MU	w.wt			0.499				0.35	0.329	0.32	0.589	0.147	0.327	0.336	0.422	0.341	0.372	0.331	0.275	0.392	m	--L	m	13

Annual median concentration of PB (ppm)

St	Species	Tissue	Base	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	ANALYSIS OC	TRND	UP95+3	POWER
30A	MYTI EDU	SB	d.wt										1.9	1.4	4	2.3	2.5	1.6	2.1	2.7	37	2.1	no	--	40.2	24
31A	MYTI EDU	SB	d.wt										1.4	1.2	1.3	1	1.4	1.7	1.8	0.73	1.5	0.63	no	--	no	13
35A	MYTI EDU	SB	d.wt										1.4	1.1	1.7	1.2	1.3	0.51	0.63	0.66	0.76	0.71	no	--	no	11
36A	MYTI EDU	SB	d.wt										1	0.85	0.79	1.1	1.4	1.2	2	2.2	1.6	1	no	--	no	11
71A	MYTI EDU	SB	d.wt										1.2	0.74	1.7	1.4	1.9	1.5	2.2	2.8	0.87	0.9	no	--	no	14
76A	MYTI EDU	SB	d.wt										1.8	0.97	1.5	0.91			0.8	1.8	1.2	2	no	--	1.9	13
15A	MYTI EDU	SB	d.wt										1.5	0.78		0.98	1.1	0.52	0.67	1.1	1.3	1.7	no	--	1.8	12
51A	MYTI EDU	SB	d.wt															150	60	17	30	37	12.4	-?	?	19
52A	MYTI EDU	SB	d.wt										12	310	190	66	16	18	9.8	21	15	12	3.9	--	37.1	>25
56A	MYTI EDU	SB	d.wt										21	23	120	110	25	46	28	37	16	30	10.1	--	24.4	19
57A	MYTI EDU	SB	d.wt										11	12	33	19	15	13	5.6	14	6.1	10	3.5	--	6.2	15
63A	MYTI EDU	SB	d.wt										12	10	15	11	7.2	12	7.6	6.1	6.4	4.8	1.6	D-	1.8	10
65A	MYTI EDU	SB	d.wt										5.6	3.8	5.2	6.5	3.3	4.7	2.4	3	1.8	1.6	no	D-	no	11
69A	MYTI EDU	SB	d.wt												4.6	3.4	2.8	3.2	4	3.7	2	3.4	1.1	--	1.6	11
22A	MYTI EDU	SB	d.wt										1.4	1.5	2.8	1.9	1.4	1.2	1.5	1.4	1.2	1.7	no	--	no	11
82A	MYTI EDU	SB	d.wt											1.3	0.93	0.92		0.62	0.67				no	D?	?	7
84A	MYTI EDU	SB	d.wt											1	1.2	1.4		1.4	0.83				no	-?	?	11
87A	MYTI EDU	SB	d.wt											0.97	0.87	0.63		1.4	2.5				no	-?	?	14
91A	MYTI EDU	SB	d.wt												0.9	1.5	2						no	-?	?	6
92A	MYTI EDU	SB	d.wt												0.93	0.63	1.1	0.66	0.65	2.2			no	--	11.5	16
98A	MYTI EDU	SB	d.wt												1.9	1.8				1.5	2.4	1.6	no	-?	?	9
98X	MYTI EDU	SB	d.wt														4.3	3.1	4.1				1.4	-?	?	11
41A	MYTI EDU	SB	d.wt														1.3	0.9	0.79	0.65			no	D?	?	6
43A	MYTI EDU	SB	d.wt														1.6	1.5		0.85			no	-?	?	8
44A	MYTI EDU	SB	d.wt														2.8	2.6	1.7	1.2			no	D?	?	7
46A	MYTI EDU	SB	d.wt														1.3	1.6	1.4				no	-?	?	8
48A	MYTI EDU	SB	d.wt														0.68	1.1	0.33				no	-?	?	19
10A	MYTI EDU	SB	d.wt														1.9	2.8	0.74	0.81	2.3	1.6	no	--	8.1	18
11A	MYTI EDU	SB	d.wt														1.5	1.5	0.34	0.37			no	-?	?	16
30B	GADU MOR	LI	w.wt										0.2	0.11	0.25	0.1	0.12	0.11	0.06	0.1	0.16	0.85	8.5	--	46.3	17
36B	GADU MOR	LI	w.wt										0.11	0.05	0.03	0.02	0.03	0.02	0.03	0.04	0.03	0.04	no	DY	no	12
15B	GADU MOR	LI	w.wt										0.17	0.06	0.03	0.03	0.03	0.02	0.03	0.04	0.03	0.03	no	DY	no	13
53B	GADU MOR	LI	w.wt										0.19	0.26	0.14	0.03		0.02	0.075	0.07	0.1	0.11	1.1	--	11.6	18
67B	GADU MOR	LI	w.wt										0.13	0.18	0.03	0.075	0.09	0.04	0.04	0.09	0.03	0.04	no	--	1.1	18
23B	GADU MOR	LI	w.wt										0.06	0.08	0.03	0.03	0.03	0.02	0.03	0.04	0.03	0.04	no	--	no	11
92B	GADU MOR	LI	w.wt													0.02	0.03	0.03	0.04				no	-?	?	7
98B	GADU MOR	LI	w.wt												0.03	0.03	0.03	0.04	0.04	0.05	0.03	0.03	no	--	no	9
43B	GADU MOR	LI	w.wt														0.03	0.03	0.03				no	-?	?	<=5
10B	GADU MOR	LI	w.wt														0.03	0.02	0.04	0.04	0.04	0.03	no	--	no	11
33B	PLAT FLE	LI	w.wt										0.24	0.35	0.06	0.03	0.03	0.02	0.03	0.04	0.04	0.04	no	DY	no	15
53B	PLAT FLE	LI	w.wt										0.71	0.81	0.41	0.23		0.024	0.46	0.35	0.52	0.46	1.5	--	49.6	24
36F	LIMA LIM	LI	w.wt										0.6	0.07	0.04	0.07	0.03	0.02	0.03	0.05	0.05	0.05	no	D-	1.1	18
15F	LIMA LIM	LI	w.wt											0.07		0.041	0.03	0.02	0.03	0.05	0.04	0.03	no	--	no	13
22F	LIMA LIM	LI	w.wt										0.25	0.16	0.042		0.06	0.07					no	-?	?	18
98F	LIMA LIM	LI	w.wt														0.02	0.04	0.03				no	-?	?	14
67B	LEPI WHI	LI	w.wt										0.19	0.07	0.06	0.07	0.04	0.07	0.03	0.04	0.04	0.03	m	D-	m	13

Annual median concentration of ZN (ppm)

St	Species	Tissue	Base	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	ANALYSIS OC	TRND	UP95+3	POWER
30A	MYTI EDU	SB	d.wt				138	90.5	140	120	93.1	76.2	161	116	147	104	117	109	114	126	173	106	no	--	1.2	11
31A	MYTI EDU	SB	d.wt			88.1	132	76.9	106	66.3	67.7	58.1	181	128	125	96.4	96.8	151	103	128	120	112	no	--	1	12
35A	MYTI EDU	SB	d.wt			91.9	79.6	75.9	89.8	68.4	81.5	83.2	166	139	131	119	97.6	82.9	94.3	103	112	111	no	UY	no	9
36A	MYTI EDU	SB	d.wt			66.5	85.8	66.1	57.7	61.5	73.6	65.3	126	127	104	84	121	115	137	145	105	95.5	no	U-	no	9
71A	MYTI EDU	SB	d.wt			124	125	77	115	101	169	128	162	143	166	120	157	150	122	192	114	114	no	--	no	10
76A	MYTI EDU	SB	d.wt										158	127	124	57.6			112	135	137	132	no	--	1.9	12
15A	MYTI EDU	SB	d.wt										157	144		71.4	88.9	62.6	232	107	127	105	no	--	1.8	15
51A	MYTI EDU	SB	d.wt							378	253							386	223	120		170	no	--	1.3	14
52A	MYTI EDU	SB	d.wt									824	272	453	408	218	141	196	183	247	160	143	no	D-	1.5	13
56A	MYTI EDU	SB	d.wt							869	410	1170	572	479	418	388	211	290	246	377	143	271	1.4	D-	2.3	14
57A	MYTI EDU	SB	d.wt							378	263	441	520	292	256	147	173	182	115	223	121	207	1	D-	1.8	12
63A	MYTI EDU	SB	d.wt							579	216	241	509	392	207	122	122	189	147	170	129	115	no	D-	1.2	14
65A	MYTI EDU	SB	d.wt							191	156	199	424	308	131	139	118	166	147	184	121	152	no	--	1.4	12
69A	MYTI EDU	SB	d.wt												135	102	135	163	161	218	144	201	1	--	1.7	9
22A	MYTI EDU	SB	d.wt										172	162	135	116	98	144	221	110	128	122	no	--	no	11
82A	MYTI EDU	SB	d.wt				127	106	132	109	76.1	129		145	123	112		109	87.6				no	--	no	9
84A	MYTI EDU	SB	d.wt				118	160	163	133	132	142		185	180	113		121	85.8				no	--	no	9
87A	MYTI EDU	SB	d.wt				100	92.8	97.7	102	105	96.6		117	114	90.2		109	97.2				no	--	no	6
91A	MYTI EDU	SB	d.wt												96.2	102	116						no	-?	?	<=5
92A	MYTI EDU	SB	d.wt												88.7	61.1	90.2	77.5	59.2	97.8			no	--	1.1	10
98A	MYTI EDU	SB	d.wt												117	105				89.9	81.6	82.1	no	D?	?	<=5
98X	MYTI EDU	SB	d.wt														187	182	146				no	-?	?	6
41A	MYTI EDU	SB	d.wt														85.1	89	94.8	90.9			no	-?	?	<=5
43A	MYTI EDU	SB	d.wt														98.7	96.6		89.2			no	-?	?	<=5
44A	MYTI EDU	SB	d.wt														67.2	91.3	81	78.8			no	-?	?	8
46A	MYTI EDU	SB	d.wt														88.4	112	93.3				no	-?	?	9
48A	MYTI EDU	SB	d.wt														74.9	87	68.8				no	-?	?	8
10A	MYTI EDU	SB	d.wt														127	120	94.6	114	102	103	no	--	no	6
11A	MYTI EDU	SB	d.wt														86.7	98.3	76.5	88.3			no	-?	?	7
30B	GADU MOR	LI	w.wt						13.8	67	30.3	12.8	16.6	22.6	31.7	23.5	24.8	19.7	20.6	24.9	29.1	38.2	1.3	--	4.3	16
36B	GADU MOR	LI	w.wt						46.4	64.4	35.4	36.4	31.8	19.7	25.8	22.6	24.3	31.1	25.7	47.3	29.9	32.3	1.1	DY	2.1	10
15B	GADU MOR	LI	w.wt										33.8	14.1	20.4	17	14.2	21.1	26.4	22.9	33.3	29.5	no	--	2.7	11
53B	GADU MOR	LI	w.wt						29		26.8	27.9	10.9	24.4	30	20.4		17.5	29.6	27.2	32.4	28.2	no	--	2.6	12
67B	GADU MOR	LI	w.wt							26.4	22.3	26.4	27	25.7	19.4	29.2	27.4	15.8	30.7	47.3	25.5	30.2	1	--	2.4	12
23B	GADU MOR	LI	w.wt										29	33.8	24.8	21.2	18.7	25.1	21.9	27.4	27.5	30.8	1	--	1.7	8
92B	GADU MOR	LI	w.wt													20.6	17.9	21.6	25				no	-?	?	7
98B	GADU MOR	LI	w.wt												19.9	24	14.6	13.5	16.2	20	14.1	17.6	no	--	no	10
43B	GADU MOR	LI	w.wt														17.1	15.1	15.7				no	-?	?	6
10B	GADU MOR	LI	w.wt														29.3	23.4	15.9	23.4	18.8	16.9	no	--	no	9
33B	PLAT FLE	LI	w.wt						52.7	91.1	54.6	48.3	56.9	47.3	45.1	50	49.4	38	51.2	43.6	44.7	41.6	no	--	no	9
53B	PLAT FLE	LI	w.wt								54.4	46.3	43.3	51.4	49.2	51.9		35.8	40.5	27.1	56.7	40.6	no	--	1.2	10
36F	LIMA LIM	LI	w.wt										39.3	26.6	32.2	27.2	28.4	28	31.1	34.7	35.6	38.7	no	--	1.2	7
15F	LIMA LIM	LI	w.wt											25		29.7	24.7	34.7	34.8	22.1	32.6	37.1	no	--	1.2	9
22F	LIMA LIM	LI	w.wt										41.3	29	34.3		27.5	37					no	-?	?	9
98F	LIMA LIM	LI	w.wt														23.5	34.8	31.7				no	-?	?	9
67B	LEPI WHI	LI	w.wt							80.5	106	68.3	85.7	94.1	73.2	78.8	58.7	80.8	83.5	61	98.6	70	m	--	m	9

Annual median concentration of CB153 (ppb)

St	Species	Tissue	Base	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	ANALYSIS OC	TRND	UP95+3	POWER
30A	MYTI EDU	SB	d.wt								25.3	23.8	30.1	19.5	24.4	10.9	20.9	19.6	26.4	29	15.5	18.7	3.7	--	6.2	12
31A	MYTI EDU	SB	d.wt								2.86	5.78	6.59	3.66	6.59	3.3	11.2	9.41	10.9	5.03	3.72	4.75	no	--	1.1	15
35A	MYTI EDU	SB	d.wt								5.65	6.9	6.11	2.92	5.52	3.03	3.76	3.69	3.07	3.76	4.13	4.79	no	--	1.8	11
36A	MYTI EDU	SB	d.wt								3.09	6.81	4.36	2.73	3.54	1.59	1.59	3.62	3.72	4.1	2.9	2.93	no	--	1.5	14
71A	MYTI EDU	SB	d.wt								5.13	12.7	5.87	3.03	4.59	3.35	5.45	3.02	7.24	2.78	3.82	4.38	no	--	1.8	15
76A	MYTI EDU	SB	d.wt										4.62	2.84	2.49	1.18			4.21	4	3.77	3.63	no	--	3.6	15
15A	MYTI EDU	SB	d.wt										2.84			0.976	2	0.898	0.793	1.27	1.19	1.4	no	--	no	14
51A	MYTI EDU	SB	d.wt															10.2	3.49	4.17	3.03	3.87	no	-?	?	14
52A	MYTI EDU	SB	d.wt									17.9	3.47		3.77	3.62	5	5.32	2.62	4.89	2.73	3.31	no	--	1.4	16
56A	MYTI EDU	SB	d.wt								2.8	14.5	5.57	3.97	2.8	2.08	4	3.97	3.09	4.34	1.76	3.33	no	--	1.3	17
57A	MYTI EDU	SB	d.wt									8.46		3.82	1.44	1.59	2.69	2.04	1.81	2.76	2.88	2.48	no	--	1.5	14
63A	MYTI EDU	SB	d.wt									8.84		4.85	1.48	1.23	1.77	1.91	1.4	1.54	2.45	2.26	no	DY	1.3	14
65A	MYTI EDU	SB	d.wt								0.1	4.7	4.45	4.31	1.17	0.741	1.69	1.3	1.83	1.24	2.48	1.89	no	--	4.6	25
69A	MYTI EDU	SB	d.wt												1.02	1.58	1.66	1.85	0.929	2.19	3.78	1.8	no	--	1.9	15
22A	MYTI EDU	SB	d.wt										2.96	3.05	2.78	1.31	2.33	2.12	1.94	1.61	3.81	1.78	no	--	1	13
84A	MYTI EDU	SB	d.wt								0.694	9.36		2.53	3.12	1.7		1.43	2.4				no	--	2	23
92A	MYTI EDU	SB	d.wt												1.27	0.452	1.82	1.17	0.888	2.39			no	--	4.7	18
98A	MYTI EDU	SB	d.wt												7.96	2.29				3.36	2.73	1.38	no	-?	?	17
98X	MYTI EDU	SB	d.wt														27.4	25.3	14.6				2.9	-?	?	9
41A	MYTI EDU	SB	d.wt														0.994	0.842	0.73	0.727			no	-?	?	<=5
43A	MYTI EDU	SB	d.wt														0.974	0.884		0.855			no	-?	?	<=5
44A	MYTI EDU	SB	d.wt															2.83	3.62	9.08			1.8	-?	?	11
46A	MYTI EDU	SB	d.wt														1.68	1.28	0.984				no	D?	?	<=5
48A	MYTI EDU	SB	d.wt														2.38	1.47	1.1				no	-?	?	6
10A	MYTI EDU	SB	d.wt														1.88	1.46	1.85	2.55		1.56	no	-?	?	11
11A	MYTI EDU	SB	d.wt														2.44	2.22	1.43	1.84			no	-?	?	10

Annual median concentration of CB153 (ppb) cont.

St	Species	Tissue	Base	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	ANALYSIS OC	TRND	UP95+3	POWER
30B	GADU MOR	LI	w.wt										405	955	957	856	885	807	872	1060	1200	1280	6.4	--	14.4	10
36B	GADU MOR	LI	w.wt										165	126	147	254	138	642	350	272	260	340	1.7	--	3.7	15
15B	GADU MOR	LI	w.wt										60	104	99	66.5	97	118	112	140	110	98	no	--	no	10
53B	GADU MOR	LI	w.wt										156	194	561	65		61	262	219	986	190	no	--	41.9	24
67B	GADU MOR	LI	w.wt										106	111	106	83.5	128	85	92	231	80	120	no	--	1.4	13
23B	GADU MOR	LI	w.wt										80	104	86	79	48	75	73	52	80	100	no	--	no	10
92B	GADU MOR	LI	w.wt													51	51	102	129				no	-?	?	9
98B	GADU MOR	LI	w.wt												65	73	33	55	80	129	62	43	no	--	no	15
43B	GADU MOR	LI	w.wt														110	113	50				no	-?	?	13
10B	GADU MOR	LI	w.wt														201	171	66	55	46	61	no	D-	no	13
30B	GADU MOR	MU	w.wt										1.47	3.7	9.2	3.3	1.23	0.89	2.54	3.71	7.79	8.4	m	--	m	20
36B	GADU MOR	MU	w.wt										0.63	0.45	0.7	1.3	0.15	5.42	1.37	1.87	1.3	1.2	m	--	m	25
15B	GADU MOR	MU	w.wt										0.52	0.39	0.49	0.2	0.13	0.36	0.43	0.503	0.58	0.25	m	--	m	15
53B	GADU MOR	MU	w.wt										3.36	0.97	4.79	0.4		0.12	6.43	1.34	32.2	2.9	m	--	m	>25
67B	GADU MOR	MU	w.wt										0.24	0.559	0.4	0.141	0.474	0.19	1.23	2.65	0.26	0.78	m	--	m	24
23B	GADU MOR	MU	w.wt										0.26	0.94	0.2	0.2	0.05	0.27	0.16	0.31	0.66	0.39	m	--	m	20
92B	GADU MOR	MU	w.wt													0.1	0.06	0.1	0.26				m	-?	m	16
98B	GADU MOR	MU	w.wt												0.2	0.3	0.03	0.08	0.12	0.5	0.13	0.13	m	--	m	24
43B	GADU MOR	MU	w.wt														0.14	0.21	0.13				m	-?	m	13
10B	GADU MOR	MU	w.wt														0.55	0.85	0.11	0.2	0.2	0.3	m	--	m	20
33B	PLAT FLE	LI	w.wt										11	10	30	22	17	17	9.4	11.1	8.7	14	no	--	no	13
53B	PLAT FLE	LI	w.wt										123	126	80	10		7.94	37	39	38	52	1	--	14	20
33B	PLAT FLE	MU	w.wt										0.65	1.24	0.5	0.3	0.12	0.22	0.34	0.22	0.2	1.6	m	--	m	19
53B	PLAT FLE	MU	w.wt										5.88	8.2	3.4	0.4		0.224	0.93	0.92	0.7	0.9	m	D-	m	21
36F	LIMA LIM	LI	w.wt										129	92.5	138	171	148	161	151	155	89	150	no	--	no	10
15F	LIMA LIM	LI	w.wt											53		21.5	28.9	28	22.8	25	20	41	no	--	no	12
22F	LIMA LIM	LI	w.wt										65.4	49	52.4		24	29.6					no	D?	?	9
36F	LIMA LIM	MU	w.wt										1.13	2.7	2.3	3.2	2.06	3.22	3.33	1.63	3.1	1.4	m	--	m	13
15F	LIMA LIM	MU	w.wt											1.42		0.245	0.118	0.41	0.69	0.48	0.53	0.73	m	--	m	21
22F	LIMA LIM	MU	w.wt										0.7	2	1.28		0.5	1.66					m	-?	m	19
98F	LIMA LIM	MU	w.wt														0.27	0.44	1.16				m	-?	m	9
67B	LEPI WHI	LI	w.wt										37	42	61	45	87	79	38.8	35	49	36	m	--	m	12
67B	LEPI WHI	MU	w.wt										0.27	0.33	0.6	0.1	0.17	0.63	0.17	0.24	0.12	0.4	m	--	m	21

Annual median concentration of DDEPP (ppb)

St	Species	Tissue	Base	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	ANALYSIS OC	TRND	UP95+3	POWER
30A	MYTI EDU	SB	d.wt												5.2	3.9	7.1	5.7	2.6	5.9	3.9	5.9	no	--	1.3	14
31A	MYTI EDU	SB	d.wt												3.3	1.9	3.4	1.8	0.5	3.4	3.5	5.5	no	--	5.1	19
35A	MYTI EDU	SB	d.wt												4.9	2.1	3.1	2.8	0.57	3.9	3.7	5.9	no	--	5.3	20
36A	MYTI EDU	SB	d.wt												2.8	1.1	1	1.8	0.44	2.1	1.8	3	no	--	2	18
71A	MYTI EDU	SB	d.wt												2.6	1.6	3.2	1.3	0.74	1	2.2	2.4	no	--	no	16
76A	MYTI EDU	SB	d.wt												1.4	0.79			0.36	1.2	2.3	2.5	no	--	4.9	20
15A	MYTI EDU	SB	d.wt													0.98	1.7	0.73	0.29	1	1.4	2.1	no	--	1.4	18
51A	MYTI EDU	SB	d.wt															34	6.7	15	17	13	1.3	-?	?	19
52A	MYTI EDU	SB	d.wt												12	25	19	18	9.5	13	17	14	1.4	--	2.7	13
56A	MYTI EDU	SB	d.wt												50	48	110	41	34	72	53	40	4	--	11.2	15
57A	MYTI EDU	SB	d.wt												26	18	35	25	16	50	83	35	3.5	--	29.6	16
63A	MYTI EDU	SB	d.wt												13	9.3	9.7	8.4	5.5	13	16	11	1.1	--	3.9	12
65A	MYTI EDU	SB	d.wt												7.6	5.2	7.8	4.1	5	6.9	12	7.4	no	--	2.7	12
69A	MYTI EDU	SB	d.wt												3.6	3.2	3.5	2.9	0.4	3.7	6.5	2.6	no	--	4.7	23
22A	MYTI EDU	SB	d.wt												2.2	1.3	1.9	1.5	0.39	1.4	5.1	2	no	--	2.8	20
84A	MYTI EDU	SB	d.wt												3.1	2.2		0.99	0.74				no	D?	?	<=5
92A	MYTI EDU	SB	d.wt												0.68	2.1	1.4	0.77	0.28	1.9			no	--	3.8	22
98A	MYTI EDU	SB	d.wt												5.8	2.3				1.6	1.9	0.87	no	-?	?	14
98X	MYTI EDU	SB	d.wt														32	23	5.2				no	-?	?	15
41A	MYTI EDU	SB	d.wt														0.62	0.42	0.29	0.61			no	-?	?	15
44A	MYTI EDU	SB	d.wt															0.49	0.34	1.4			no	-?	?	20
46A	MYTI EDU	SB	d.wt														1	0.76	0.27				no	-?	?	11
48A	MYTI EDU	SB	d.wt														1.7	1.1	0.29				no	-?	?	14
10A	MYTI EDU	SB	d.wt														0.85	0.78	0.44	1.5		1.5	no	-?	?	16
11A	MYTI EDU	SB	d.wt														1.3	1.9	0.41	1.2			no	-?	?	21
30B	GADU MOR	LI	w.wt										160	440	180	160	190	190	310	380	260	230	1.2	--	3.5	14
36B	GADU MOR	LI	w.wt										92	51	50	75	55	110	140	130	45	86	no	--	no	14
15B	GADU MOR	LI	w.wt										50	140	48	57	86	33	75	140	72	76	no	--	1.7	16
53B	GADU MOR	LI	w.wt										640	810	940	85		42	490	940	490	160	no	--	44.9	>25
67B	GADU MOR	LI	w.wt										780	550	350	390	470	110	460	2100	270	200	no	--	10.3	23
23B	GADU MOR	LI	w.wt										68	85	42	41	35	31	49	33	49	48	no	--	no	10
92B	GADU MOR	LI	w.wt													53	50	50	200				no	-?	?	17
98B	GADU MOR	LI	w.wt												73	83	43	49	140	200	78	41	no	--	1.2	18
43B	GADU MOR	LI	w.wt														130	69	60				no	-?	?	9
10B	GADU MOR	LI	w.wt														210	71	75	99	65	90	no	--	no	14
33B	PLAT FLE	LI	w.wt										13	9.1	24	14	13	7	10	9.7	8.6	6.8	no	--	no	13
53B	PLAT FLE	LI	w.wt										94	70	32	41		8	25	45	38	44	1.5	--	9.9	17
36F	LIMA LIM	LI	w.wt										28	34	28	21	50	40	40	22	18	52	no	--	no	15
15F	LIMA LIM	LI	w.wt											39		13	23	9	21	20	13	40	no	--	1.4	16
22F	LIMA LIM	LI	w.wt										69	48	40		21	9.2					no	D?	?	10
67B	LEPI WHI	LI	w.wt										290	240	180	160	250	140	140	170	160	160	m	--	m	9

