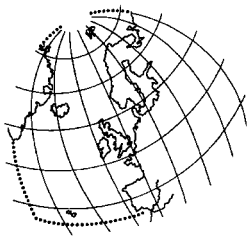
Assessment and Monitoring Series

2005/2006 CEMP Assessment Trends and concentrations of selected hazardous substances in the marine environment



OSPAR Commission
2006

The Convention for the Protection of the Marine Environment of the North-East Atlantic (the "OSPAR Convention") was opened for signature at the Ministerial Meeting of the former Oslo and Paris Commissions in Paris on 22 September 1992. The Convention entered into force on 25 March 1998. It has been ratified by Belgium, Denmark, Finland, France, Germany, Iceland, Ireland, Luxembourg, Netherlands, Norway, Portugal, Sweden, Switzerland and the United Kingdom and approved by the European Community and Spain.

La Convention pour la protection du milieu marin de l'Atlantique du Nord-Est, dite Convention OSPAR, a été ouverte à la signature à la réunion ministérielle des anciennes Commissions d'Oslo et de Paris, à Paris le 22 septembre 1992. La Convention est entrée en vigueur le 25 mars 1998. La Convention a été ratifiée par l'Allemagne, la Belgique, le Danemark, la Finlande, la France, l'Irlande, l'Islande, le Luxembourg, la Norvège, les Pays-Bas, le Portugal, le Royaume-Uni de Grande Bretagne et d'Irlande du Nord, la Suède et la Suisse et approuvée par la Communauté européenne et l'Espagne.

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Executive Summary/*Récapitulatif*

This annual assessment of OSPAR marine monitoring data confirms the conclusion from the comprehensive trend assessment published in 2005 that there are widespread downward trends in the concentrations of hazardous substances in the North East Atlantic. The majority of measurements, however, show that concentrations of both naturally occurring and man-made contaminants remain above long-term targets. Some hotspots were highlighted resulting from known point sources although many downward trends were also found in such areas.

La présente évaluation annuelle des données OSPAR, qui découlent de la surveillance marine, confirme les conclusions de l'évaluation exhaustive des tendances qui a été publiée en 2005, à savoir que, dans l'ensemble, les tendances des teneurs en substances dangereuses dans l'Atlantique du nord-est sont à la baisse. La plupart des analyses révèlent cependant que les teneurs en contaminants, qu'il s'agisse de ceux qui sont présents naturellement ou des contaminants synthétiques, sont toujours