Annual median concentration of HCHG (ppb)

St	Species	Tissue	Base	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	ANALYSIS OC	TRND	UP95+3	POWER
30A	MYTI EDU	SB	d.wt										2	3.6	1.5	1.6	1.7	1.5	0.65	1.6	1.8	1.2	no	--	no	14
31A	MYTI EDU	SB	d.wt										2	3.7	2.2	1.4	1.4	0.78	0.66	2.7	1.2	0.94	no	--	no	16
35A	MYTI EDU	SB	d.wt										2.7	4.1	2.3	1.5	1.6	1.1	0.84	4.5	1	0.67	no	--	no	18
36A	MYTI EDU	SB	d.wt										3.6	5.5	2.8	1.6	0.77	1.3	0.56	2.9	2	1.7	no	--	2.3	17
71A	MYTI EDU	SB	d.wt										2.1	4.8	2	2.1	0.96	0.79	0.48	1	1.9	1.1	no	--	1.1	16
76A	MYTI EDU	SB	d.wt										1.6	2.2	1.4	2.4			0.61	1.7	2.4	1.2	no	--	1.1	17
15A	MYTI EDU	SB	d.wt										1.7			2	1.1	1.1	0.37	2	2.3	1.4	no	--	2.4	18
51A	MYTI EDU	SB	d.wt															1.7	1.1	1.2	2.3	1.1	no	-?	?	13
52A	MYTI EDU	SB	d.wt										1		0.94	1.1	1.3	1.3	2.6	1.2	2.2	1.1	no	--	no	12
56A	MYTI EDU	SB	d.wt										1.8	2.4	0.93	1	1.2	1.2	1.7	1.3	2.3	1	no	--	no	13
57A	MYTI EDU	SB	d.wt											2.3	1.4	0.79	0.86	1	2.5	1	3.6	1	no	--	1.4	17
63A	MYTI EDU	SB	d.wt											2.9	1.5	0.71	0.98	0.86	1.3	0.78	2.8	1.1	no	--	1.3	16
65A	MYTI EDU	SB	d.wt										2.2	2.6	1.3	0.74	1.2	0.65	2.9	1	2.9	1.1	no	--	1.4	17
69A	MYTI EDU	SB	d.wt												1.6	1.1	0.94	0.65	0.36	1.3	3.1	0.79	no	--	2.2	19
22A	MYTI EDU	SB	d.wt										0.8	1.9	1.7	1.3	1.1	1	0.58	1.2	2.3	0.8	no	--	no	16
84A	MYTI EDU	SB	d.wt											1.5	0.63	1.1		0.79	0.52				no	-?	?	13
92A	MYTI EDU	SB	d.wt												0.68	0.84	0.99	0.77	0.41	0.86			no	--	no	13
98A	MYTI EDU	SB	d.wt												0.62	0.57				0.6	1.2	0.75	no	-?	?	12
98X	MYTI EDU	SB	d.wt														1.5	0.64	0.42				no	-?	?	8
41A	MYTI EDU	SB	d.wt														0.68	0.53	0.29	0.43			no	-?	?	12
43A	MYTI EDU	SB	d.wt														0.52	0.41		0.45			no	-?	?	8
44A	MYTI EDU	SB	d.wt															0.54	0.29	0.64			no	-?	?	18
46A	MYTI EDU	SB	d.wt														0.44	0.47	0.33				no	-?	?	8
48A	MYTI EDU	SB	d.wt														0.34	0.48	0.33				no	-?	?	12
10A	MYTI EDU	SB	d.wt														0.52	0.54	0.44	0.4		1.1	no	-?	?	13
11A	MYTI EDU	SB	d.wt														0.44	0.51	0.34	0.46			no	-?	?	10
30B	GADU MOR	LI	w.wt										3	15	5	5	10	7	10	11	4	2.5	no	--	no	17
36B	GADU MOR	LI	w.wt										6.5	14	9	9	17	3	11	6	8.1	6.9	no	--	no	17
15B	GADU MOR	LI	w.wt										11	37	7	9	10	6	13	10	8.1	6.5	no	--	no	17
53B	GADU MOR	LI	w.wt										12	8.5	5	6		6	7	8	10	3.5	no	--	no	13
67B	GADU MOR	LI	w.wt										12	7	10	7	6.3	5	10	11	21	4.8	no	--	no	16
23B	GADU MOR	LI	w.wt										13	5.9	11	5	8	5	13	8	9.4	5.5	no	--	no	14
92B	GADU MOR	LI	w.wt													6	6	4	6				no	-?	?	10
98B	GADU MOR	LI	w.wt												5		8	3	6	3	8	5	no	--	no	15
43B	GADU MOR	LI	w.wt														3	3	4				no	-?	?	7
10B	GADU MOR	LI	w.wt														3	3	4	3	8	4.2	no	--	no	13
33B	PLAT FLE	LI	w.wt										2	0.5	5	2	2	1	1.9	1.8	1.1	0.69	no	--	no	20
53B	PLAT FLE	LI	w.wt										3	2	5	2		1.4	2	3	2	2.4	no	--	no	14
36F	LIMA LIM	LI	w.wt										8.9	3	5	1	4	3	8	5	2	3.8	no	--	no	19
15F	LIMA LIM	LI	w.wt											3		4	3.5	3	5.1	5.6	4.1	3.4	no	--	no	10
22F	LIMA LIM	LI	w.wt										6.9	3	5		1	1					no	D?	?	14
67B	LEPI WHI	LI	w.wt										3	2	5	2	2	1	3.7	3	4.6	1.1	m	--	m	18

Annual median concentration of HCB (ppb)

St	Species	Tissue	Base	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	ANALYSIS OC	TRND	UP95+3	POWER
30A	MYTI EDU	SB	d.wt				1.2	0.88	2.1	0.92	1.1	0.87	0.35	0.59	0.95	0.54	0.27	0.24	0.25	0.27	0.3		no	D-	no	14
31A	MYTI EDU	SB	d.wt			13	1.4	3.8	1.9	0.93	0.89	0.36	0.32	0.61	0.55	0.45	0.24	0.31	0.22	0.26	0.21		no	D-	no	16
35A	MYTI EDU	SB	d.wt			13	0.95	3.3	0.79	0.98	1.1	0.47	0.42	0.58	0.58	0.51	0.23	0.28	0.22	0.52	0.2	0.34	no	D-	2.1	18
36A	MYTI EDU	SB	d.wt			15	0.95	3.8	2.9	2.4	0.96	0.43	0.33	0.55	0.39	0.53	0.24	0.33	0.28	0.31	0.15		no	D-	no	19
71A	MYTI EDU	SB	d.wt			15	10	91	11	210	1.8	150	8.5	6.9	4.1	3.9	1.5	2.1	4.5	2	1.8	3.1	6.2	--	70.1	>25
76A	MYTI EDU	SB	d.wt										0.38	0.57	0.5	0.79			0.25	0.29	0.4	0.26	no	--	no	14
15A	MYTI EDU	SB	d.wt										0.2			0.49	0.25	0.22	0.29	0.25	0.16	0.22	no	--	no	13
51A	MYTI EDU	SB	d.wt															0.61	0.33	0.31	0.4	0.4	no	-?	?	11
52A	MYTI EDU	SB	d.wt									0.85	0.38		0.81	0.81	0.28	0.32	0.26	0.33	0.21	0.33	no	--	1.3	14
56A	MYTI EDU	SB	d.wt								0.2	0.79	0.41	0.79	0.93	1	0.31	0.38	0.31	0.44	0.35	0.7	1.4	--	3.8	15
57A	MYTI EDU	SB	d.wt									0.77		0.76	0.72	0.79	0.36	0.3	0.26	0.43	0.58	0.63	1.3	DY	3.5	11
63A	MYTI EDU	SB	d.wt									1		0.97	0.74	0.63	0.32	0.33	0.33	0.41	0.45	0.51	1	DY	1.9	9
65A	MYTI EDU	SB	d.wt								0.2	0.43	0.52	0.86	0.62	0.67	0.28	0.3	0.29	0.34	0.38	0.52	1	DY	2.3	12
69A	MYTI EDU	SB	d.wt												0.53	0.53	0.29	0.25	0.29	0.5	0.48	0.36	no	--	2.2	12
22A	MYTI EDU	SB	d.wt										0.26	0.61	0.56	0.44	0.25	0.25	0.3	0.31	0.17	0.32	no	--	1.1	13
82A	MYTI EDU	SB	d.wt				2.3	11	0.66	0.62	0.8	0.53											1.1	--	9.7	24
84A	MYTI EDU	SB	d.wt				3.4	8.8	3.3	2	1.2	0.48		0.51	0.63	0.53		0.25	0.21				no	D-	no	15
92A	MYTI EDU	SB	d.wt												0.68	0.42	0.24	0.23	0.23	0.25			no	D-	1.2	12
98A	MYTI EDU	SB	d.wt												0.62	0.57				0.34	0.31	0.43	no	-?	?	9
98X	MYTI EDU	SB	d.wt														0.56	0.32	0.26				no	-?	?	8
41A	MYTI EDU	SB	d.wt														0.29	0.26	0.29	0.3			no	-?	?	6
43A	MYTI EDU	SB	d.wt														0.32	0.34		0.45			no	-?	?	<=5
44A	MYTI EDU	SB	d.wt															0.27	0.29	0.33			no	-?	?	<=5
46A	MYTI EDU	SB	d.wt														0.26	0.29	0.27				no	-?	?	6
48A	MYTI EDU	SB	d.wt														0.28	0.29	0.24				no	-?	?	7
10A	MYTI EDU	SB	d.wt														0.29	0.27	0.25	0.31		0.28	no	-?	?	7
11A	MYTI EDU	SB	d.wt														0.35	0.43	0.34	0.46			no	-?	?	8
30B	GADU MOR	LI	w.wt										10	17	7.5	16	11	11	12	7	5.3	5.1	no	--	no	12
36B	GADU MOR	LI	w.wt										7	9	9	10	9	5	9	6	4.4	6.5	no	--	no	11
15B	GADU MOR	LI	w.wt										5	20	10	14	14	9	11	13	11	11	no	--	1.3	14
53B	GADU MOR	LI	w.wt										10	10	16	7		5	7	7	5	4.7	no	--	no	12
67B	GADU MOR	LI	w.wt										14	8	7.9	8	8.5	10	8	15	9.9	4.6	no	--	no	13
23B	GADU MOR	LI	w.wt										6	9.5	12	9	8	6	10	6	8.4	7.8	no	--	no	11
92B	GADU MOR	LI	w.wt													17	11	14	13				no	-?	?	9
98B	GADU MOR	LI	w.wt												20	9.9	12	18	35	20	16	13	no	--	1.6	14
43B	GADU MOR	LI	w.wt														15	16	13				no	-?	?	8
10B	GADU MOR	LI	w.wt														13	11	16	17	17	25	1.3	U-	3	8
33B	PLAT FLE	LI	w.wt										1	0.5	5	2	1	1	0.6	0.8	0.59	0.54	no	--	no	19
53B	PLAT FLE	LI	w.wt										6	4.5	5	2		1	2	3	1.8	2.5	no	--	1.6	14
36F	LIMA LIM	LI	w.wt										5.5	3	5	2	3	2	2.3	3	1.1	2.5	no	--	no	14
15F	LIMA LIM	LI	w.wt											4		4	4	2	3	3.2	3	4.7	no	--	no	10
22F	LIMA LIM	LI	w.wt										6	3	5		1	1.4					no	-?	?	15
67B	LEPI WHI	LI	w.wt										9	4	5	4	5	2	4.6	4	5	2.8	m	--	m	13

Appendix I.
Geographical distribution of contaminants in biota 1998-1999

Sorted by contaminant and species:

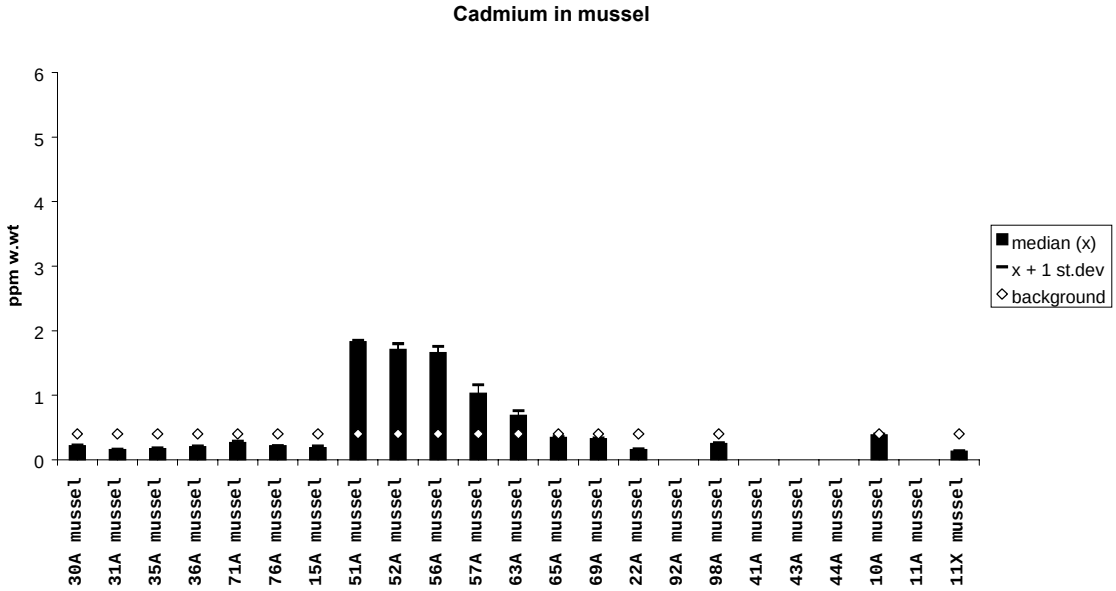
Cadmium (Cd)
Copper (Cu)
Mercury (Hg)
Lead (Pb)
Zinc (Zn)
Sum of 7 CBs (CB-28, -52, 101, -118, -138, -153 and -180)
CB-153
DDEPP (ppDDE)
γ-HCH
HCB

MYTI EDU - Blue Mussel (*Mytilus edulis***)**
GADU MOR - Atlantic cod (*Gadus morhua***)**
PLAT FLE - Flounder (*Platichthys flesus***)**
LIMA LIM - Dab (*Limanda limanda***)**
PLEU PLA - Plaice (*Pleuronectes platessa***)**
MICR KIT - Lemon sole (*Microstomus kitt***)**
LEPI WHI - Megrim (*Lepidorhombus whiff-iagonis***)**

Station positions are shown on maps in Appendix F. .

Appendix I.
Geographical distribution of contaminants in biota 1998-1999 (cont.)

A



B

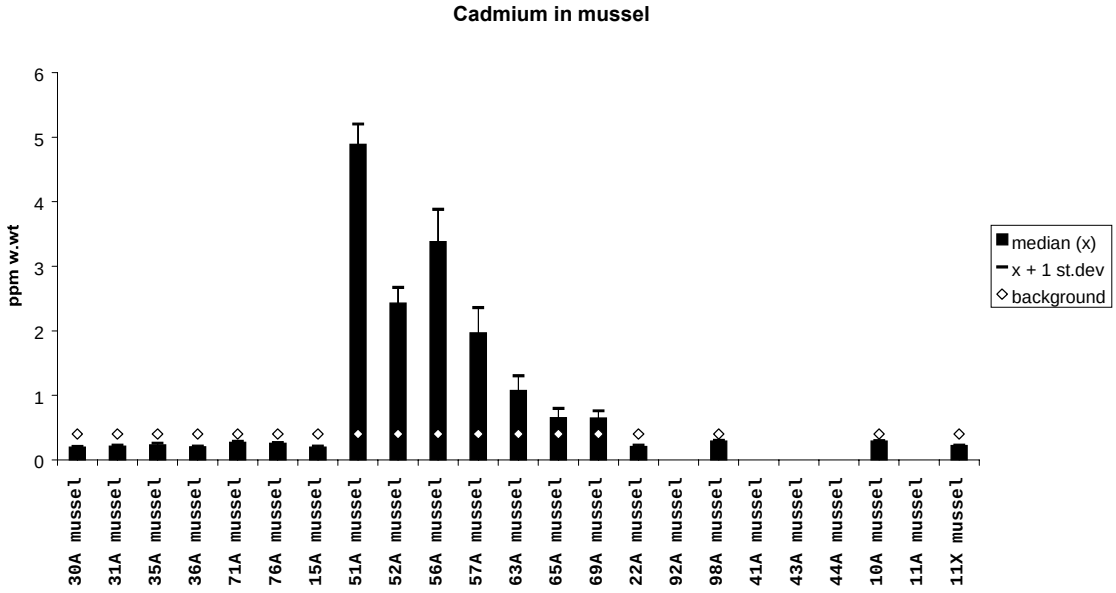


Figure 22. Median, standard deviation and provisional "high background" concentration for cadmium in mussels (*Mytilus edulis*) 1998 (**A**) and 1999 (**B**), ppm wet weight (see maps in Appendix F.).

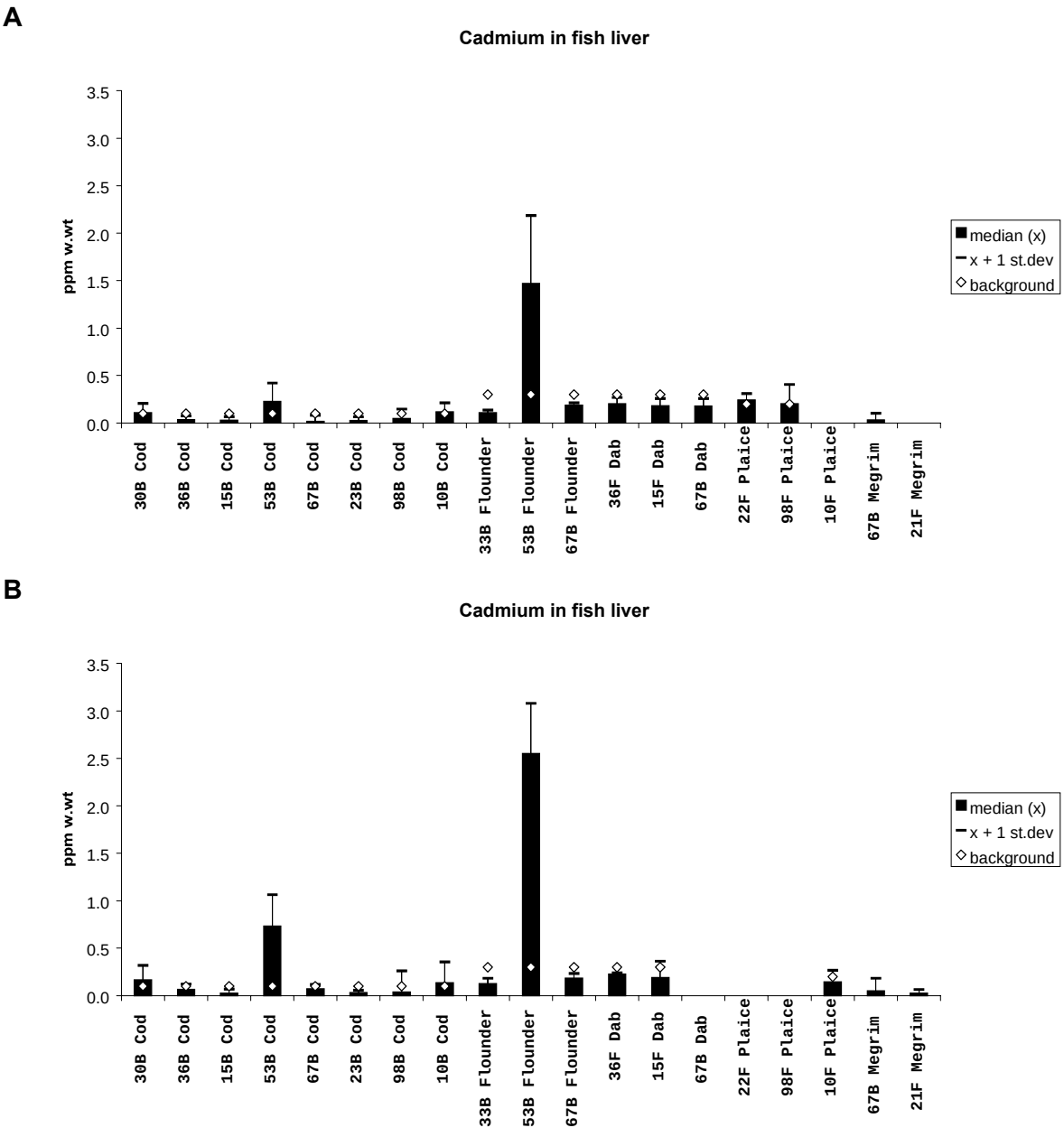


Figure 23. Median, standard deviation and provisional "high background" concentration for cadmium in fish liver 1998 (**A**) and 1999 (**B**), ppm wet weight (see maps in Appendix F.).

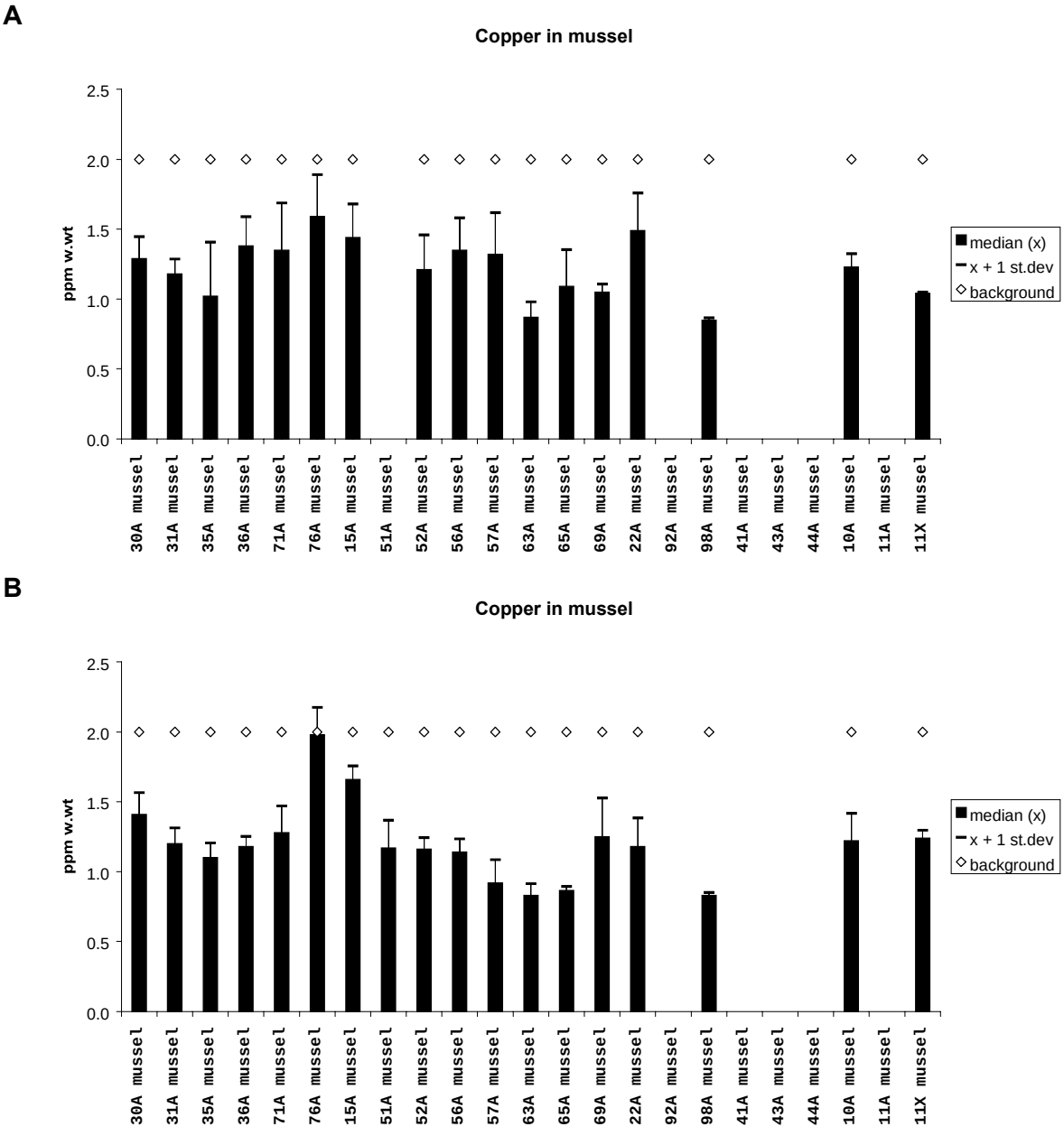


Figure 24. Median standard deviation and provisional "high background" concentration for copper in mussels (*Mytilus edulis*) 1998 (**A**) and 1999 (**B**), ppm wet weight (see maps in Appendix F.).

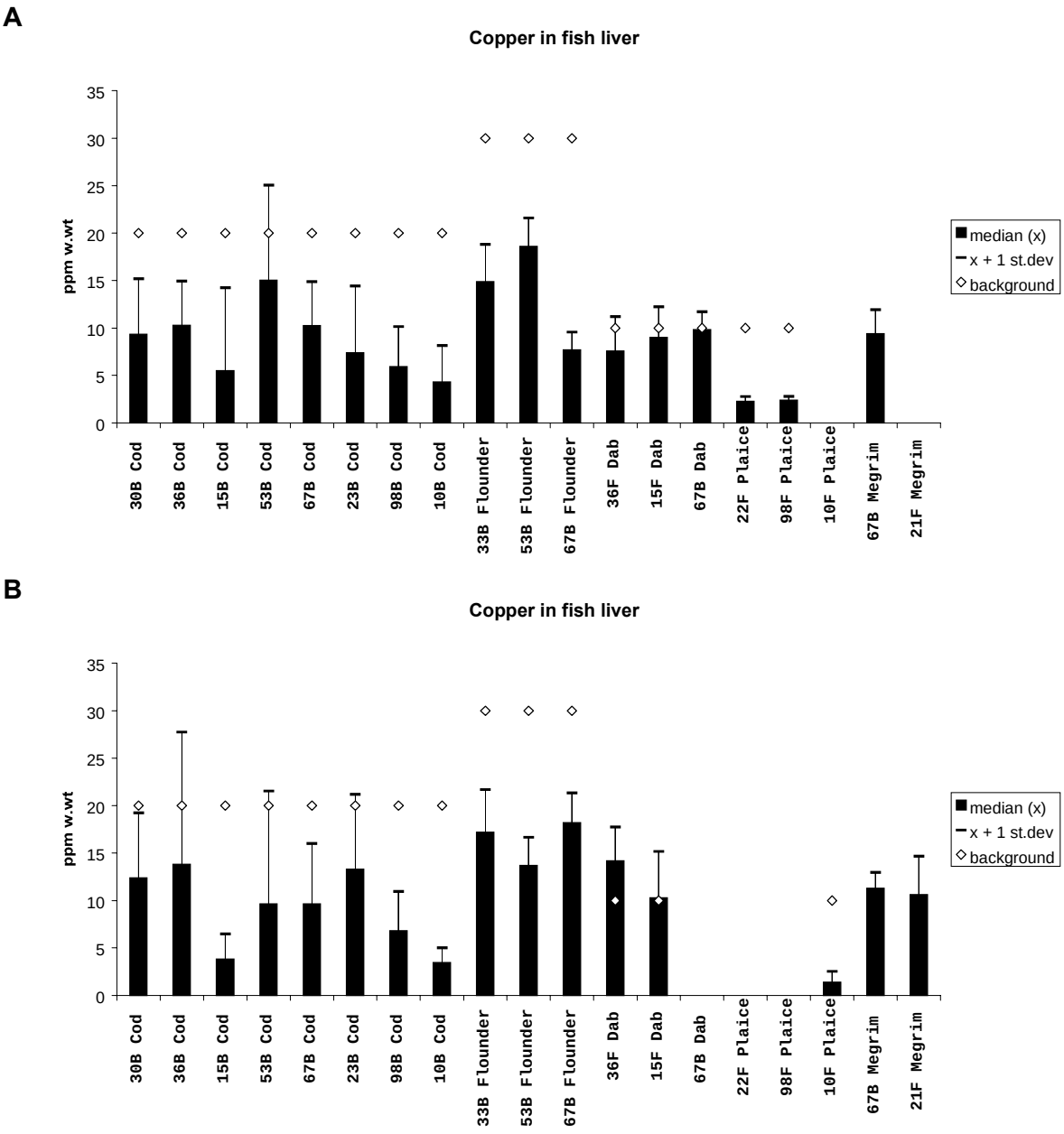


Figure 25. Median, standard deviation and provisional "high background" concentration for copper in fish liver 1998 (**A**) and 1999 (**B**), ppm wet weight (see maps in Appendix F.).

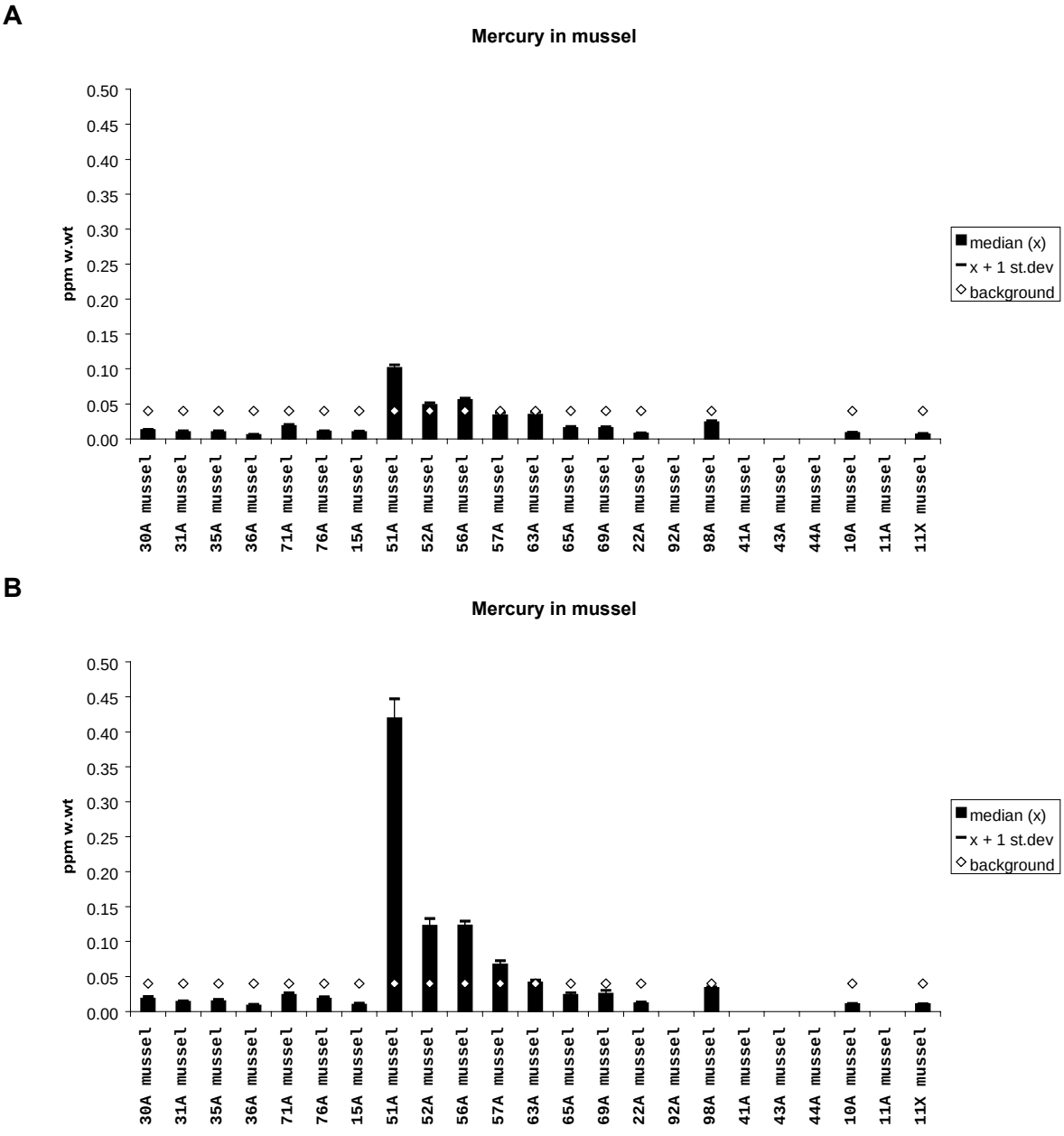


Figure 26. Median, standard deviation and provisional "high background" concentration for mercury in mussels (*Mytilus edulis*) 1998 (**A**) and 1999 (**B**), ppm wet weight (see maps in Appendix F.).

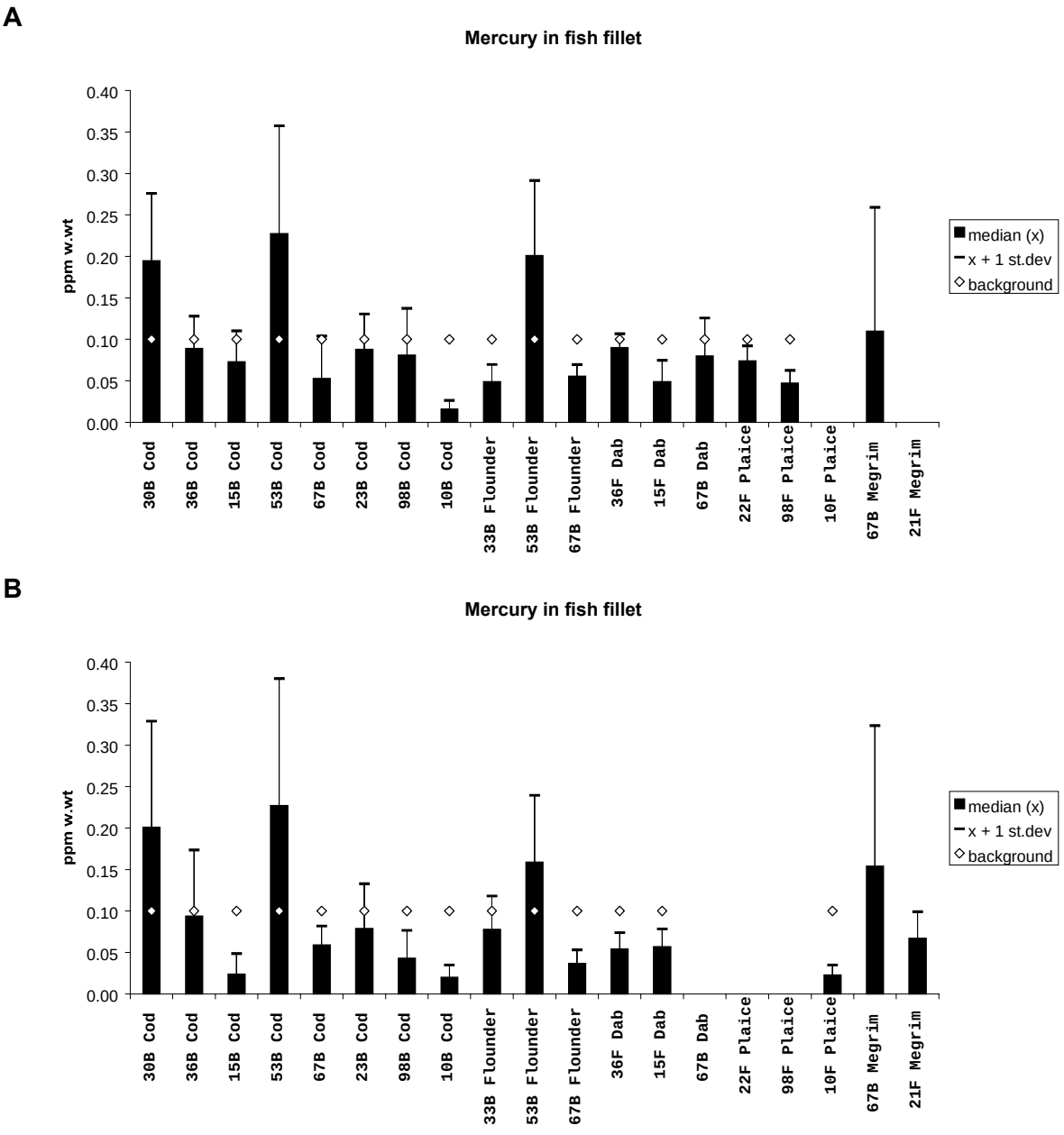


Figure 27. Median, standard deviation and provisional "high background" concentration for mercury in fish fillet 1998 (**A**) and 1999 (**B**), ppm wet weight (see maps in Appendix F.).

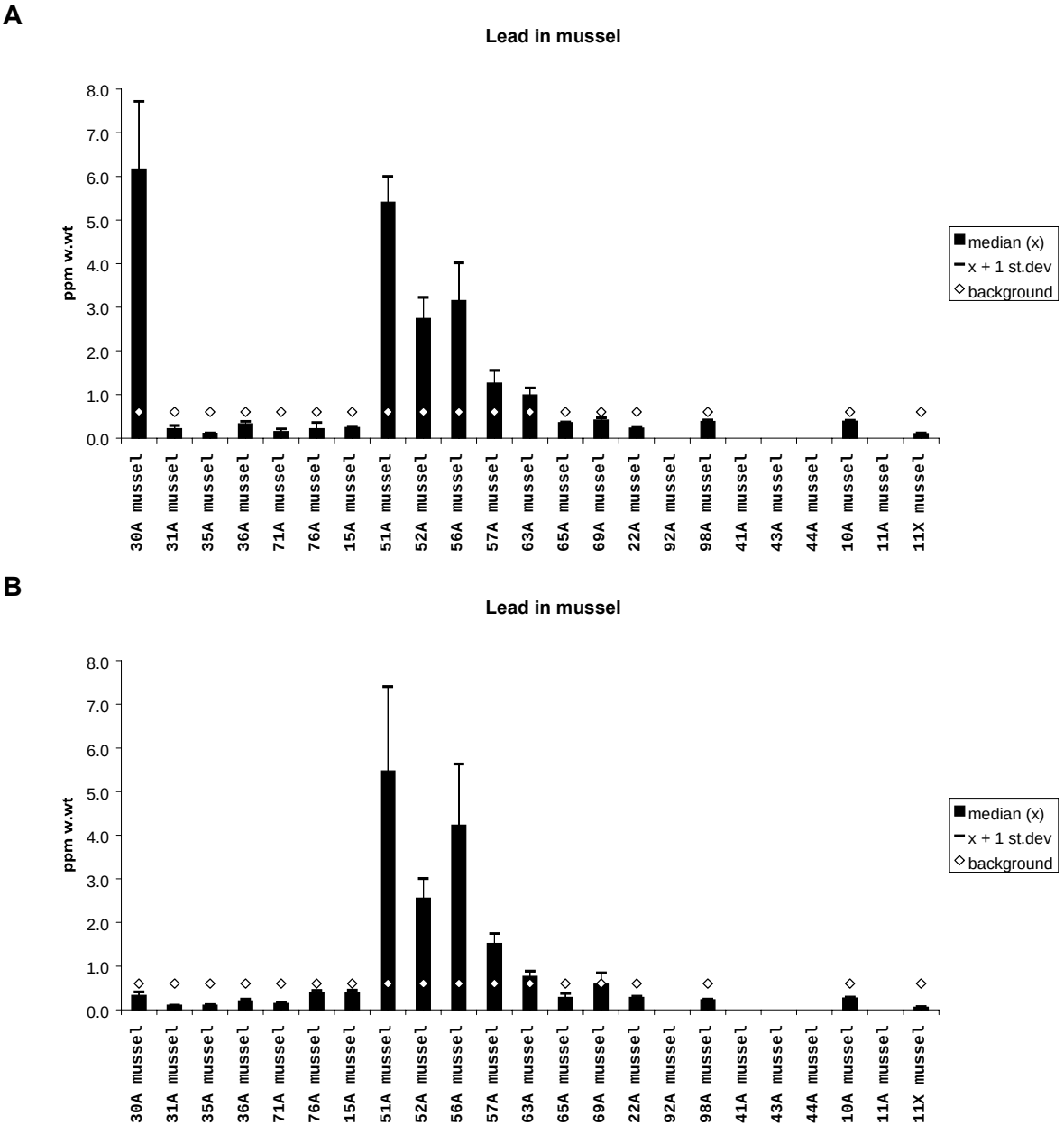


Figure 28. Median, standard deviation and provisional "high background" concentration for lead in mussels (*Mytilus edulis*) 1998 (**A**) and 1999 (**B**), ppm wet weight (see maps in Appendix F.).

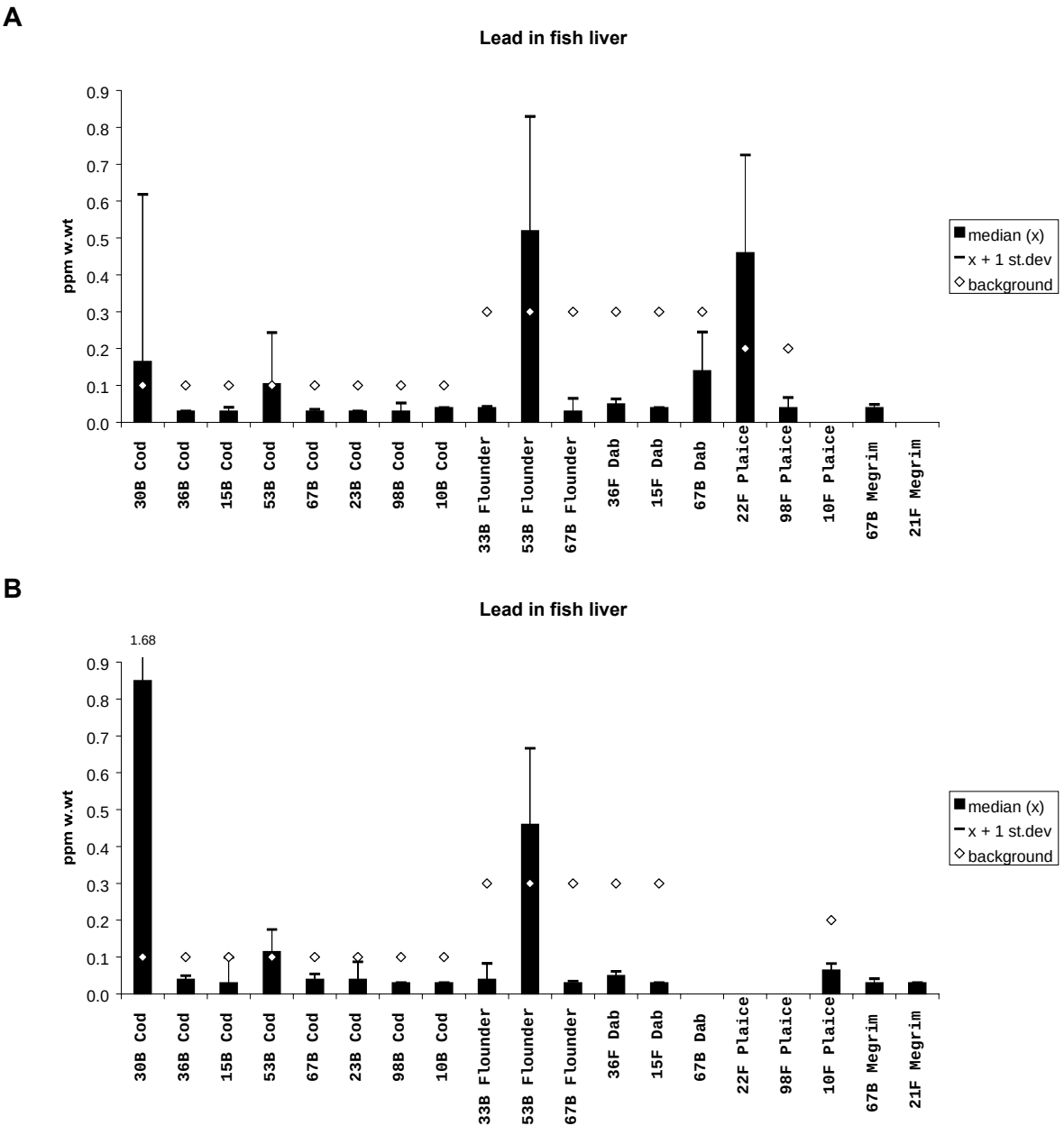


Figure 29. Median, standard deviation and provisional "high background" concentration for lead in fish liver 1998 (**A**) and 1999 (**B**), ppm wet weight (see maps in Appendix F.).

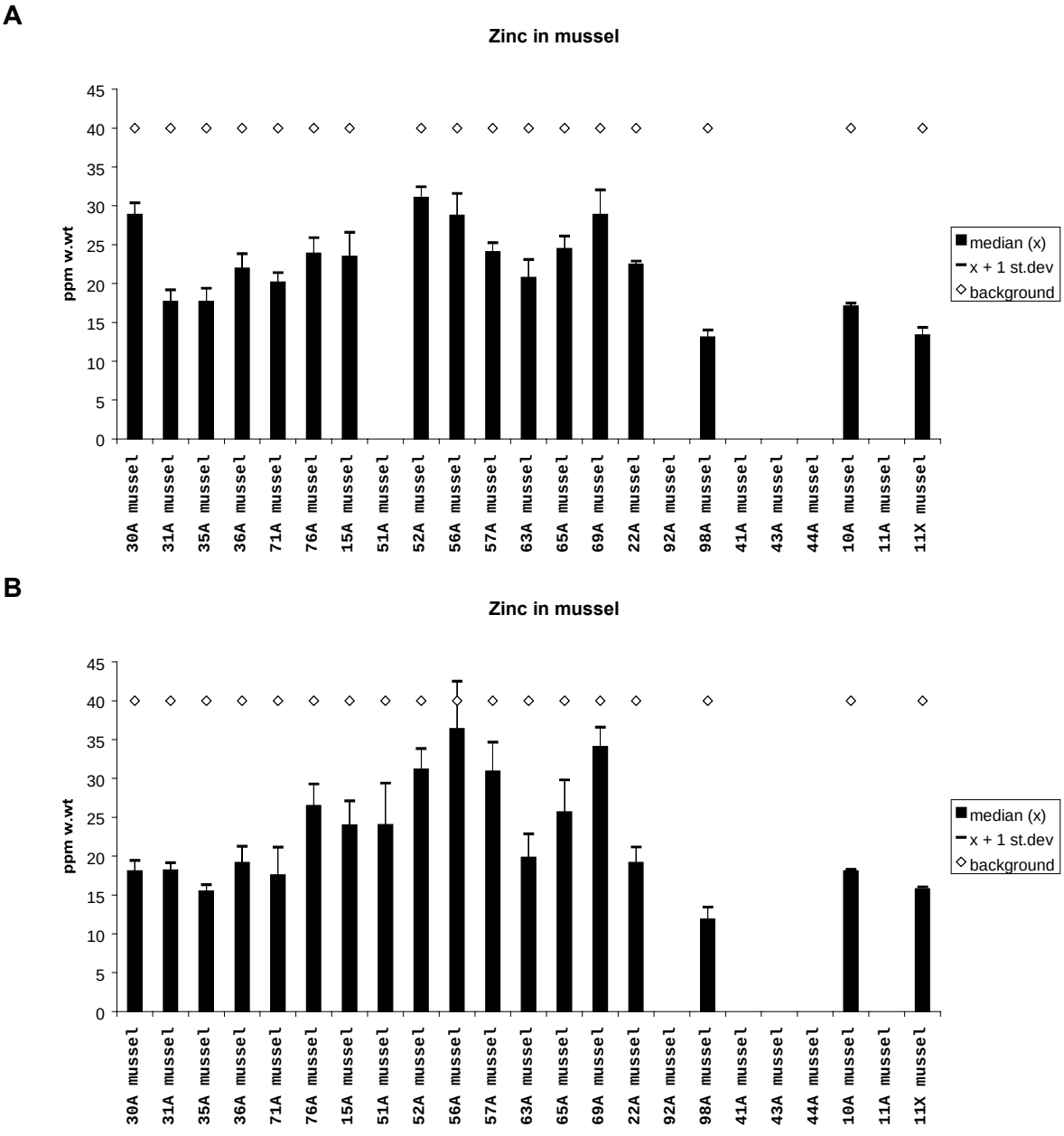


Figure 30. Median, standard deviation and provisional "high background" concentration for zinc in mussels (*Mytilus edulis*) 1998 (**A**) and 1999 (**B**), ppm wet weight (see maps in Appendix F.).

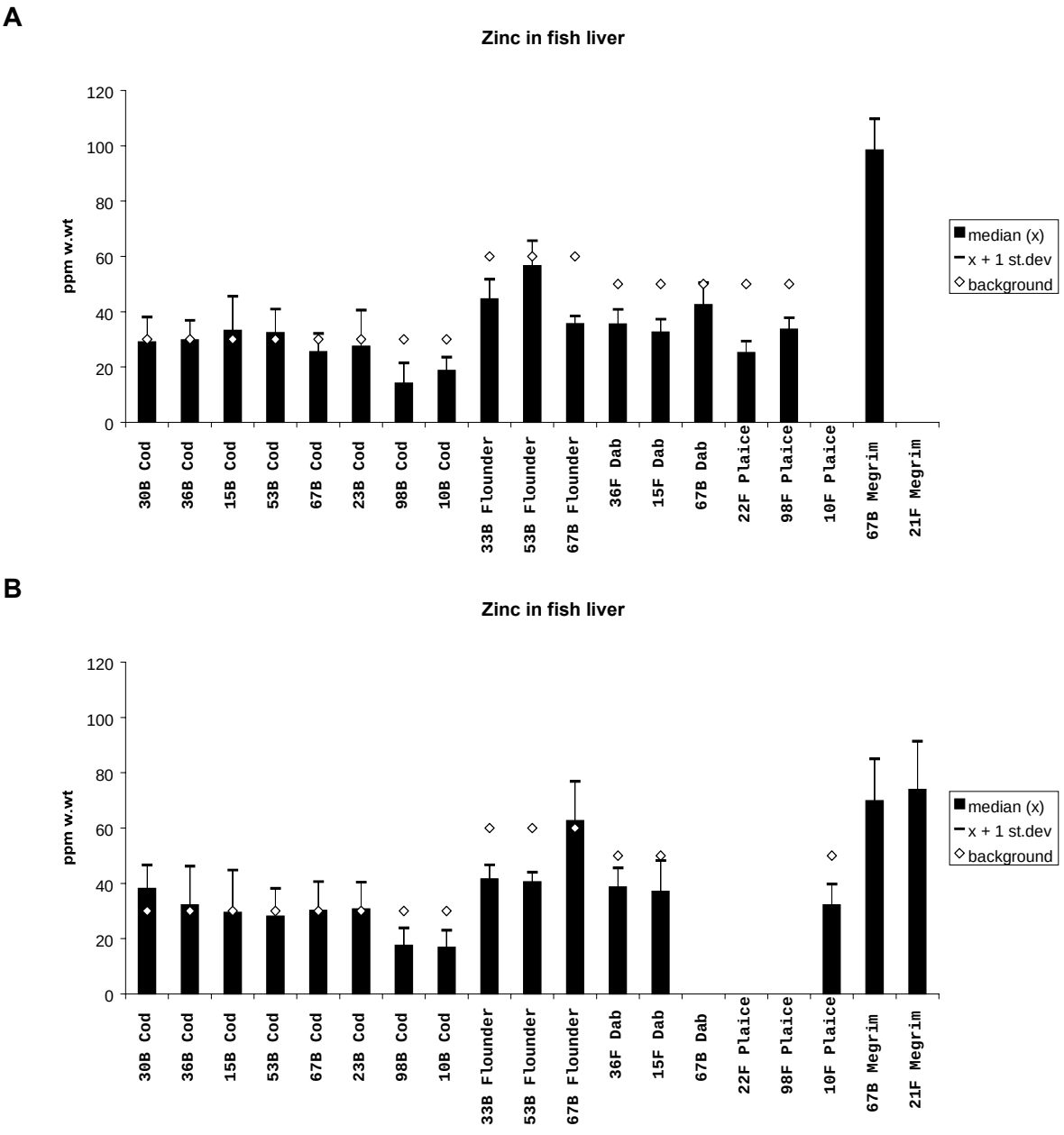


Figure 31. Median, standard deviation and provisional "high background" concentration for zinc in fish liver 1998 (**A**) and 1999 (**B**), ppm wet weight (see maps in Appendix F.).

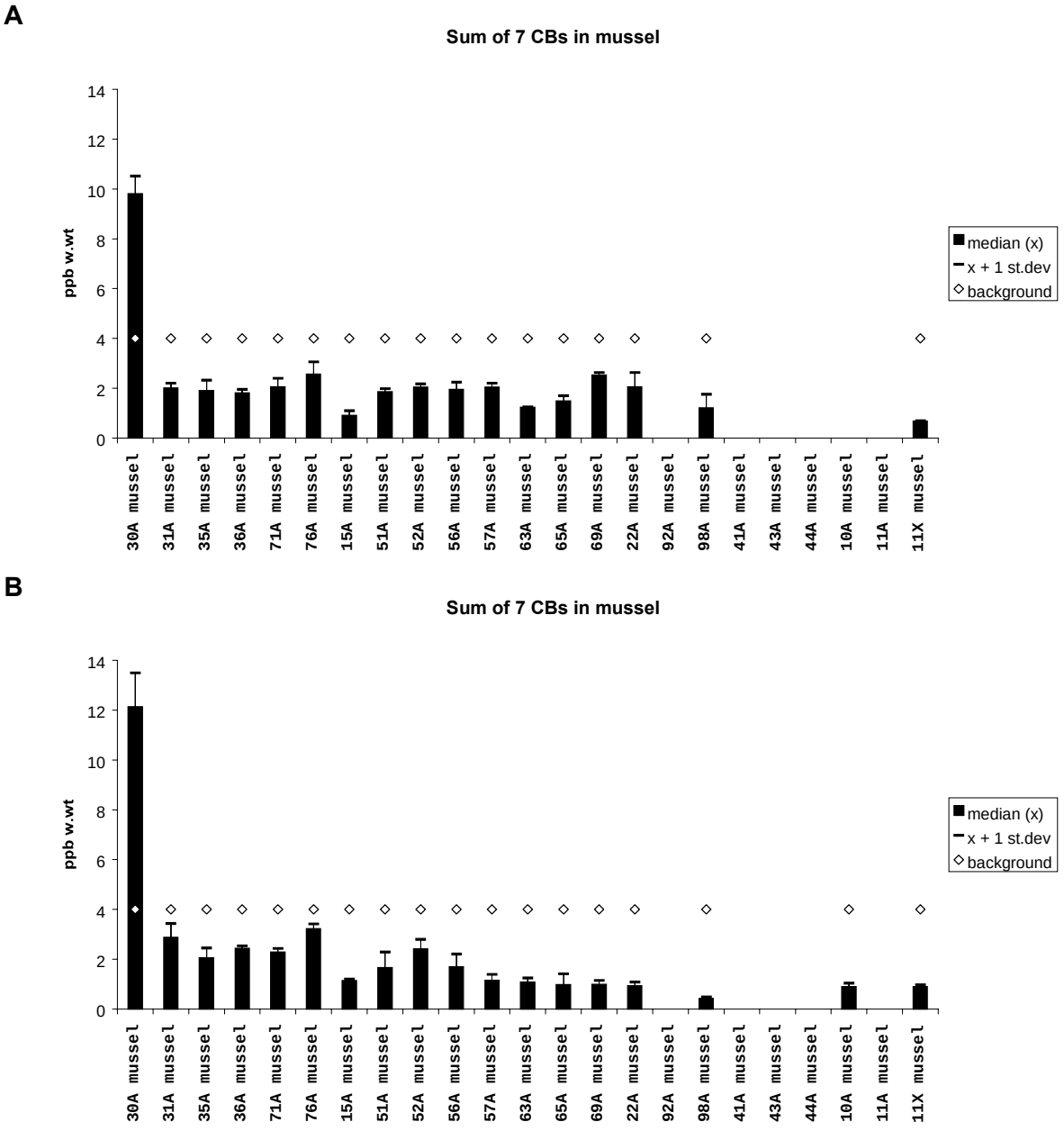


Figure 32. Median, standard deviation and provisional "high background" concentration for sum of 7 PCBs (CB-28, -52, 101, -118, -138, -153 and -180) in mussels (*Mytilus edulis*) 1998 (**A**) and 1999 (**B**), ppb wet weight (see maps in Appendix F.).

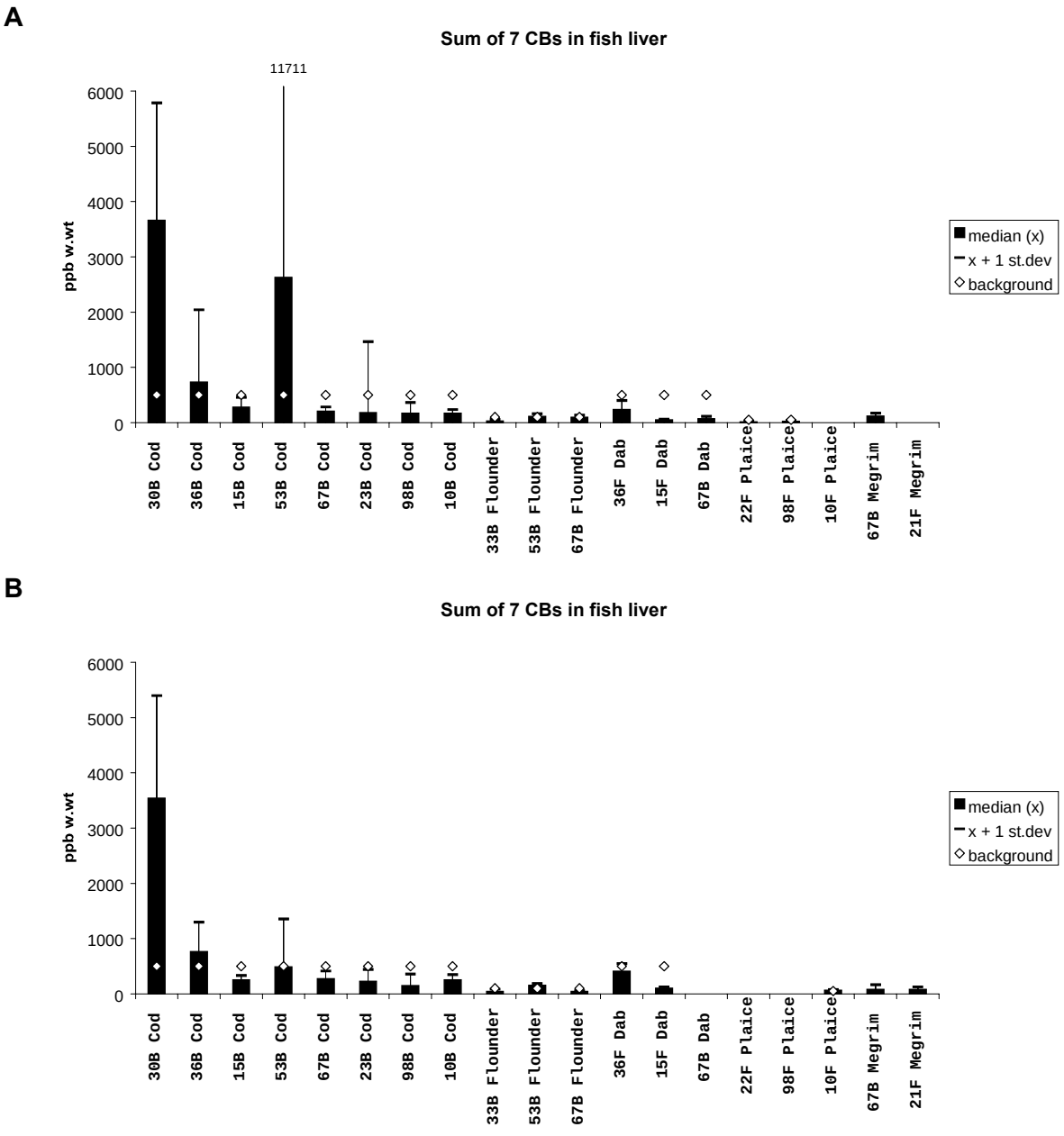
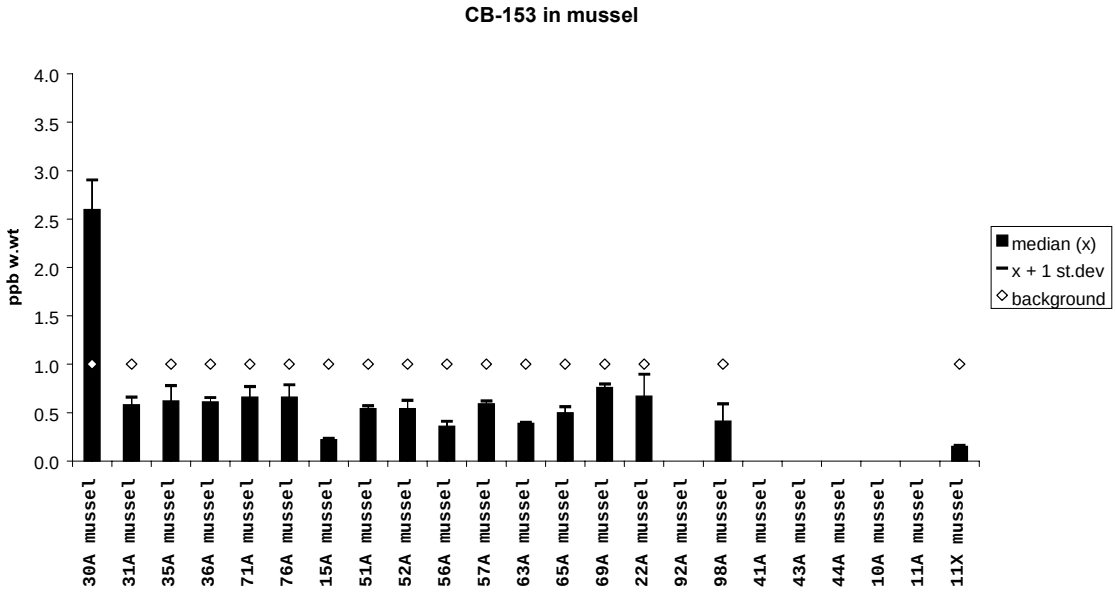


Figure 33. Median, standard deviation and provisional "high background" concentration for sum of 7 PCBs (CB-28, -52, 101, -118, -138, -153 and -180) in fish liver 1998 (**A**) and 1999 (**B**), ppb wet weight (see maps in Appendix F.).

A



B

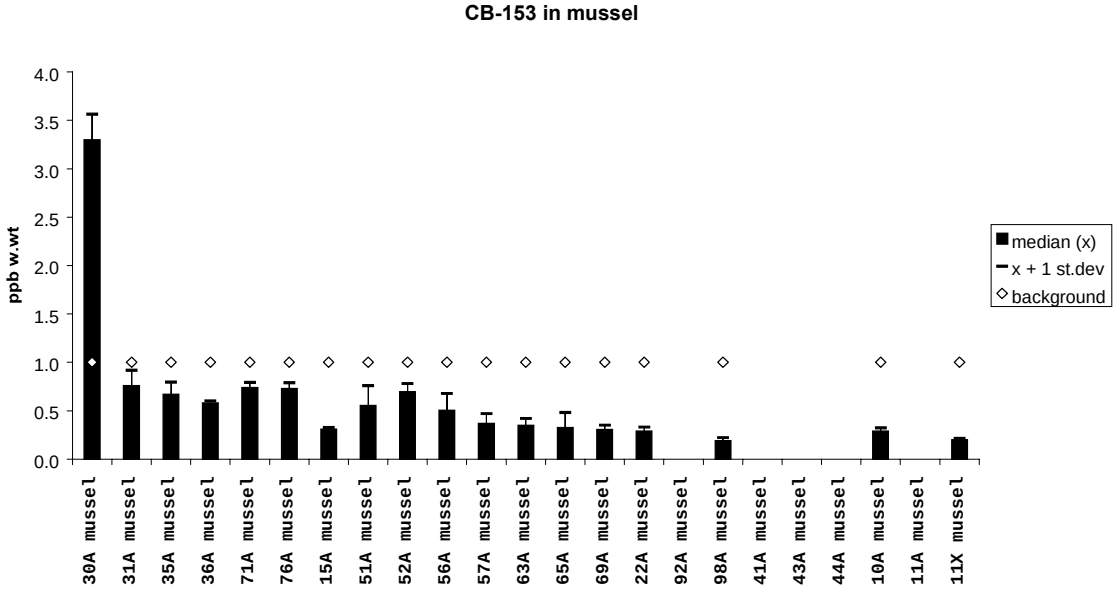


Figure 34. Median, standard deviation and provisional "high background" concentration for CB-153 in mussels (*Mytilus edulis*) 1998 (**A**) and 1999 (**B**), ppb wet weight (see maps in Appendix F.).

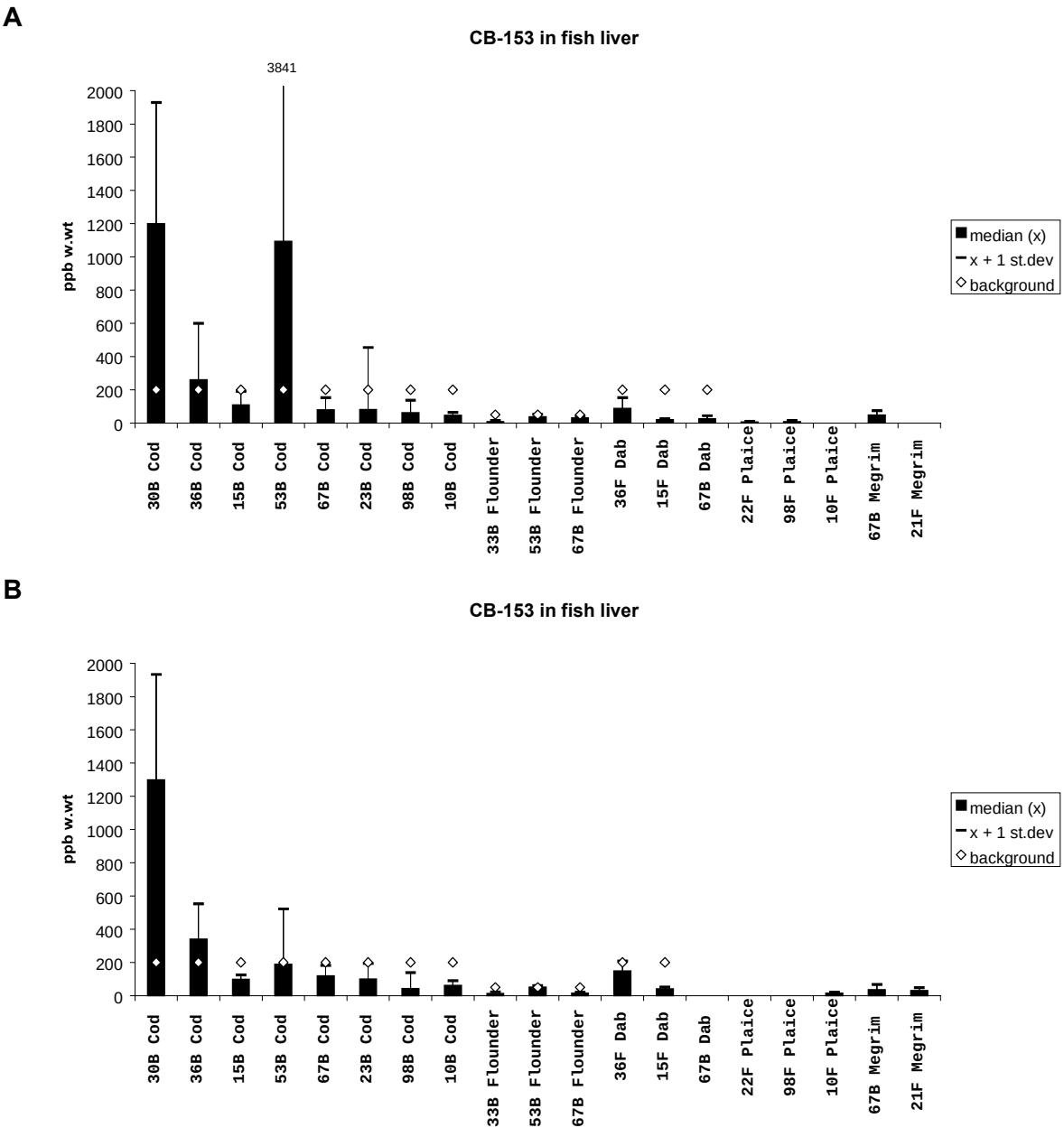


Figure 35. Median, standard deviation and provisional "high background" concentration for CB-153 in fish liver 1998 (**A**) and 1999 (**B**), ppb wet weight (see maps in Appendix F.).

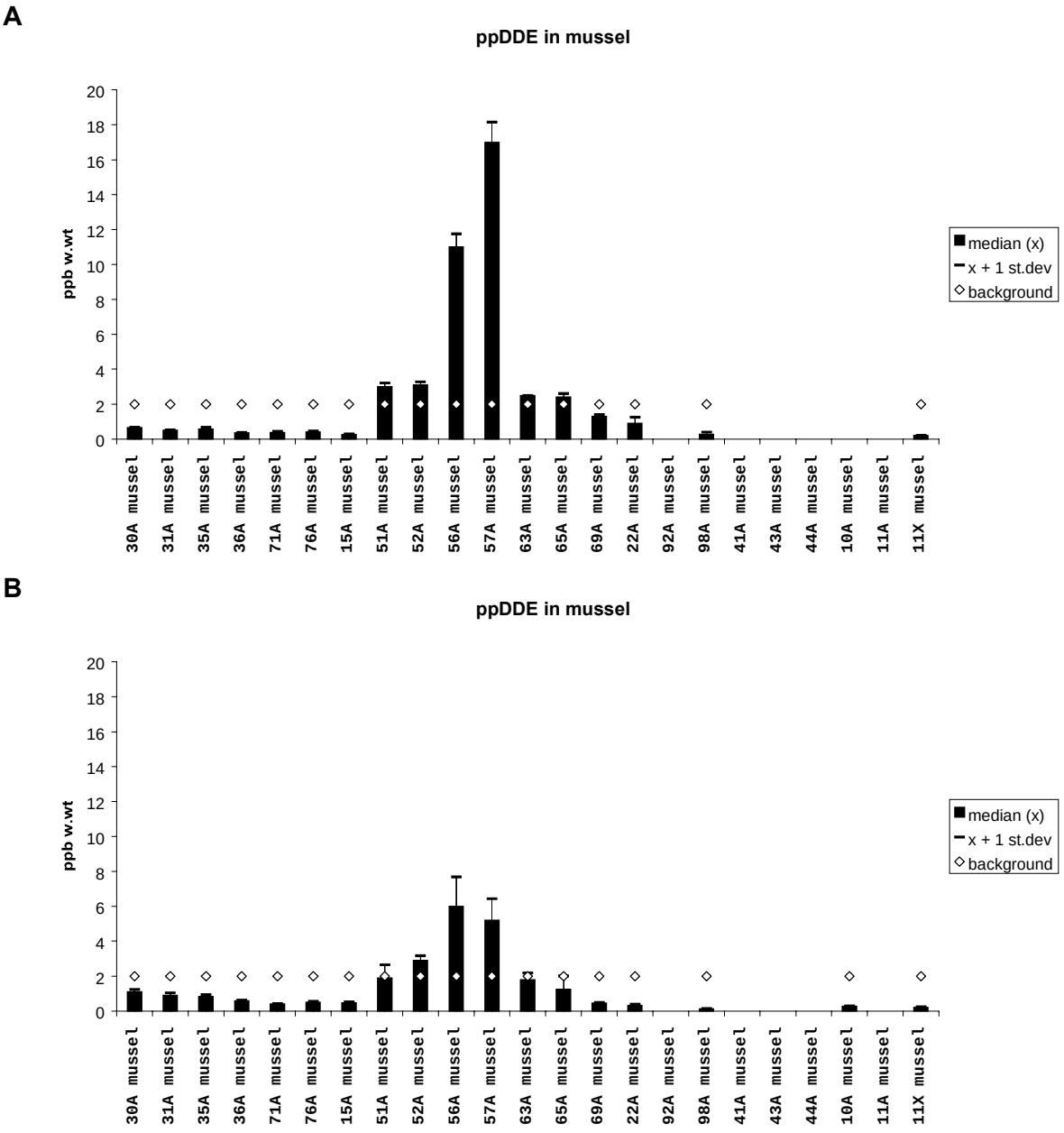


Figure 36. Median, standard deviation and provisional "high background" concentration for ppDDE (DDEPP) in mussels (*Mytilus edulis*) 1998 (**A**) and 1999 (**B**), ppb wet weight (see maps in Appendix F.). (See also footnote in Table 5.)

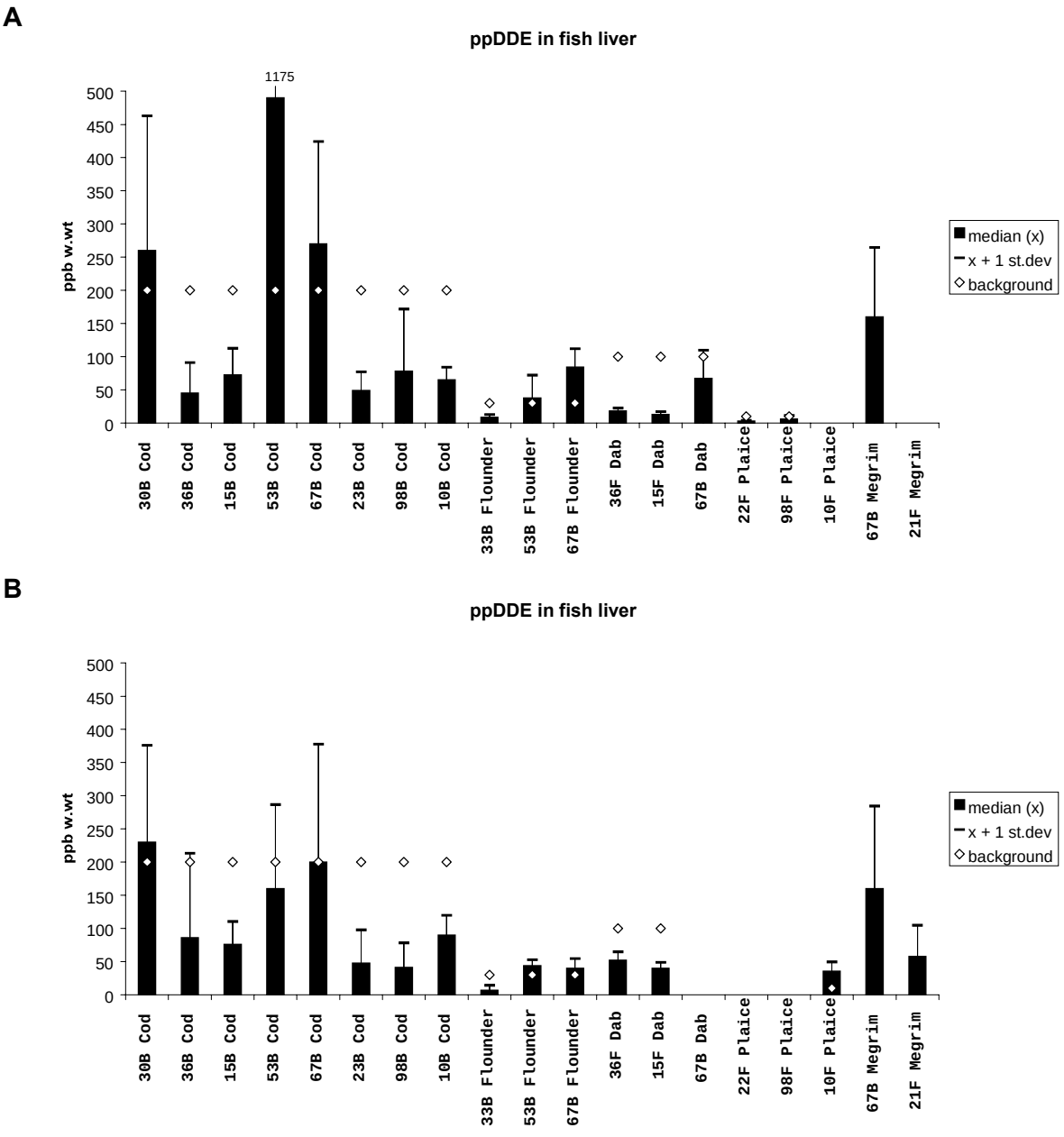


Figure 37. Median, standard deviation and provisional "high background" concentration for ppDDE (DDEPP) in fish liver 1998 (**A**) and 1999 (**B**), ppb wet weight (see maps in Appendix F.). (See also footnote in Table 5.)

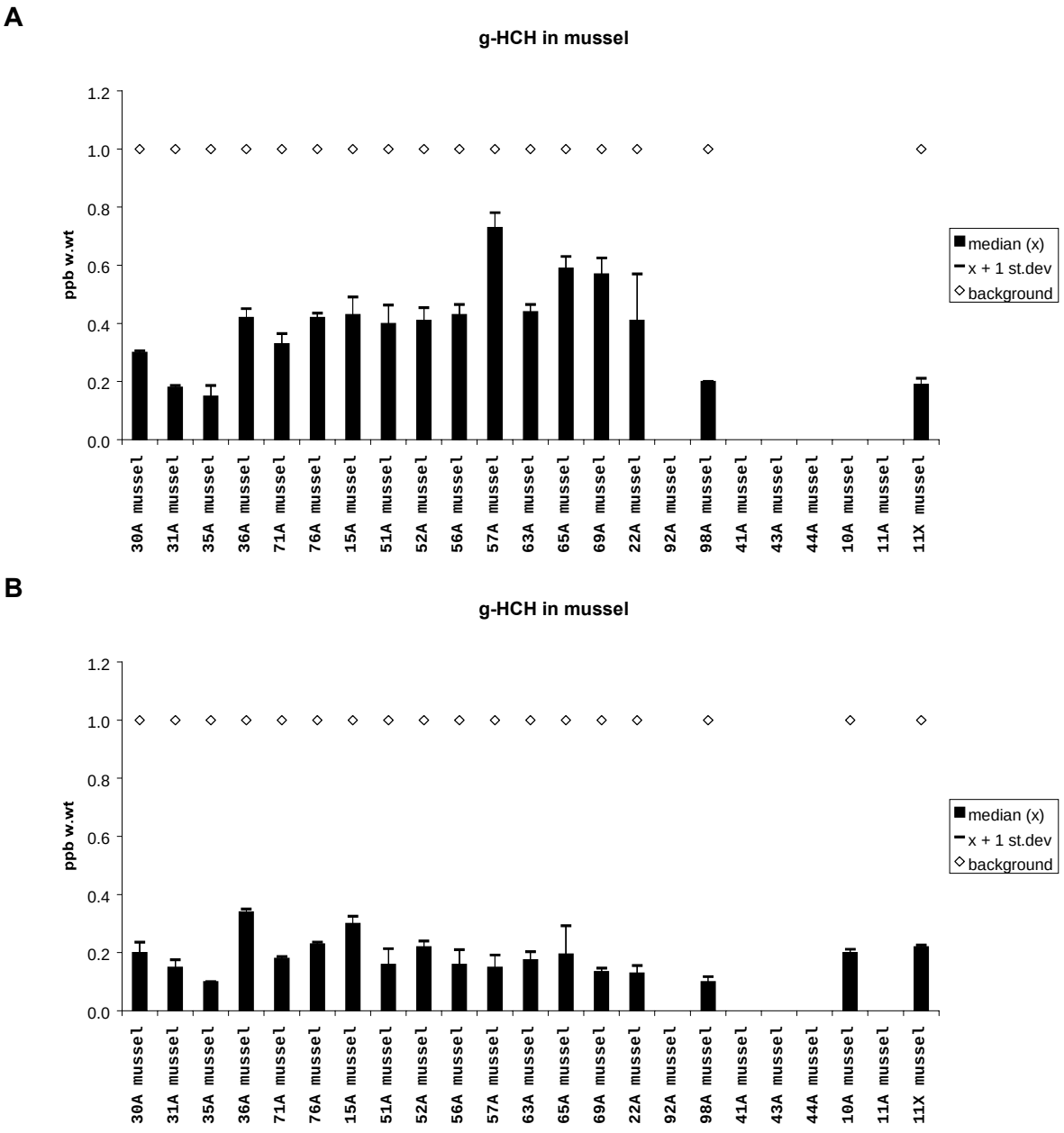
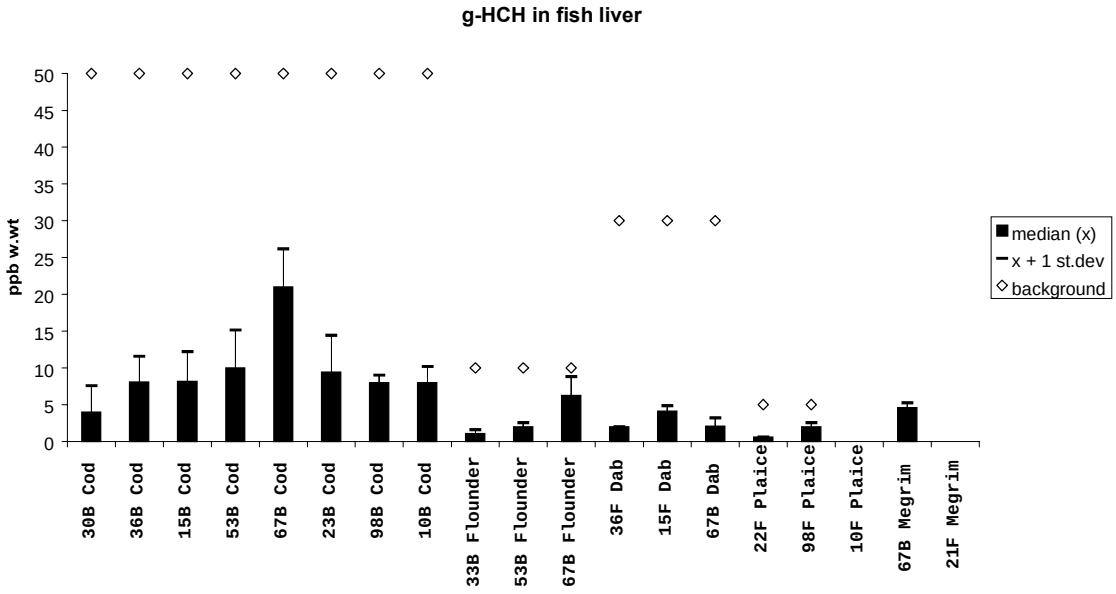


Figure 38. Median, standard deviation and provisional "high background" concentration for γ-HCH (Lindane) in mussels (*Mytilus edulis*) 1998 (**A**) and 1999 (**B**), ppb wet weight (see maps in Appendix F.). (See also footnote in Table 5.)

A



B

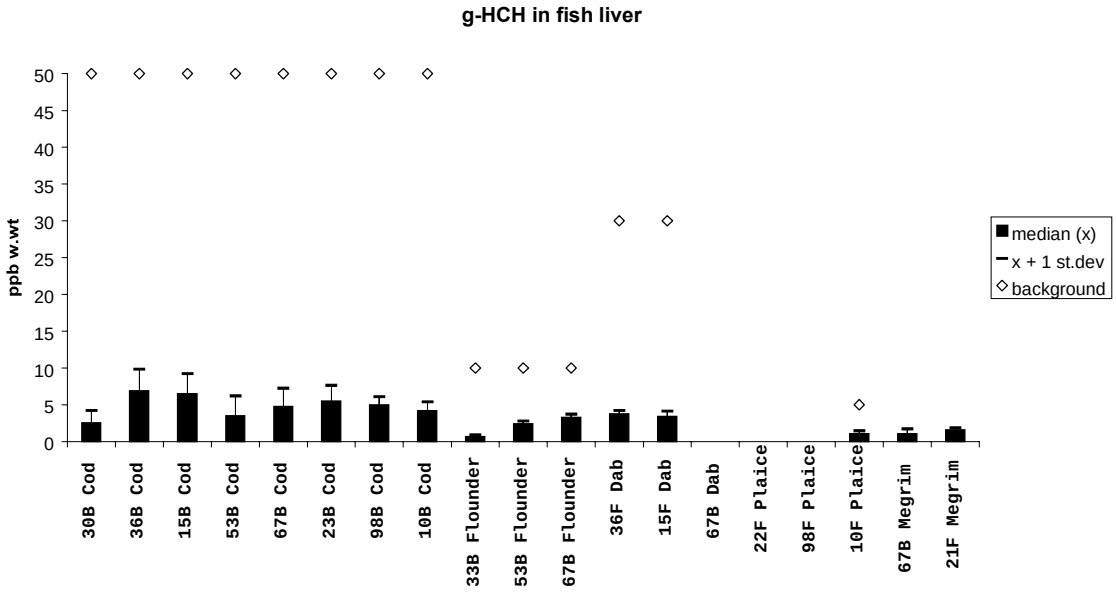


Figure 39. Median, standard deviation and provisional "high background" concentration for γ-HCH (Lindane) in fish liver 1998 (**A**) and 1999 (**B**), ppb wet weight (see maps in Appendix F.). (See also footnote in Table 5.)

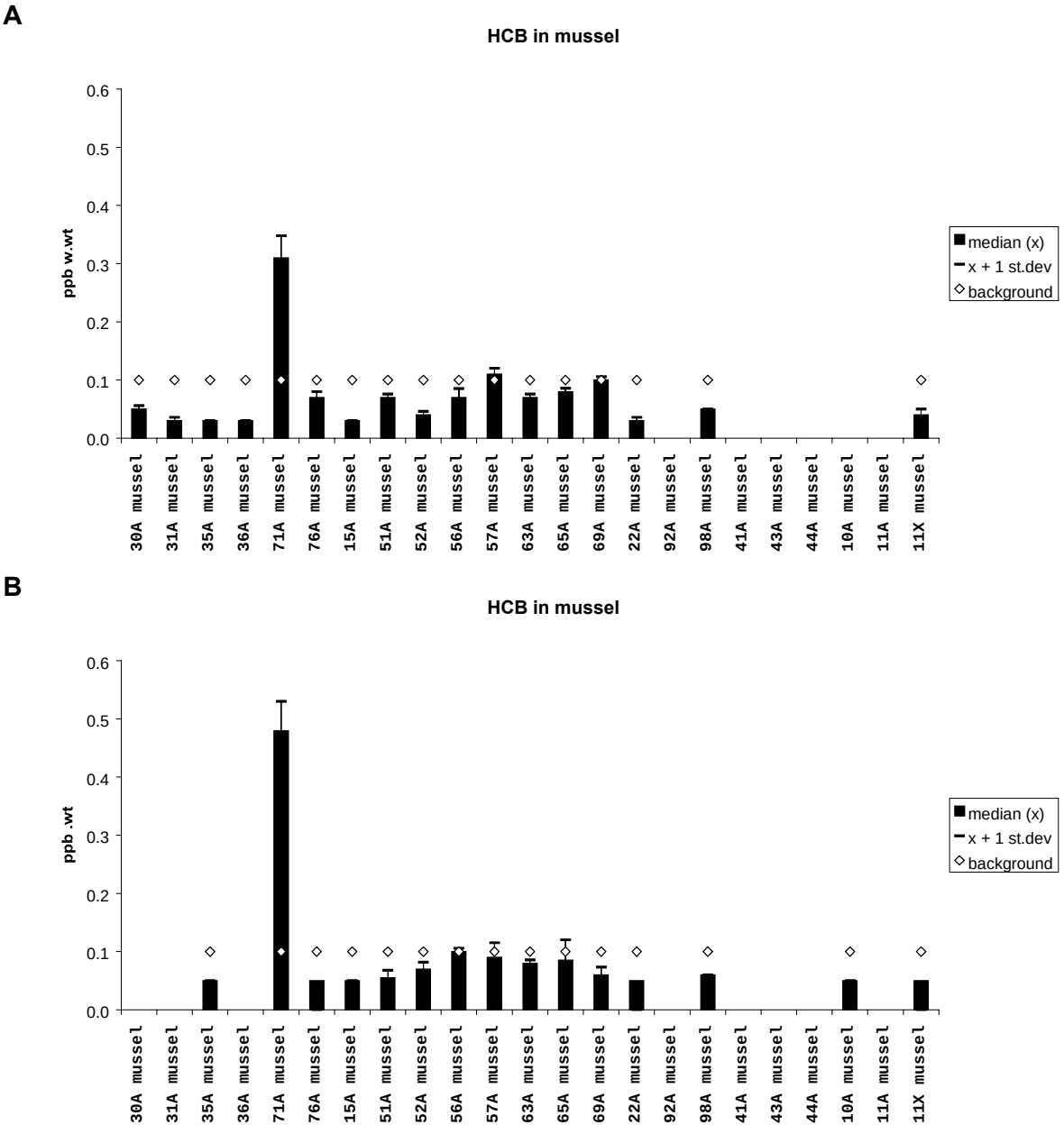


Figure 40. Median, standard deviation and provisional "high background" concentration for HCB in mussels (*Mytilus edulis*) 1998 (**A**) and 1999 (**B**), ppb wet weight (see maps in Appendix F.).

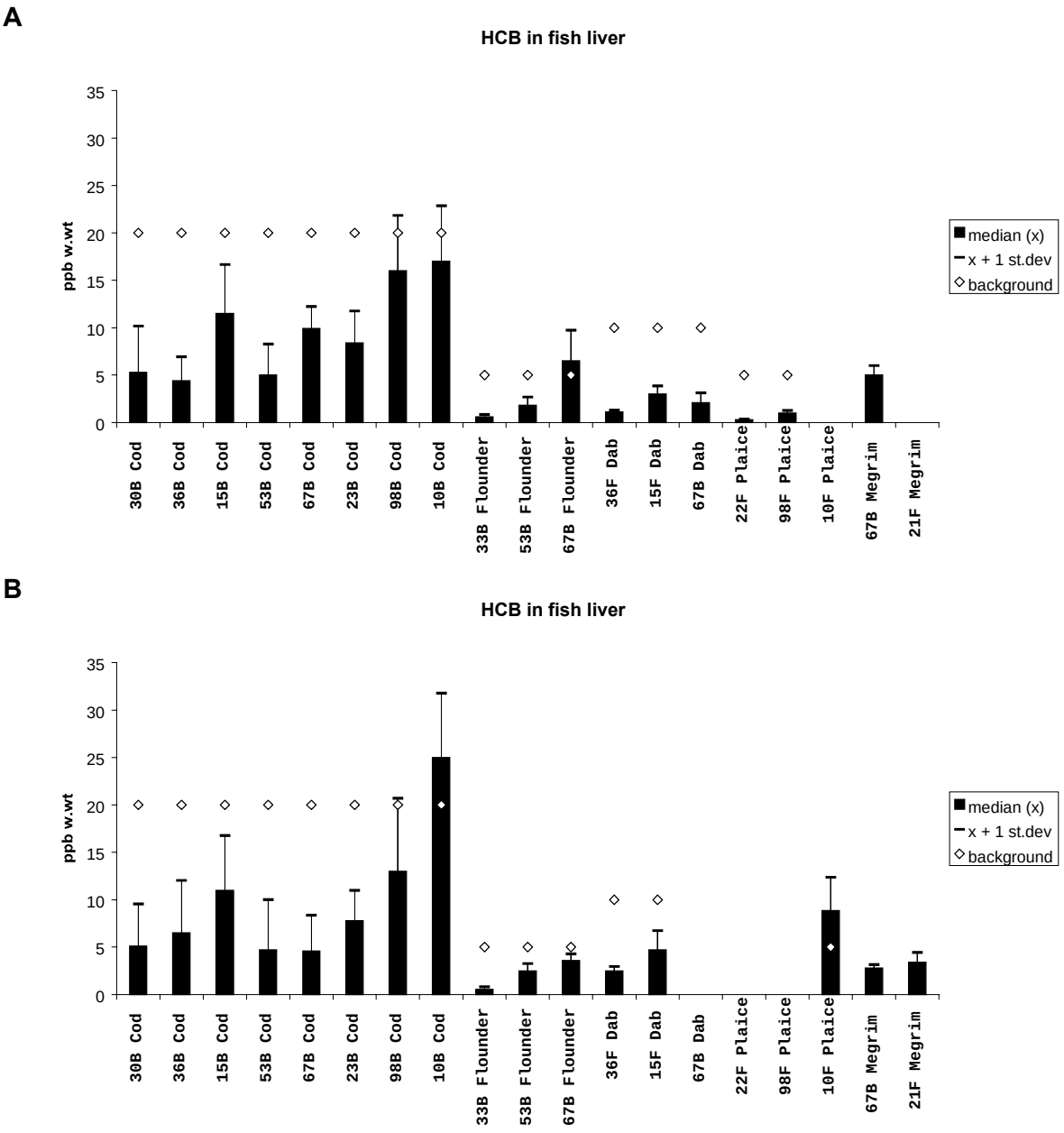


Figure 41. Median, standard deviation and provisional "high background" concentration for HCB in fish liver 1998 (**A**) and 1999 (**B**), ppb wet weight (see maps in Appendix F.).

Appendix J.
Results from INDEX determinations 1995-1999

Introduction

The Norwegian Pollution Control Authority (SFT) has requested that a small group of indices be established to assess the quality of the environment with respect to contaminants. The target medium for both indices may vary depending on the purpose, however sediment, cod and mussels are considered to be the most likely choices. Blue mussels were selected for this investigation (Appendix J. 1 and Appendix J. 2).

Two indices are calculated. One index is based on the contaminant concentrations in the blue mussel collected annually from 9 of the more contaminated fjords in Norway (Walday *et al*. 1995), herein designated "Pollution Index". This index was initiated in 1995. Initially there were 11 fjords but sampling from Orkdalsfjord and Iddefjord was discontinued in 1997. It was practical to organise sampling within JAMP. Some JAMP results could be used to calculate the index value.

In addition, a "Reference Index" was initiated in 1995 based on annual contaminant concentrations in the blue mussel. The mussels were collect at JAMP stations along the entire coast where there is presumably low levels of contamination. The importance of "reference" stations for monitoring of contaminants has been discussed earlier (cf. Green 1987). One of the main reasons for this work is to establish points of reference for contaminated fjords. Initially 8 areas were involved but since 1998 only 5 have been sampled.

Calculation of the index

Sampling strategy and a detailed discussion of calculation of the Pollution Index has been given earlier (cf. Walday *et al.* 1995) and only a brief summary will be given here. The relevant contaminants for each of the Pollution Index fjords are summarised in Appendix J. 2 and 3. Their selection is based on earlier investigations. Two to five stations were sampled from each area. Three parallels of 20 individuals from 3-5 cm are collected from each station. Each sample was analysed for the contaminants according to the scheme in Appendix J. 3. "Dioxins" were only investigated in 1995-96.

One to three stations were sampled from selected areas for the determination of the Reference Index. Each station included three parallels which were analysed for the usual JAMP contaminants (cf. analysis code A, Appendix J. 3). Some samples were also analysed for PAHs and dioxins.

The strategy for sampling mussels differed depending on whether the mussels were to be used for the Index or for JAMP and Index in that stations that were exclusively to be used for Index calculations allowed a slightly greater size range (3-5 cm) compared to JAMP and that the mussels were frozen directly and not depurated.

The maximum median for each contaminant for all the stations in an area was determined. These concentrations were classified according to SFT's classification system for contaminants in the marine environment (Appendix J. 4). The highest class found for any contaminant measured in an area determined the index value for that area.

The SFT Classes are based on the provisional "high background" levels. This system has been revised (Molvær *et al.* 1997); where among other changes the sum of CB-28, -52, -101, -118, -138, -153, and -180 (CBΣΣe) is now a distinct parameter for classification. The sum of all PAHs excluding the dicyclic PAHs (PAH_Σ) was compared to the system's "sum-PAH". Previously the calculation of sum-PAH included the dicyclic PAHs. For this report PAH_Σ was calculated for previous years and hence, the classification may vary a class from what has been previously reported. "Dioxins" were assessed based on toxicity equivalency factors (TEQ) according to a Nordic model (Ahlborg 1989) which differs insignificantly from the recently revised WHO-model (van den Berg *et al.* 1998). Note that EPOCl is considered a relevant contaminant for one area but is not included in the part of the classification system based on levels in mussels. Likewise, there are contaminants which are included in the classification system but have not been measured in any area (e.g., tributyltin (TBT), arsenic, fluoride, nickel, silver).

The maximum class found for any contaminant determined the Class (I-V) of the area. The average Class for all the contaminated sub areas and all the reference localities determined the Pollution or Reference Index, respectively. The lowest Index value is 1 and means that all median values were in Class I ("Good"). The highest Index value is 5 and means that at least one median value from each of the areas was in Class V ("Very bad").

Conclusion from application of the indices

To compare the 1999 results with previous years the calculations were done on a common basis with respect to areas and contaminants. Nine fjord areas were used to calculate the Pollution Index for 1998-1999 compared to eight for 1995-97. No special considerations were made when one but not all the stations within an area were sampled. This occurred five times for the Pollution Index (st. I205 Bølsnes from Saudafjord 1996, st.I911 Horvika in the Sunndalsfjord 1997 and 1998, st. I021 in the Hvaler area and st.I962 in the Inner Ranfjord 1999). Because insufficient amount of mussels were not found at station I911 Horvika 1997-1998, a new station (I913 Fjøseid) was introduced in 1999 between st.I911 and I912 Honnhammer about 15km farther out the fjord. The Pollution Index for 1999 is 3.1 (Table 8, Appendix J. 5). A value between 3 and 4 would be termed by the SFT system as “Bad”.

Only 5 fjords/areas were monitored for the Reference Index for 1998-1999 compared to 7 for 1997 and 8 for 1995-1996 (Table 9, Appendix J. 6). However only four of these provided a common basis (cf., Table 9). As for Pollution Index, no special considerations were made when one but not all the stations within an area were sampled. This occurred five times in these four areas for the Reference Index (Varangerfjord st.48A 1997-1999 and st.11A 1998-1999). The value for 1999 is 1.3 and the same as for 1997-1998. A value between 1 and 2 would be termed by the SFT system as “Fair”.

Table 8. Maximum environmental classification for fjords selected for Pollution INDEX. (See text and Appendix J. 5).

Index Area [1]	1995	1996	1997 [2]	1998	1999
Hvaler/Singlefjord	2	2	2	3	2
Iddefjord	-	-	-	-	-
Inner Oslofjord	3	3	4	2	3
Frierfjord, Grenlandsfjords	3	4	3	3	3
Inner Kristiansandsfjord	5	5	5	5	5
Saudafjord	4	5	5	3	4
Sørfjord	5	4	3	3	4
Byfjorden, Bergen [3]	3	3	3	2	2
Sunndalsfjord	3	3	3 [4]	2	3
Orkdalsfjord	-	-	-	-	-
Inner Ranfjord	5	3	3 [5]	4	2
AVERAGE (Pollution INDEX)	**3.7**	**3.6**	**3.4**	**3.0**	**3.1**

[1] Iddefjord and Orkdalsfjord not sampled since 1997, hence the indices 1995-96 do not include the local indices from these fjords

[2] Copper, zinc and TCDDN excluded since 1997, hence indices for 1995-96 excludes these contaminants

[3] PCB (DDTΣ, HCB, HCHΣΣ and CBΣΣ) analysed in stored samples for 1995-1996

[4] Change in classification (cf. Green *et al.* 1999) due to recalculation of PAHs that excluded the dicyclic compounds

[5] Change in classification (cf. Green *et al.* 1999) due to calculation error

Table 9. Maximum environmental classification for fjords selected for Reference INDEX. (See text and Appendix J. 6).

Index Area	1995	1996	1997	1998	1999
Mid and outer Oslofjord [1]	2	2	2	1	1
Lista	1	1	1	1	2
Bømlo-Sotra	1	1	1	1	1
Outer Ranfjord, Helgeland [2]	(1)	(1)	-	-	-
Lofoten [3]	(2)	(2)	(1)	(2)	(2)
Finnsnes-Skjervøy [2]	(2)	(1)	(1)	-	-
Hammerfest-Honningsvåg [2]	(2)	(3) [4]	(2)	-	-
Varanger Peninsula	1	2	1	2	1
AVERAGE (Reference INDEX)	**1.3**	**1.5**	**1.3**	**1.3**	**1.3**

[1] Inclusion of results for arsenic, nickel and silver in 1996 (see Appendix J. 6) did not affect the classification

[2] Outer Ranfjord, Finnsnes-Skjervøy and Hammerfest-Honningsvåg stations were not sampled in 1998, hence, the index for 1995-97 did not take these results into account. See cf., Green *et al.* 2000 for more details for outer Ranfjord.

[3] Inconsistency in sampling site, st.98X in 1995-96 and st.98A in 1997, hence, results from Lofoten excluded. See cf., Green *et al.* 2000 for more details for st 98X.

[4] Change in classification (cf. Green *et al.* 1999) due to recalculation of PAHs that excluded the dicyclic compounds

Appendix J. 1.
INDEX - Stations and programme 1995-99

Appendix J. 1. INDEX station positions and sampling overview for blue mussels 1995-98, where P = "Pollution Index" and R = "Reference Index" (contaminated and assumed "background" stations, respectively). Mussels were sampled from rock surfaces unless otherwise noted. See Walday *et al.* (1995) for discussion of station selection and analyses.

Station		Locality name	North latitude	East longitude	ICES position	INDEX type P/R	notes
HVALER/SINGLEFJORDEN, east of outer OSLOFJORD							
	I021	Kjøkø, south	59°07.8'	10°57.1'	47G13	P	
	I024	Kirkø, north west	59°04.9'	10°59.2'	47G09	P	
	I022	West Damholmen	59°06.2'	10°57.9'	47G09	P	
	I023	Kirkø, north west	59°05.7'	11°08.2'	47G09	P	
IDDEFJORD, east of outer OSLOFJORD							
	I001	Sponvikskansen	59°05.4'	11°12.5'	47G09	P	
	I011	Kråkenebbet	59°06.1'	11°17.3'	47G09	P	
INNER OSLOFJORD							
JAMP	30A	Gressholmen	59°52.5'	10°43.0'	48G07	P	
	I301	Akershuskaia	59°54.2'	10°45.5'	48G07	P	
	I304	Gåsøya	59°51.0'	10°35.5'	48G04	P	
	I307	Ramtonholmen	59°44.7'	10°31.4'	48G05	P	
	I306	Håøya	59°24.7'	10°33.4'	48G04	P	
MID and OUTER OSLOFJORD							
JAMP	31A	Solbergstrand	59°36.9'	10°39.4'	48G06	R	
JAMP	35A	Mølen	59°29.2'	10°30.1'	47G04	R	
JAMP	36A	Færder	59°01.6'	10°31.7'	47G06	R	
FRIERFJORD AREA, west of outer Oslofjord							
	I711	Steinholmen	59°31.7'	09°40.7'	48F99	P	
	I712	Gjermundsholmen	59°21.7'	09°42.6'	47F99	P	
JAMP	71A	Bjørkøya (Risøyodden)	59°01.4'	09°45.4'	47F99	P	
INNER KRISTIANSANDSFJORD							
	I132	Fiskåtangen	57°07.7'	07°59.2'	43F79	P	
	I133	Odderø, west	57°07.9'	08°00.3'	43F83	P	
LISTA AREA							
JAMP	15A	Gåsøy (Ullerø area)	58°03.1'	06°53.3'	45F69	R	
	I131	Lastad	58°03.3'	07°42.4'	45F79	R	7
SAUDAFJORD							
	I201	Ekkjegrunn (G1)	59°38.7'	06°21.4'	48F66	P	
**	I205	Bølsnes (G5)	59°35.5'	06°18.3'	48F63	P	
BØMLO AREA							
JAMP	22A	Espevær, west	59°35.2'	05°58.5'	48F59	R	C, 1
SØRFJORD							
*	51A	Byrkjenes	60°05.1'	06°33.1'	49F66	P	
JAMP	52A	Eitrheimsneset	60°05.8'	06°32.2'	49F66	P	3

Appendix J. 1 (cont'd)

Station	Locality name	North latitude	East longitude	ICES position	INDEX type P/R	notes
BYFJORDEN, Bergen						
I242	Valheimneset	60°23.7'	05°16.1'	49F51	P	
I241	Nordnes	60°24.1'	05°18.2'	49F51	P	
I243	Hagreneset	60°24.9'	05°18.3'	49F51	P	
SUNNDALSFJORDen						
I912	Honnhammer	62°51.2'	08°09.7'	54F81	P	
I911	Horvika	62°44.1'	08°31.4'	54F85	P	
I913	Fjøseid	62°49.0'	08°16.48'	54F85	P	
[TRONDHEIM AREA - not related to INDEX investigation**]**						
* 80A	Østmerknes	63°27.5'	10°27.5'	56G04	P	
ORKDALSFJORD AREA, supplementary area (cf. Walday *et al*. 1995)						
JAMP 82A	Flakk	63°27.1'	10°12.6'	56G01	P	
JAMP 84A	Trossavika	63°20.8'	09°57.8'	55F97	P	
JAMP 87A	Ingdalsbukt	63°27.8'	09°54.8'	55F97	P	
INNER RANFJORD						
I969	Bjørnbærviken (B9)	66°16.8'	14°02.1'	61G42	P	
I962	Koksverkkaien (B2)	66°19.4'	14°08.0'	61G42	P	3
OUTER RANFJORD, Helgeland area						
* 96A	Breiviken	66°17.6'	12°50.5'	61G28	R	1
LOFOTEN AREA						
JAMP 98A	Husvågen (1997)	68°15.4'	14°40.6'	65G46	R	5
JAMP 98A	Husvågen (1998)	68°16.9'	14°40.1'	65G46	R	
FINNSNES-SKJERVØY AREA						
JAMP 41A	Fensneset, Grytøya	68°56.9'	16°38.5'	66G64	R	3
HAMMERFEST-HONNINGSVÅG AREA						
JAMP 44A	Elenheimsundet	70°30.8'	22°14.8'	70H23	R	1, 6
JAMP 46A	Smineset in Altesula	70°58.4'	25°48.1'	70H57	R	3, 6
VARANGER PENINSULA AREA						
JAMP 48A	Trollfjorden i Tanafjord	70°41.6'	28°33.3'	70H85	R	
JAMP 10A	Skagoodden	70°04.2'	30°09.8'	69J03	R	2
JAMP 11A	Sildkroneset, Bøkfjorden	69°47.0'	30°11.1'	68J02	R	

notes:

* - JAMP station but not sampled in accordance to JAMP guidelines, see Annex text.
** - Sufficient mussel-sample not found in 1996.
1 - mussels collected from buoy and/or buoy anchor lines
2 - mussels collected from sand/gravel bottom
3 - mussels collected from iron/cement pilings
4 - mussels collected from metal navigation buoys
5 - mussels collected from floating dock
6 - mussels collected from wooden docks
7 - mussels collected from tire on jetty

Appendix J. 2.
INDEX - Sampling and analyses for 1995-99

Appendix J. 2. Blue mussel samples planned or used in INDEX 1995-99, where P = "Pollution Index" and R = "Reference Index" (contaminated and assumed "background" stations, respectively). + indicates JAMP sampling and analyses (i.e. equivalent to analysis code A). The number indicates the number samples analysed. Codes for analysis (A, B etc.) are defined in Appendix J. 3. See Walday *et al.* (1995) for discussion of selection of stations and analyses.

	STATION	INDEX	ANALYSIS CODE									
JAMP st.			+	A	B	C	D	E	F	G	H	I	J
	HVALER/SINGLEFJORD AREA												
021	Kjøkø, south	P		3									
024	Kirøy, north west	P		3									
022	West Damholmen	P		3									
023	Singlekalven, south	P		3									
	IDDEFJORD												
01A	Sponvikskansen	P			3								
011	Kråkenebbet	P			3								
	OSLOFJORD, inner												
30A	Gressholmen	P	+								3		.1
301	Akershuskaia	P				3							
304	Gåsøya	P				3							
307	Ramtonholmen	P				3							
306	Håøya	P				3							
	OSLOFJORD, mid and outer												
31A	Solbergstrand	R	+										1
35A	Mølen	R	+										
36A	Færder	R	+										2*
	FRIERFJORD AREA, west of outer Oslofjord												
711	Steinholmen	P					3						1
712	Gjermundsholmen	P					3						1
71A	Bjørkøya	P	+										1
	INNER KRISTRIANSANDSFJORD												
132	Fiskåtangen	P						3					1
133	Odderø, west	P						3					1
	LISTA AREA												
15A	Gåsøya	R	+										1
131	Lastad	R				3.							
	SAUDAFJORD												
201	Ekkjegrunn (G1)	P							3				
205	Bølsnes (G5)	P							3				
	BØMLO-SOTRA AREA												
22A	Espevær, west	R	+										2*
	SØRFJORD												
51A	Byrkjeneset	P		3									
52A	Eirtrheimsneset	P	+										

*) indicates Toxaphene included

Appendix J. 2 (cont'd)

JAMP st.	STATION	INDEX	ANALYSIS CODE +	A	B	C	D	E	F	G	H	I	J
	BYFJORDEN, BERGEN												
242	Valheimsneset	P								3			
241	Nordnes	P								3			
243	Hagreneset	P								3			
	SUNNDALSFJORD												
912	Honnhammer	P									3		
913	Fjøseid	P									3		
	[TRONDHEIM AREA - not related to index investigation]												
80A	Østmarknes	-										3	
	ORKDALSFJORD AREA (not suggested in Walday *et al.* 1993)												
82A	Flakk	P	+										
84A	Trossavika	P	+										
87A	Ingdalsbukta	P	+										
	INNER RANFJORD												
962	Koksverkkaien (B2)	P										0	
969	Bjørnbærvikenn (B9)	P										3	
	OUTER RANFJORD, HELGELAND AREA												
96A	Breivika, Tomma	R		3									
	LOFOTEN AREA												
98A	Husvågen	R	+										1
	FINNSNES-SKJERVØY AREA												
41A	Fensneset, Grytøya	R	+								3		1
	HAMMERFEST-HONNINGSVÅG AREA												
44A	Elenheimsundet	R	+								3		2*
46A	Smineset in Altesula	R	+								3		1*
	VARANGER PENINSULA AREA												
48A	Trollfjorden i Tanafjord	R	+								3		
10A	Skagoodden	R	+								3		1
11A	Sildkroneset	R	+										1

*) indicates Toxaphene included

Appendix J. 3.
INDEX - Key to analysis codes and sample counts

(Used in Appendix J. 2.)

ANALYSIS CODES[1)] See Walday *et al.* (1995) for discussion of selection of analyses.

Contaminant	Analysis code									
	A	B	C	D	E	F	G	H	I	J
Lead	x	x	.	.	.	x	.	.	x	.
Cadmium	x	x	x	.	.	x	.	.	x	.
Copper [2])	x	x	x	.	.	.	.	.	.	.
Mercury	x	x	x	.	.	.	.	.	.	.
Zinc [2])	x	x	x	.	.	.	x	.	x	.
EPOCl	.	.	.	.	x	.	.	.	.	.
PAHs	.	.	x	.	x	x	.	x	x	.
PCBs	x	.	x	x	x	.	x	.	.	.
"Dioxin" [3])	.	.	.	.	.	.	.	.	.	x

[1]) Concerns MUSSEL 1 size group (3-5 cm), 3 parallel samples each a bulk of 20 individuals (see text)
[2]) Concerns MUSSEL discontinued since 1996
[3]) Concerns MUSSEL discontinued since 1995

Appendix J. 4.
INDEX - SFT Environmental quality classes

(Molvær *et al.* 1997)

As	arsenic
Pb	lead
F	fluoride
Cd	cadmium
Cu	copper
Cr	chromium
Hg	mercury
Ni	nickel
Zn	zinc
Ag	silver
PAH_S	total PAH excluding dicyclic (=PAH_Σ)*
BAP	benzo[*a*]pyrene
DDTSS	DDTPP+DDEPP+TDEPP (=DDTΣΣ)*
HCB	hexachlorobenzene
HCHSS	HCHG+HCHA+HCHB (=HCHΣΣ)*
CBSSe	sum of CB: 28+52+101+118+138+153+180 *
TCDDN	Sum of TCDD-toxicity equivalents *

*) See also Appendix B. for definitions.

Appendix J. 5.
INDEX - Summary table “Pollution index”
1995-1999

Max(median). Statistics for all areas: (n = Index-station measured, N = Station programmed for index)

Average of Max E.C is 3.7

Index areaname (Pollution area) **1995**	n	N	As ppm d.wt	Pb ppm d.wt	F ppm d.wt	Cd ppm d.wt	Cu ppm d.wt	Cr ppm d.wt	Hg ppm d.wt	Ni ppm d.wt	Zn ppm d.wt	Ag ppm d.wt	PAH_S ppb w.wt	BAP ppb w.wt	DDTSS ppb w.wt	HCB ppb w.wt	HCHSS ppb w.wt	CBSSe ppb w.wt	TCDDN ppp w.wt	Max E.C I:V
Hvaler/Singlefjorden	4	4	i	1.06	i	1.73	i	i	0.2	i	i	i	i	i	0.93	0.1	0.53	6.73	i	II
Iddefjord	1	2	i	i	i	i	i	i	i	i	i	i	i	i	i	i	i	i	i	miss
Inner Oslofjord	5	5	i	i	i	1.33	i	i	0.1	i	i	i	<132.90	0.8	1.95	<0.05	0.41	20.6	i	III
Frierfjorden	3	3	i	i	i	i	i	i	i	i	i	i	i	i	0.85	0.6	0.27	4.74	i	III
Inner Kristiandsfjord	2	2	i	i	i	i	i	i	i	i	i	i	1088.5	15	0.65	9.6	0.76	5.08	i	V
Saudafjord	2	2	i	4.77	i	0.82	i	i	i	i	i	i	<428.80	15	i	i	i	i	i	IV
Sørfjord	2	2	i	149	i	36.8	i	i	1.5	i	i	i	i	i	6.01	0.1	0.28	2.67	i	V
Byfjorden	3	3	i	i	i	i	i	i	i	i	i	i	i	i	3.76	0.2	0.74	19	i	III
Sunndalsfjord	2	2	i	i	i	i	i	i	i	i	i	i	809.8	8	i	i	i	i	i	III
Orkdalsfjord area	3	3	i	i	i	i	i	i	i	i	i	i	i	i	i	i	i	i	i	miss
Inner Ranfjord	2	2	i	4.44	i	0.75	i	i	i	i	i	i	785.7	31	i	i	i	i	i	V

I	20
II	10
III	9
IV	4
V	3

Max(median). Statistics for all areas: (n = Index-station measured, N = Station programmed for index)

Average of Max E.C is 3.6

Index areaname (Pollution area) **1996**	n	N	As ppm d.wt	Pb ppm d.wt	F ppm d.wt	Cd ppm d.wt	Cu ppm d.wt	Cr ppm d.wt	Hg ppm d.wt	Ni ppm d.wt	Zn ppm d.wt	Ag ppm d.wt	PAH_S ppb w.wt	BAP ppb w.wt	DDTSS ppb w.wt	HCB ppb w.wt	HCHSS ppb w.wt	CBSSe ppb w.wt	TCDDN ppp w.wt	Max E.C I:V
Hvaler/Singlefjorden	4	4	i	2.29	i	2.26	i	i	0.4	i	i	i	i	i	<0.56	0.1	0.27	4.83	i	II
Iddefjord	1	2	i	i	i	i	i	i	i	i	i	i	i	i	i	i	i	i	i	miss
Inner Oslofjord	5	5	i	i	i	0.82	i	i	0.1	i	i	i	<644.80	3.3	1.08	<0.05	0.3	20.86	i	III
Frierfjorden	3	3	i	i	i	i	i	i	i	i	i	i	i	i	0.26	2.2	0.19	4.18	i	IV
Inner Kristiandsfjord	2	2	i	i	i	i	i	i	i	i	i	i	<542.40	17	0.61	18	1.32	6.64	i	V
Saudafjord	1	2	i	4.39	i	0.86	i	i	i	i	i	i	891.4	35	i	i	i	i	i	V
Sørfjord	2	2	i	60.3	i	25.3	i	i	0.9	i	i	i	i	i	4.08	<0.05	0.6	1.92	i	IV
Byfjorden	3	3	i	i	i	i	i	i	i	i	i	i	i	i	7.8	0.2	1.03	30.72	i	III
Sunndalsfjord	2	2	i	i	i	i	i	i	i	i	i	i	<290.00	3.8	i	i	i	i	i	III
Orkdalsfjord area	3	3	i	i	i	i	i	i	i	i	i	i	i	i	i	i	i	i	i	miss
Inner Ranfjord	2	2	i	5.34	i	0.61	i	i	i	i	i	i	301.9	6.2	i	i	i	i	i	III

I	16
II	12
III	12
IV	4
V	2

Max(median). Statistics for all areas: (n = Index-station measured, N = Station programmed for index)

Average of Max E.C is 3.4

Index areaname (Pollution area) **1997**	n	N	As ppm d.wt	Pb ppm d.wt	F ppm d.wt	Cd ppm d.wt	Cu ppm d.wt	Cr ppm d.wt	Hg ppm d.wt	Ni ppm d.wt	Zn ppm d.wt	Ag ppm d.wt	PAH_S ppb w.wt	BAP ppb w.wt	DDTSS ppb w.wt	HCB ppb w.wt	HCHSS ppb w.wt	CBSSe ppb w.wt	TCDDN ppp w.wt	Max E.C I:V
Hvaler/Singlefjorden	4	4	i	1.65	i	2.48	i	i	0.5	i	i	i	i	i	1.14	0.1	0.42	5.61	i	II
Iddefjord	0	2	i	i	i	i	i	i	i	i	i	i	i	i	i	i	i	i	i	miss
Inner Oslofjord	5	5	i	i	i	0.86	i	i	0.1	i	i	i	<409.10	3.5	12.08	0.1	0.79	33.81	i	IV
Frierfjorden	3	3	i	i	i	i	i	i	i	i	i	i	i	i	0.65	0.8	0.26	<2.68	i	III
Inner Kristiandsfjord	2	2	i	i	i	i	i	i	i	i	i	i	356	9.1	1.22	7.6	0.81	<6.00	i	V
Saudafjord	2	2	i	6.96	i	1.37	i	i	i	i	i	i	2726.5	108	i	i	i	i	i	V
Sørfjord	2	2	i	20.6	i	13.4	i	i	0.3	i	i	i	i	i	5.07	<0.05	0.29	<2.71	i	III
Byfjorden	3	3	i	i	i	i	i	i	i	i	i	i	i	i	2.94	0.1	0.4	24.54	i	III
Sunndalsfjord	1	2	i	i	i	i	i	i	i	i	i	i	<238.90	1.4	i	i	i	i	i	III
Orkdalsfjord area	0	3	i	i	i	i	i	i	i	i	i	i	i	i	i	i	i	i	i	miss
Inner Ranfjord	2	2	i	3.55	i	0.64	i	i	i	i	i	i	<132.90	3.1	i	i	i	i	i	III

I	17
II	13
III	12
IV	2
V	2

Max(median). Statistics for all areas: (n = Index-station measured, N = Station programmed for index)

Average of Max E.C is 3.0

Index areaname (Pollution area) **1998**	n	N	As ppm d.wt	Pb ppm d.wt	F ppm d.wt	Cd ppm d.wt	Cu ppm d.wt	Cr ppm d.wt	Hg ppm d.wt	Ni ppm d.wt	Zn ppm d.wt	Ag ppm d.wt	PAH_S ppb w.wt	BAP ppb w.wt	DDTSS ppb w.wt	HCB ppb w.wt	HCHSS ppb w.wt	CBSSe ppb w.wt	TCDDN ppp w.wt	Max E.C I:V
Hvaler/Singlefjorden	4	4	i	2.12	i	3.31	i	i	0.9	i	i	i	i	i	1.13	0.1	<0.23	<4.42	i	III
Iddefjord	0	2	i	i	i	i	i	i	i	i	i	i	i	i	i	i	i	i	i	miss
Inner Oslofjord	5	5	i	i	i	1.27	i	i	0.1	i	i	i	<149.20	1	2.34	0.1	0.59	13.75	i	II
Frierfjorden	3	3	i	i	i	i	i	i	i	i	i	i	i	i	<0.63	0.7	0.41	3.18	i	III
Inner Kristiandsfjord	2	2	i	i	i	i	i	i	i	i	i	i	<279.00	3.8	0.53	7.2	<0.65	<5.09	i	V
Saudafjord	2	2	i	4.67	i	0.93	i	i	i	i	i	i	<550.50	9.8	i	i	i	i	i	III
Sørfjord	2	2	i	29.6	i	10.3	i	i	0.6	i	i	i	i	i	w	0.1	0.51	2.04	i	III
Byfjorden	3	3	i	i	i	i	i	i	i	i	i	i	i	i	<2.83	0.2	0.79	10.87	i	II
Sunndalsfjord	1	2	i	i	i	i	i	i	i	i	i	i	<180.00	1	i	i	i	i	i	II
Orkdalsfjord area	0	3	i	i	i	i	i	i	i	i	i	i	i	i	i	i	i	i	i	miss
Inner Ranfjord	2	2	i	2.99	i	0.61	i	i	i	i	i	i	257.5	12	i	i	i	i	i	IV

I	19
II	14
III	10
IV	1
V	1

Max(median). Statistics for all areas: (n = Index-station measured, N = Station programmed for index)

Average of Max E.C is 3.1

Index areaname (Pollution area) **1999**	n	N	As ppm d.wt	Pb ppm d.wt	F ppm d.wt	Cd ppm d.wt	Cu ppm d.wt	Cr ppm d.wt	Hg ppm d.wt	Ni ppm d.wt	Zn ppm d.wt	Ag ppm d.wt	PAH_S ppb w.wt	BAP ppb w.wt	DDTSS ppb w.wt	HCB ppb w.wt	HCHSS ppb w.wt	CBSSe ppb w.wt	TCDDN ppp w.wt	Max E.C I:V
Hvaler/Singlefjorden	3	4	i	1.94	i	2.45	i	i	0.4	i	i	i	i	i	<1.15	0.1	<0.26	3.27	i	II
Iddefjord	0	2	i	i	i	i	i	i	i	i	i	i	i	i	i	i	i	i	i	miss
Inner Oslofjord	5	5	i	i	i	1.29	i	i	0.1	i	i	i	211.7	2.1	2.2	0.3	<0.34	20.01	i	III
Frierfjorden	3	3	i	i	i	i	i	i	i	i	i	i	i	i	0.76	0.6	<0.28	<2.64	i	III
Inner Kristiandsfjord	2	2	i	i	i	i	i	i	i	i	i	i	<1163.40	48	0.73	0.3	0.29	<4.10	i	V
Saudafjord	2	2	i	5.97	i	1.49	i	i	i	i	i	i	620.8	14	i	i	i	i	i	IV
Sørfjord	2	2	i	37.1	i	34.7	i	i	2.9	i	i	i	i	i	6.21	0.1	0.35	<2.42	i	IV
Byfjorden	3	3	i	i	i	i	i	i	i	i	i	i	i	i	4.5	0.1	0.28	13.88	i	II
Sunndalsfjord	2	3	i	i	i	i	i	i	i	i	i	i	360.5	3	i	i	i	i	i	III
Orkdalsfjord area	0	3	i	i	i	i	i	i	i	i	i	i	i	i	i	i	i	i	i	miss
Inner Ranfjord	1	2	i	5.13	i	0.59	i	i	i	i	i	i	<172.90	2	i	i	i	i	i	II

I	19
II	13
III	10
IV	3
V	1

Appendix J. 6.
INDEX - Summary table “Reference Index”
1995-1999

Max(median). Statistics for all areas: (n = Index-station measured, N = Station programmed for index)

Average of Max E.C is 1.5

Index areaname (Reference area) **1995**	n	N	As ppm d.wt	Pb ppm d.wt	F ppm d.wt	Cd ppm d.wt	Cu ppm d.wt	Cr ppm d.wt	Hg ppm d.wt	Ni ppm d.wt	Zn ppm d.wt	Ag ppm d.wt	PAH_S ppb w.wt	BAP ppb w.wt	DDTSS ppb w.wt	HCB ppb w.wt	HCHSS ppb w.wt	CBSSe ppb w.wt	TCDDN ppp w.wt	Max E.C I:V
Mid and outer Oslofjord	3	3	w	1.68	w	1.32	i	w	0.1	w	i	w	w	w	<0.95	0.1	0.4	7.86	i	II
Lista area	2	2	w	0.52	w	1.44	i	w	0.1	w	i	w	<31.60	0.5	<0.34	<0.05	0.38	<1.28	i	I
Bømlo-Sotra area	1	1	w	1.18	w	1.41	i	w	0.1	w	i	w	w	w	<0.46	<0.05	0.31	<1.38	i	I
Outer Ranfjord, Helgeland area	1	2	w	1.12	w	0.96	i	w	0.1	w	i	w	<37.70	<0.50	0.21	<0.05	0.38	<0.90	i	I
Lofoten area	1	2	w	3.12	w	0.69	i	w	0.3	w	i	w	w	w	4.42	0.1	0.15	12.31	i	II
Finnsnes- Skjervøy area	1	1	w	0.9	w	2.95	i	w	0.1	w	i	w	w	w	<0.18	<0.05	0.16	<0.81	i	II
Hammerfest-Honningsvåg area	2	2	w	2.57	w	2.74	i	w	0.1	w	i	w	<129.90	0.7	<0.23	<0.05	<0.15	<1.34	i	II
Varanger peninsula area	3	3	w	2.78	w	1.71	i	w	0.2	w	i	w	<6.90	<0.50	<0.36	<0.05	0.16	<0.88	i	I

I	56
II	8
III	0
IV	0
V	0

Max(median). Statistics for all areas: (n = Index-station measured, N = Station programmed for index)

Average of Max E.C is 1.6

Index areaname (Reference area) **1996**	n	N	As ppm d.wt	Pb ppm d.wt	F ppm d.wt	Cd ppm d.wt	Cu ppm d.wt	Cr ppm d.wt	Hg ppm d.wt	Ni ppm d.wt	Zn ppm d.wt	Ag ppm d.wt	PAH_S ppb w.wt	BAP ppb w.wt	DDTSS ppb w.wt	HCB ppb w.wt	HCHSS ppb w.wt	CBSSe ppb w.wt	TCDDN ppp w.wt	Max E.C I:V
Mid and outer Oslofjord	3	3	7	2.04	w	1.6	i	0.5	0	0.9	i	0.1	w	w	<0.25	<0.05	0.25	13.95	i	II
Lista area	2	2	w	0.67	w	1.22	i	w	0.1	w	i	w	<44.60	<0.50	<0.20	<0.05	0.29	<2.14	i	I
Bømlo-Sotra area	1	1	w	1.51	w	1.14	i	w	0.1	w	i	w	w	w	<0.11	<0.05	<0.14	<0.78	i	I
Outer Ranfjord, Helgeland area	1	2	w	0.9	w	0.78	i	w	0.1	w	i	w	w	w	<0.12	<0.05	0.21	<0.62	i	I
Lofoten area	1	2	w	4.11	w	0.78	i	w	0.3	w	i	w	w	w	<1.15	<0.05	<0.13	8.9	i	II
Finnsnes- Skjervøy area	1	1	w	0.79	w	1.63	i	w	0.1	w	i	w	<24.25	<0.50	<0.05	<0.05	<0.05	<0.40	i	I
Hammerfest-Honningsvåg area	2	2	w	1.66	w	2.72	i	w	0.1	w	i	w	<212.50	0.8	<0.11	<0.05	<0.11	<1.59	i	III
Varanger peninsula area	3	3	w	0.74	w	2.34	i	w	0.1	w	i	w	<21.30	<0.50	<0.14	<0.05	0.14	<0.98	i	II

I	61
II	6
III	1
IV	0
V	0

Max(median). Statistics for all areas: (n = Index-station measured, N = Station programmed for index)

Average of Max E.C is 1.3

Index areaname (Reference area) **1997**	n	N	As ppm d.wt	Pb ppm d.wt	F ppm d.wt	Cd ppm d.wt	Cu ppm d.wt	Cr ppm d.wt	Hg ppm d.wt	Ni ppm d.wt	Zn ppm d.wt	Ag ppm d.wt	PAH_S ppb w.wt	BAP ppb w.wt	DDTSS ppb w.wt	HCB ppb w.wt	HCHSS ppb w.wt	CBSSe ppb w.wt	TCDDN ppp w.wt	Max E.C I:V
Mid and outer Oslofjord	3	3	w	2.17	w	1.84	i	w	0.1	w	i	w	w	w	2.75	0.1	1.16	4.9	i	II
Lista area	2	2	w	1.12	w	1.14	i	w	0.1	w	i	w	<36.70	<0.50	0.58	<0.05	0.53	2.43	i	I
Bømlo-Sotra area	1	1	w	1.37	w	1.01	i	w	0.1	w	i	w	w	w	<0.39	<0.05	0.26	<0.73	i	I
Outer Ranfjord, Helgeland area	0	2	w	w	w	w	i	w	w	w	i	w	w	w	w	w	w	w	i	miss
Lofoten area	1	2	w	1.54	w	0.85	i	w	0.1	w	i	w	w	w	0.61	<0.05	0.14	<1.57	i	I
Finnsnes- Skjervøy area	1	1	w	0.65	w	1.88	i	w	0.1	w	i	w	w	w	<0.15	<0.05	0.12	<0.40	i	I
Hammerfest-Honningsvåg area	1	2	w	1.15	w	1.51	i	w	0.1	w	i	w	w	w	0.27	<0.05	0.18	<4.49	i	II
Varanger peninsula area	2	3	w	0.81	w	1.59	i	w	0.2	w	i	w	w	w	0.33	0.1	0.13	<1.07	i	I

I	46
II	5
III	0
IV	0
V	0

Max(median). Statistics for all areas: (n = Index-station measured, N = Station programmed for index)

Average of Max E.C is 1.4

Index areaname (Reference area) **1998**	n	N	As ppm d.wt	Pb ppm d.wt	F ppm d.wt	Cd ppm d.wt	Cu ppm d.wt	Cr ppm d.wt	Hg ppm d.wt	Ni ppm d.wt	Zn ppm d.wt	Ag ppm d.wt	PAH_S ppb w.wt	BAP ppb w.wt	DDTSS ppb w.wt	HCB ppb w.wt	HCHSS ppb w.wt	CBSSe ppb w.wt	TCDDN ppp w.wt	Max E.C I:V
Mid and outer Oslofjord	3	3	w	1.57	w	1.14	i	w	0.1	w	i	w	w	w	<1.30	<0.03	<0.52	<2.01	i	I
Lista area	2	2	w	1.28	w	1.31	i	w	0.1	w	i	w	<42.70	<0.50	0.6	<0.03	<0.53	3.58	i	I
Bømlo-Sotra area	1	1	w	1.21	w	0.85	i	w	0.1	w	i	w	w	w	<1.61	<0.03	<0.51	<2.05	i	I
Outer Ranfjord, Helgeland area	0	2	w	w	w	w	i	w	w	w	i	w	w	w	w	w	w	w	i	miss
Lofoten area	1	2	w	2.36	w	1.58	i	w	0.2	w	i	w	w	w	<2.28	<0.05	<0.20	<1.21	i	II
Finnsnes- Skjervøy area	0	1	w	w	w	w	i	w	w	w	i	w	w	w	w	w	w	w	i	miss
Hammerfest-Honningsvåg area	0	2	w	w	w	w	i	w	w	w	i	w	w	w	w	w	w	w	i	miss
Varanger peninsula area	1	3	w	2.34	w	2.32	i	w	0.1	w	i	w	w	w	w	w	w	w	i	II

I	31
II	2
III	0
IV	0
V	0

Max(median). Statistics for all areas: (n = Index-station measured, N = Station programmed for index)

Average of Max E.C is 1.4

Index areaname (Reference area) **1999**	n	N	As ppm d.wt	Pb ppm d.wt	F ppm d.wt	Cd ppm d.wt	Cu ppm d.wt	Cr ppm d.wt	Hg ppm d.wt	Ni ppm d.wt	Zn ppm d.wt	Ag ppm d.wt	PAH_S ppb w.wt	BAP ppb w.wt	DDTSS ppb w.wt	HCB ppb w.wt	HCHSS ppb w.wt	CBSSe ppb w.wt	TCDDN ppp w.wt	Max E.C I:V
Mid and outer Oslofjord	3	3	w	1	w	1.53	i	w	0.1	w	i	w	w	w	1.83	<0.05	<0.44	2.88	i	I
Lista area	2	2	w	1.66	w	1.18	i	w	0.1	w	i	w	<68.05	1	<0.67	0.1	<0.40	<2.49	i	II
Bømlo-Sotra area	1	1	w	1.7	w	1.32	i	w	0.1	w	i	w	w	w	<0.54	<0.05	<0.23	<0.93	i	I
Outer Ranfjord, Helgeland area	0	2	w	w	w	w	i	w	w	w	i	w	w	w	w	w	w	w	i	miss
Lofoten area	1	2	w	1.59	w	2.17	i	w	0.3	w	i	w	w	w	<0.52	<0.06	<0.20	<0.43	i	II
Finnsnes- Skjervøy area	0	1	w	w	w	w	i	w	w	w	i	w	w	w	w	w	w	w	i	miss
Hammerfest-Honningsvåg area	0	2	w	w	w	w	i	w	w	w	i	w	w	w	w	w	w	w	i	miss
Varanger peninsula area	1	3	w	1.57	w	1.61	i	w	0.1	w	i	w	w	w	<0.47	<0.05	<0.30	<0.90	i	I

I	33
II	4
III	0
IV	0
V	0

Appendix K.
Biological effects methods summary results 1997-1999

Table 10. Summary statistics for biological effects parameters measured in cod (*Gadus morhua*), 1997-1999.

Station:	36B	15B	23B	30B	53B	67B
1997						
count	21	25	22	16	25	25
Weight, median	**1.1**	**1.4**	**1.3**	**0.8**	**1.2**	**1.1**
Weight, st.dev.	0.4	0.5	0.3	0.3	0.3	0.5
380 nm, median	**966.7**	**628.0**	**674.4**	**--**	**410.0**	**663.4**
380 nm, st.dev.	806.1	173.1	363.0	--	395.9	286.8
microsomal protein (mg/mL), median	**8.5**	**5.3**	**6.1**	**3.9**	**6.6**	**6.4**
microsomal protein (mg/mL), st.dev.	2.6	2.6	2.2	2.2	1.4	1.6
cytosol protein (mg/mL), median	**16.8**	**13.3**	**14.4**	**8.5**	**17.9**	**17.4**
cytosol protein (mg/mL), st.dev.	5.5	6.5	6.1	4.6	4.1	5.1
OH-pyrene/380 nm, median	**22.5**	**265.1**	**15.9**	**--**	**113.3**	**71.1**
OH-pyrene/380 nm, st.dev.	12.9	1073.1	12.5	--	72.6	29.5
ALA-D (µg pbg/min/mg protein), median	**3.6**	**4.5**	**4.2**	**2.4**	**2.0**	**1.9**
ALA-D (µg pbg/min/mg protein), st.dev.	1.2	1.7	1.3	1.6	1.6	2.1
EROD (pmol/min/mg protein), median	**110.0**	**44.5**	**94.1**	**68.8**	**429.6**	**103.4**
EROD (pmol/min/mg protein), st.dev.	53.4	61.6	27.4	38.8	376.7	51.9
MT (µg/mg protein), median	**0.9**	**2.1**	**1.1**	**1.3**	**0.4**	**1.5**
MT (µg/mg protein), st.dev.	0.8	3.3	2.8	1.7	1.5	1.3
1998						
count	27	25	25	30	30	30
Weight, median	**0.6**	**1.1**	**1.2**	**1.0**	**1.1**	**0.5**
Weight, st.dev.	0.2	0.3	0.5	0.1	0.4	0.5
380 nm, median	**26.1**	**23.4**	**42.0**	**15.3**	**16.9**	**18.4**
380 nm, st.dev.	15.0	11.4	25.2	9.5	8.5	11.3
microsomal protein (mg/mL), median	**1.6**	**3.2**	**2.7**	**3.6**	**2.8**	**1.2**
microsomal protein (mg/mL), st.dev.	0.9	1.7	1.8	1.6	1.4	1.3
cytosol protein (mg/mL), median	**5.3**	**10.4**	**8.0**	**10.2**	**9.1**	**3.1**
cytosol protein (mg/mL), st.dev.	2.2	4.3	5.8	2.9	4.2	4.4
OH-pyrene/380 nm, median	**42.7**	**3770.4**	**12.7**	**115.4**	**83.0**	**20.5**
OH-pyrene/380 nm, st.dev.	16.9	3625.4	26.8	33.6	172.1	11.5
ALA-D (µg pbg/min/mg protein), median	**3.3**	**2.9**	**3.0**	**1.9**	**1.2**	**3.4**
ALA-D (µg pbg/min/mg protein), st.dev.	2.2	2.9	1.4	0.8	1.0	2.9
EROD (pmol/min/mg protein), median	**9.1**	**14.8**	**20.2**	**33.0**	**39.7**	**60.8**
EROD (pmol/min/mg protein), st.dev.	18.2	25.2	20.8	32.8	31.9	44.0
MT (µg/mg protein), median	**1.2**	**1.4**	**2.5**	**1.3**	**1.6**	**1.7**
MT (µg/mg protein), st.dev.	0.8	1.8	1.6	0.6	1.0	1.2

Table 10 (cont.)

Station:	36B	15B	23B	30B	53B	67B
1999						
count	**25**	**25**	**25**	**25**	**25**	**25**
Weight, median	**0.89**	**0.99**	**1.02**	**0.99**	**0.93**	**1.00**
Weight, st.dev.	**0.09**	**0.09**	**0.09**	**0.10**	**0.09**	**0.14**
380 nm, median	**27.67**	**24.54**	**46.51**	**21.51**	**38.90**	**30.81**
380 nm, st.dev.	**17.29**	**13.58**	**17.45**	**57.17**	**45.94**	**14.24**
cytosol protein (mg/mL), median	**6.51**	**5.34**	**7.72**	**9.41**	**7.73**	**7.25**
cytosol protein (mg/mL), st.dev.	**1.48**	**2.39**	**2.03**	**2.14**	**1.67**	**1.89**
microsomal protein (mg/mL), median	**2.36**	**2.26**	**2.59**	**3.82**	**3.11**	**3.07**
microsomal protein (mg/mL), st.dev.	**0.82**	**1.05**	**0.81**	**1.17**	**0.78**	**1.00**
OH-pyrene/380 nm, median	**28.9**	**252.9**	**11.2**	**129.7**	**58.6**	**16.5**
OH-pyrene/380 nm, st.dev.	**18.5**	**15819.6**	**9.5**	**45.5**	**1.9**	**1.3**
ALA-D (µg pbg/min/mg protein), median	**0.7**	**0.8**	**1.1**	**0.8**	**0.7**	**1.0**
ALA-D (µg pbg/min/mg protein), st.dev.	**0.4**	**0.4**	**0.3**	**0.2**	**0.2**	**0.3**
EROD (pmol/min/mg protein), median	**100.2**	**277.0**	**99.6**	**74.6**	**90.1**	**144.3**
EROD (pmol/min/mg protein), st.dev.	**75.3**	**271.5**	**55.6**	**223.8**	**74.0**	**209.9**
MT (µg/mg protein), median	**n/r**	**n/r**	**n/r**	**n/r**	**n/r**	**n/r**
MT (µg/mg protein), st.dev.						

Table 11. Summary statistics for biological effects parameters measured in dab, 1999 (*Limanda limanda*, st.36F, 15F and 218F (21F)) and flounder (*Platichthys flesus*, 53F and 67F) 1999.

Station:	36F	15F	218F	53F	67F
1999					
count	**25**	**21**	**11**	**25**	**25**
Weight, median	**0.76**	**0.90**	**0.96**	**0.97**	**1.01**
Weight, st.dev.	**0.21**	**0.22**	**0.18**	**0.08**	**0.08**
380 nm, median	**6.92**	**10.50**	**26.77**	**28.50**	**15.76**
380 nm, st.dev.	**8.64**	**8.40**	**25.60**	**30.21**	**15.54**
microsomal protein (mg/mL), median	**3.34**	**3.10**	**3.16**	**4.74**	**3.48**
microsomal protein (mg/mL), st.dev.	**1.34**	**0.84**	**1.07**	**1.12**	**1.07**
cytosol protein (mg/mL), median	**7.07**	**7.32**	**7.42**	**8.48**	**7.03**
cytosol protein (mg/mL), st.dev.	**1.64**	**1.86**	**0.71**	**1.21**	**1.31**
OH-pyrene/380 nm, median	**333.8**	**48.8**	**50.00**	**74.63**	**41.05**
OH-pyrene/380 nm, st.dev.	**2968.5**	**45.1**	**35.01**	**6.26**	**5.56**
ALA-D (µg pbg/min/mg protein), median	**0.8**	**0.5**	**0.84**	**0.66**	**0.95**
ALA-D (µg pbg/min/mg protein), st.dev.	**0.4**	**0.3**	**0.19**	**0.21**	**0.32**
EROD (pmol/min/mg protein), median	**565.0**	**619.5**	**23.21**	**24.57**	**16.09**
EROD (pmol/min/mg protein), st.dev.	**2816.4**	**4312.0**	**26.35**	**30.99**	**35.84**
MT (µg/mg protein), median	**11.0**	**13.7**	**18.25**	**15.04**	**34.14**
MT (µg/mg protein), st.dev.	**7.9**	**10.8**	**9.27**	**6.75**	**15.28**

Appendix L.
Effects and concentrations of organotin 1999

Table 12. Imposex (VDSI, RPSI) in dogwhelks (*Nucella lapillus*) in Haugesund (st. 224G, 226G, 227G, 220G, 221G) and Outer Oslofjord (36G), 1999. SH = avg. shell height in mm, PS = avg. penis length in mm, nm = not measured. (cf. Appendix F. , Maps 2 and 5).

St.	Area	Sex	SH	VDSI	PS	RPSI
224G	Heggjelen	F/M	29.0/28.8	4	2.2/3.1	35.3
226G	Karmsund bridge (east)	F/M	30.9/27.5	4.1	3.4/3.4	96
227G	Melandholmen	F/M	27.7/26.6	4.1	3.1/3.4	77.4
220G	Smørstakk	F/M	30.6/31.0	4	3.1/4.1	43
221G	Stangeland	F/M	29.4/29.2	4.2	3.3/3.7	72
36G	Færder	F/M	31.4/28.9	4	2.4/4.7	13.3

Table 13. Levels of organotin (µg Sn/kg d.w.) in mussels (*Mytilus edulis*) at five stations in Southern Norway; Oslofjord (st.30A, 36A) and Haugesund area (st.226X, 227A, 221A) in 1999. Sh.length = avg. shell length in mm, ∑BT = TBT+DBT+MBT. Class condition for TBT on a dry weight basis in the Norwegian classification system for environmental quality. (cf. Table 6) (cf. Appendix F. , Maps 2 and 5).

St.	Area	Sh. length	TBT	∑BT	TPhT	TBT* (ppm)	Class
30A	Gressholmen	33.4	630	982	46	1.41	markedly polluted
30A	Gressholmen	44.1	578	1074	38	1.54	markedly polluted
36A	Færder	35.2	100	123	5.2	0.24	moderately polluted
36A	Færder	43.2	79	97.8	5.6	0.19	moderately polluted
226X	Karmsund bridge (east)	36.4	350	476	21	0.85	markedly polluted
226X	Karmsund bridge (east)	36.4	330	487	27	0.81	markedly polluted
226X	Karmsund bridge (east)	36.1	350	464	22	0.85	markedly polluted
227A	Melandholmen	38.0	600	789	34	1.46	markedly polluted
227A	Melandholmen	37.2	350	467	25	0.85	markedly polluted
227A	Melandholmen	38.0	310	447	22	0.76	markedly polluted
221A	Stangeland	34.1	2100	2852	130	5.12	extremely polluted
221A	Stangeland	34.1	1500	2286	100	3.66	severely polluted
221A	Stangeland	34.2	1800	2450	70	4.39	severely polluted

*) TBT ppb dw converted to formulation basis ppm dw by a factor of 2.44/1000.

Appendix M.
Supplementary investigations of mussels from Sørfjord and Hardangerfjord 1999

Introduction and methods

Concentration of DDT as well as metals and PCBs in blue mussels from the inner Sørfjord are difficult to understand for several reasons:

- Inconsistent relationship between depurated and non-depurated samples;
- Inconsistent DDT-gradient
- Unknown "normal" proportion between DDT and its' breakdown metabolites (DDE and DDD).

JAMP 2000 examined these problems by analysing parallel samples from stations 51A, 52A, 56A, 57A, 63A, 65A and 69A (cf. Appendix E. , Appendix F. Map 6) that have been frozen directly without depuration prior to cleaning. The three parallel samples from these seven stations were compared to three other parallel samples that were depurated and cleaned prior to freezing.

Furthermore three additional stations between st.56A and 57A (56A-1, 56A-2, and 57A-1, cf. Appendix E. , Appendix F. Map 6) were sampled in order to investigate the local DDT gradient.

Results

The raw data is shown in Table 14 and the results from the paired t-test comparing the JAMP and INDEX methods are shown in Table 15. Results were not considered where a third or more of the comparisons involved a value below the detection limit.

Table 14. Levels of contaminants in mussels (*Mytilus edulis*) from six standard JAMP stations (52A, 56A, 57A, 63A, 67A and 69A) and four supplementary stations (51A, 56A-1, 56A-2 and 57A-1) (cf. Appendix E. , Appendix F. Map 6). Two methods of analysis pre-treatment were applied: cleaned after depuration (JAMP-method) and not depurated, frozen and then clean (Index-method). Distance from Odda at the head of Sørfjord is indicated (km). Metals are in ppm w.w. and organic contaminants in ppb ww. Code descriptions are given in Appendix B. Also shown are: dry weight percent (drywt), average weight of soft tissue (tiswt, g), lipid weight percent (exlip),

jmpst	stnam	km	subno	drywt	tiswt	exlip	basis	CD	CU	HG	PB	ZN	CB101	CB105	CB118	CB138	CB153	CB156	CB180	CB209	CB28	CB52	DDEPP	DDTPP	HCB	HCHA	HCHG	OCS	QCB	TDEPP
	JAMP method																													
51A	**Byrkjenes**	0	1	13.4	1.45	1.19	W	5.07	1.2	0.38	4.7	19	0.22	<0.1	0.19	0.39	0.49	<0.1	<0.1	<0.1	<0.1		1.7	2.1	<0.05	<0.1	0.11	<0.05	<0.05	0.2
51A	**Byrkjenes**		2	13	1.35	1.19	W	5.01	1.4	0.43	4.7	20	0.2	<0.1	0.18	0.35	0.41	<0.1	<0.1	<0.1	<0.1		1.6	1.9	<0.05	<0.1	0.12	<0.05	<0.05	<0.2
51A	**Byrkjenes**		3	12	1.32	1.08	W	5.16	1.6	0.38	4.1	21	0.17	<0.1	0.15	0.3	0.36	<0.1	<0.1	<0.1	<0.1		1.3	1.5	<0.05	<0.1	0.1	<0.05	<0.05	<0.2
52A	**Eitrheimsneset**	1.5	1	19.1	0.92	2.23	W	2.63	1.4	0.14	1.9	27	0.38	0.12	0.29	0.55	0.59	<0.1	0.11	<0.1	<0.1		2.5	2.6	0.06	0.12	0.22	<0.05	0.07	0.49
52A	**Eitrheimsneset**		2	20.3	1.87	2.47	W	2.44	1.2	0.12	2	28	0.41	0.11	0.32	0.61	0.66	<0.1	0.11	<0.1	<0.1		2.9	2.7	0.07	0.13	0.25	<0.05	0.08	0.62
52A	**Eitrheimsneset**		3	19.9	3.88	2.33	W	2.56	1.2	0.12	2.7	34	0.38	0.1	0.28	0.5	0.59	<0.1	0.1	<0.1	<0.1		2.7	2.6	0.05	0.12	0.25	<0.05	0.07	0.63
56A	**Kvalnes**	16	1	13.6	0.56	1.19	W	3.65	1.2	0.13	2.2	31	0.23	0.12	0.22	0.37	0.38	<0.1	0.1	<0.1	<0.1	<0.1	4.8	4.5		<0.1	0.12	<0.05	<0.05	0.86
56A	**Kvalnes**		2	12.5	1.05	1.02	W	3.85	1.2	0.12	2.9	36	0.19	0.1	0.21	0.33	0.36	<0.1	<0.1	<0.1	<0.1	<0.1	4.2	4		<0.1	<0.1	<0.05	<0.05	0.77
56A	**Kvalnes**		3	13.4	2.05	1.2	W	3.98	1	0.12	3.8	37	0.21	0.11	0.2	0.34	0.36	<0.1	<0.1	<0.1	<0.1	<0.1	4.9	4.1		<0.1	0.11	<0.05	<0.05	0.89
57A	**Krossanes**	35	1	15	0.42	1.34	W	2.73	1.3	0.08	1.3	32	0.15	<0.1	0.15	0.25	0.29	<0.1	<0.1	<0.1	<0.1	<0.1	3.6	2.6		<0.1	0.12	<0.05	<0.05	0.44
57A	**Krossanes**		2	14.7	0.99	1.23	W	2.15	0.9	0.06	1.3	28	0.14	<0.1	0.13	0.21	0.24	<0.1	<0.1	<0.1	<0.1	<0.1	3.6	2.5		<0.1	0.1	<0.05	<0.05	0.37
57A	**Krossanes**		3	14.9	1.97	1.36	W	2.08	0.9	0.06	1.5	30	0.16	<0.1	0.17	0.26	0.31	<0.1	<0.1	<0.1	<0.1	<0.1	4.5	3.2		<0.1	0.14	<0.05	<0.05	0.54
63A	**Ranaskjær**	51	1	17.2	0.44	1.48	W	1.34	0.8	0.05	0.6	19	0.16	<0.1	0.16	0.28	0.32	<0.1	<0.1	<0.1	<0.1	<0.1	1.6	1.4		<0.1	0.16	<0.05	<0.05	0.24
63A	**Ranaskjær**		2	16.7	1.16	1.42	W	1.22	0.7	0.05	0.7	21	0.15	<0.1	0.15	0.26	0.3	<0.1	<0.1	<0.1	<0.1	<0.1	1.5	1.3		<0.1	0.15	<0.05	<0.05	0.24
63A	**Ranaskjær**		3	18.1	2.04	1.63	W	1.3	0.8	0.04	0.8	21	0.17	<0.1	0.17	0.28	0.32	<0.1	<0.1	<0.1	<0.1	<0.1	1.8	1.6		<0.1	0.17	<0.05	<0.05	0.29
65A	**Vikingneset**	74	1	18.7	0.57	1.67	W	0.79	0.9	0.03	0.3	22	0.16	<0.1	0.16	0.26	0.31	<0.1	<0.1	<0.1	0.18	<0.1	1.2	1.3		<0.1	0.2	<0.05	<0.05	0.36
65A	**Vikingneset**		2	18.5	1.40	1.62	W	0.75	0.8	0.03	0.3	24	0.13	<0.1	0.11	0.2	0.23	<0.1	<0.1	<0.1	<0.1	<0.1	0.92	0.89	<0.05	<0.1	<0.1	<0.05	<0.05	0.27
65A	**Vikingneset**		3	18.9	2.60	1.67	W	0.83	0.8	0.03	0.3	26	0.14	<0.1	0.13	0.22	0.28	<0.1	<0.1	<0.1	<0.1	<0.1	1.1	0.91		<0.1	0.13	<0.05	<0.05	0.36
69A	**Lille Terøy**	111	1	17.3	3.08	1.43	W	0.75	1.5	0.02	0.4	31	0.15	<0.1	0.17	0.26	0.29	<0.1	<0.1	<0.1	<0.1	<0.1	0.42	0.42	<0.05	<0.1	0.13	<0.05	<0.05	<0.2
69A	**Lille Terøy**		2	19.1	3.26	1.79	W	0.72	1.5	0.02	0.3	30	0.18	0.11	0.18	0.28	0.31	<0.1	<0.1	<0.1	<0.1	<0.1	0.48	0.46	<0.05	<0.1	0.14	<0.05	<0.05	<0.2
69A	**Lille Terøy**		3	19	3.34	1.55	W	0.74	1.6	0.02	0.4	34	0.14	<0.1	0.16	0.23	0.26	<0.1	<0.1	<0.1	<0.1	<0.1	0.43	0.47	<0.05	<0.1	0.13	<0.05	<0.05	<0.2

Table 14 **(cont., INDEX-method)**

jmpst	stnam	km	subno	drywt	tiswt	exlip	basis	CD	CU	HG	PB	ZN	CB101	CB105	CB118	CB138	CB153	CB156	CB180	CB209	CB28	CB52	DDEPP	DDTPP	HCB	HCHA	HCHG	OCS	QCB	TDEPP
	INDEX-method																													
51A	**Byrkjenes**	0	1	15.1	0.79	1.94	W	4.77	1.1	0.44	9.1	29	0.32	<0.1	0.29	0.5	0.62	<0.1	<0.1	<0.1	<0.1	0.1	2.3	2.1	0.08	<0.1	<0.2	<0.05	0.05	0.51
51A	**Byrkjenes**		2	15.3	0.77	1.92	W	4.66	1.1	0.41	7.5	31	0.32	0.1	0.28	0.55	0.7	<0.1	0.1	<0.1	<0.1	<0.1	2.1	1.8	0.07	<0.1	<0.2	<0.05	<0.05	0.51
51A	**Byrkjenes**		3	16.3	0.85	2.02	W	4.31	1.1	0.44	6.2	28	0.39	0.13	0.34	0.77	0.91	<0.1	0.11	<0.1	<0.1	0.12	3.4	3.1	0.06	0.11	0.22	<0.05	<0.05	0.46
52A	**Eitrheimsneset**	1.5	1	22.3	1.44	3.07	W	2.42	1.2	0.13	2.7	31	0.52	0.15	0.42	0.71	0.78	<0.1	0.14	<0.1	<0.1	0.17	3.3	2.9	0.08	0.14	0.22	<0.05	0.08	0.71
52A	**Eitrheimsneset**		2	21.7	1.55	2.98	W	2.03	1.2	0.12	2.5	32	0.5	0.14	0.37	0.65	0.73	<0.1	0.11	<0.1	<0.1	0.16	2.9	2.6	0.07	0.13	<0.2	<0.05	0.07	0.7
52A	**Eitrheimsneset**		3	21.6	1.57	2.78	W	2.11	1.1	0.14	3.1	32	0.52	0.13	0.39	0.67	0.77	<0.1	0.13	<0.1	<0.1	0.15	3	2.7	0.08	0.12	0.22	<0.05	0.07	0.68
56A	**Kvalnes**	16	1	14.2	0.85	1.74	W	2.75	1.2	0.13	4.7	38	0.35	0.13	0.36	0.66	0.73	<0.1	0.12	<0.1	<0.1	<0.1	8.4	9.5	0.1	<0.1	<0.2	<0.05	<0.05	1.8
56A	**Kvalnes**		2	12.5	0.82	1.83	W	3.12	1	0.14	5.8	49	0.34	0.13	0.33	0.6	0.67	<0.1	0.1	<0.1	<0.1	<0.1	7.2	8.3	0.1	<0.1	<0.2	<0.05	<0.05	1.5
56A	**Kvalnes**		3	16.4	0.85	1.68	W	3.03	1.1	0.12	5.3	35	0.3	0.12	0.3	0.57	0.63	<0.1	0.11	<0.1	<0.1	<0.1	7.1	5.7	0.09	<0.1	<0.2	<0.05	<0.05	1.8
5610	**Kvalnes, north**	17	1	16.6	1.17	2.11	W	2.61	1.1	0.11	4.1	41	0.4	0.16	0.35	0.75	0.78	<0.1	0.14	<0.1	<0.1	0.12	21	22	0.11	0.13	0.24	<0.05	<0.05	2.8
5610	**Kvalnes, north**		2	16	1.09	1.84	W	2.57	1	0.12	4.1	39	0.36	0.13	0.3	0.64	0.67	<0.1	0.12	<0.1	<0.1	0.1	19	24	0.11	0.11	0.22	<0.05	<0.05	2.3
5610	**Kvalnes, north**		3	15.6	1.08	1.84	W	2.52	1.1	0.12	6	37	0.35	0.13	0.3	0.64	0.69	<0.1	0.12	<0.1	<0.1	0.1	19	26	0.1	0.11	0.21	<0.05	<0.05	2.2
5620	**Kjeken (Helland)**	30	1	16.9	0.89	2.38	W	2.13	1.1	0.09	2.5	30	0.41	0.15	0.36	0.7	0.77	<0.1	0.15	<0.1	0.1	0.18	17	16	0.15	0.15	0.29	<0.05	0.06	2.1
5620	**Kjeken (Helland)**		2	16.1	0.94	2.26	W	1.8	1	0.08	2.3	29	0.41	0.18	0.37	0.75	0.8	<0.1	0.18	<0.1	<0.1	0.17	18	16	0.12	0.14	0.27	<0.05	0.05	2.2
5620	**Kjeken (Helland)**		3	16.6	1.00	2.26	W	2.26	1.1	0.08	2.1	32	0.39	0.14	0.34	0.73	0.78	<0.1	0.16	<0.1	<0.1	0.17	18	17	0.14	0.14	0.28	<0.05	0.06	2.2
5710	**Urdhem, s.Kross**	33	1	16.7	1.62	1.92	W	1.64	0.9	0.07	2	30	0.27	0.11	0.21	0.45	0.5	<0.1	<0.1	<0.1	<0.1	0.1	29	27	0.1	0.12	0.25	<0.05	<0.05	3.7
5710	**Urdhem, s.Kross**		2	17.4	1.56	2.11	W	1.67	0.9	0.07	2.3	28	0.29	0.11	0.24	0.5	0.55	<0.1	0.11	<0.1	<0.1	0.11	32	29	0.08	0.11	0.26	<0.05	<0.05	3.6
5710	**Urdhem, s.Kross**		3	16.3	1.37	1.96	W	1.75	0.8	0.07	2.3	27	0.27	0.1	0.23	0.51	0.57	<0.1	0.1	<0.1	<0.1	0.1	34	39	0.1	0.13	0.25	<0.05	<0.05	3.5
57A	**Krossanes**	35	1	14	0.73	1.7	W	1.85	0.9	0.07	1.9	35	0.2	<0.1	0.18	0.4	0.49	<0.1	<0.1	<0.1	<0.1	<0.1	6.2	4.5	0.06	<0.1	0.16	<0.05	<0.05	0.78
57A	**Krossanes**		2	14.4	0.74	1.6	W	1.59	1.1	0.07	1.6	24	0.21	<0.1	0.19	0.37	0.44	<0.1	<0.1	<0.1	<0.1	<0.1	5.9	4.9	0.09	<0.1	<0.2	<0.05	<0.05	0.82
57A	**Krossanes**		3	14.5	0.80	1.71	W	1.86	0.9	0.07	1.6	32	0.22	<0.1	0.21	0.36	0.43	<0.1	<0.1	<0.1	<0.1	<0.1	6.1	5.3	0.11	<0.1	<0.2	<0.05	<0.05	0.77
63A	**Ranaskjær**	51	1	13.8	0.72	1.67	W	0.91	0.9	0.04	0.7	15	0.18	<0.1	0.14	0.32	0.38	<0.1	<0.1	<0.1	<0.1	<0.1	1.8	1.3	0.07	0.1	0.18	<0.05	<0.05	0.35
63A	**Ranaskjær**		2	15.7	0.73	1.83	W	0.93	0.9	0.04	0.9	20	0.19	<0.1	0.17	0.38	0.44	<0.1	<0.1	<0.1	<0.1	<0.1	2.2	1.8	0.08	0.12	0.21	<0.05	<0.05	0.39
63A	**Ranaskjær**		3	15.2	0.73	1.97	W	0.82	0.8	0.04	0.8	15	0.21	<0.1	0.18	0.42	0.47	<0.1	<0.1	<0.1	<0.1	<0.1	2.5	3.3	0.08	0.1	0.22	<0.05	<0.05	0.4
65A	**Vikingneset**	74	1	15.6	1.21	1.73	W	0.56	0.9	0.02	0.3	26	0.29	<0.1	0.22	0.56	0.67	<0.1	<0.1	<0.1	<0.1	0.11	3	3.8	0.12	0.19	0.38	<0.05	<0.05	0.62
65A	**Vikingneset**		2	15.3	1.12	1.68	W	0.5	0.9	0.02	0.4	25	0.14	<0.1	0.11	0.27	0.35	<0.1	<0.1	<0.1	<0.1	<0.1	1.3	1	0.06	<0.1	0.2	<0.05	<0.05	0.27
65A	**Vikingneset**		3	15.7	1.20	1.72	W	0.55	0.9	0.02	0.5	34	0.15	<0.1	0.12	0.28	0.34	<0.1	<0.1	<0.1	<0.1	<0.1	1.4	1.3	0.11	<0.1	0.19	<0.05	<0.05	0.35
69A	**Lille Terøy**	111	1	15.5	1.63	1.71	W	0.52	1	0.03	0.7	34	0.11	<0.1	0.13	0.29	0.38	<0.1	<0.1	<0.1	<0.1	<0.1	0.53	<0.8	0.08	<0.1	0.16	<0.05	<0.05	<0.2
69A	**Lille Terøy**		2	15.5	1.48	1.58	W	0.58	1	0.03	1	36	<0.1	<0.1	<0.1	0.23	0.3	<0.1	<0.1	<0.1	<0.1	<0.1	0.42	<0.8	0.07	<0.1	0.13	<0.05	<0.05	<0.2
69A	**Lille Terøy**		3	15	1.47	1.35	W	0.52	1	0.03	0.8	36	0.12	<0.1	0.13	0.31	0.37	<0.1	<0.1	<0.1	<0.1	<0.1	0.5	<0.8	0.07	<0.1	0.14	<0.05	<0.05	<0.2

Table 15. Comparison between the standard JAMP-method and Index-method for pre-treatment of mussels (*Mytilus edulis*) (cf. Table 14), using the paired t-test on ln-transformed data on a dry weight and wet weight basis. For each contaminant the following is indicated: total number of pairs (N), number of pairs where at least one sample was below the detection limit (d), the results from the test (ns, * - p<0.05, ** - p<0.01 or *** - p<0.001), average percent difference (%chg, JAMP - INDEX), average and standard deviation for difference (dif-x/-SD), JAMP-method (JAMP-x/-SD) and INDEX-method (INDEX-x/-SD). Results in bold type have not more than a third of the comparison involving a value below the detection limit. Code descriptions are given in Appendix B. .

contam.	units-basis	N	d	sign.	%chg	dif-x	dif-SD	JAMP -x	JAMP -SD	INDEX -x	INDEX -SD
CD	ppm-dw	21		***	**-24.16**	-3.90	4.18	16.15	12.94	12.25	9.37
CU	ppm-dw	21		ns	-10.27	-0.73	2.01	7.13	2.40	6.40	0.90
HG	ppm-dw	21		ns	-5.18	-0.04	0.18	0.81	1.01	0.77	0.88
PB	ppm-dw	21		***	**45.43**	5.54	7.35	12.19	12.02	17.73	17.71
ZN	ppm-dw	21		*	**14.23**	24.22	41.54	170.18	49.24	194.40	65.54
CB101	ppb-dw	21	1	**	**34.60**	0.07	0.07	0.20	0.08	0.27	0.13
CB105	ppb-dw	21	15	*	7.37	0.01	0.01	0.10	0.01	0.11	0.02
CB118	ppb-dw	21	1	*	**27.84**	0.05	0.07	0.18	0.05	0.24	0.10
CB138	ppb-dw	21		***	**46.66**	0.15	0.12	0.32	0.11	0.47	0.17
CB153	ppb-dw	21		***	**51.44**	0.19	0.13	0.36	0.12	0.55	0.18
CB156	ppb-dw	21	21	ns	0.00	0.00	0.00	0.10	0.00	0.10	0.00
CB180	ppb-dw	21	17	*	4.72	0.00	0.01	0.10	0.00	0.11	0.01
CB209	ppb-dw	21	21	ns	0.00	0.00	0.00	0.10	0.00	0.10	0.00
CB28	ppb-dw	21	21	ns	-3.67	0.00	0.02	0.10	0.02	0.10	0.00
CB52	ppb-dw	15	16	ns	0.67	0.00	0.00	0.10	0.00	0.11	0.02
DDEPP	ppb-dw	21		***	**49.84**	1.13	1.11	2.27	1.48	3.41	2.42
DDTPP	ppb-dw	21	3	***	**58.65**	1.20	1.45	2.05	1.21	3.25	2.41
HCB	ppb-dw	10	7	***	35.85	0.02	0.01	0.05	0.01	0.08	0.02
HCHA	ppb-dw	21	18	ns	6.45	0.01	0.02	0.10	0.01	0.11	0.02
HCHG	ppb-dw	21	9	***	38.69	0.06	0.05	0.15	0.05	0.20	0.05
OCS	ppb-dw	21	21	ns	0.00	0.00	0.00	0.05	0.00	0.05	0.00
QCB	ppb-dw	21	18	ns	0.00	0.00	0.00	0.05	0.01	0.05	0.01
TDEPP	ppb-dw	21	5	***	**63.59**	0.26	0.29	0.41	0.23	0.67	0.48
CD	ppm-ww	21		***	**-18.81**	-0.45	0.26	2.37	1.55	1.92	1.41
CU	ppm-ww	21		ns	-10.86	-0.12	0.24	1.13	0.28	1.01	0.11
HG	ppm-ww	21		ns	5.37	0.01	0.02	0.12	0.13	0.12	0.14
PB	ppm-ww	21		***	**56.63**	1.00	1.22	1.76	1.51	2.76	2.62
ZN	ppm-ww	21		ns	11.30	3.08	5.33	27.23	5.83	30.30	7.85
CB101	ppb-ww	21	1	**	**34.60**	0.07	0.07	0.20	0.08	0.27	0.13
CB105	ppb-ww	21	15	*	7.37	0.01	0.01	0.10	0.01	0.11	0.02
CB118	ppb-ww	21	1	*	**27.84**	0.05	0.07	0.18	0.05	0.24	0.10
CB138	ppb-ww	21		***	**46.66**	0.15	0.12	0.32	0.11	0.47	0.17
CB153	ppb-ww	21		***	**51.44**	0.19	0.13	0.36	0.12	0.55	0.18
CB156	ppb-ww	21	21	ns	0.00	0.00	0.00	0.10	0.00	0.10	0.00
CB180	ppb-ww	21	17	*	4.72	0.00	0.01	0.10	0.00	0.11	0.01
CB209	ppb-ww	21	21	ns	0.00	0.00	0.00	0.10	0.00	0.10	0.00
CB28	ppb-ww	21	21	ns	-3.67	0.00	0.02	0.10	0.02	0.10	0.00
CB52	ppb-ww	15	16	ns	0.67	0.00	0.00	0.10	0.00	0.11	0.02
DDEPP	ppb-ww	21		***	**49.84**	1.13	1.11	2.27	1.48	3.41	2.42
DDTPP	ppb-ww	21	3	***	**58.65**	1.20	1.45	2.05	1.21	3.25	2.41
HCB	ppb-ww	10	7	***	35.85	0.02	0.01	0.05	0.01	0.08	0.02
HCHA	ppb-ww	21	18	ns	6.45	0.01	0.02	0.10	0.01	0.11	0.02
HCHG	ppb-ww	21	9	***	38.69	0.06	0.05	0.15	0.05	0.20	0.05
OCS	ppb-ww	21	21	ns	0.00	0.00	0.00	0.05	0.00	0.05	0.00
QCB	ppb-ww	21	18	ns	0.00	0.00	0.00	0.05	0.01	0.05	0.01
TDEPP	ppb-ww	21	5	***	**63.59**	0.26	0.29	0.41	0.23	0.67	0.48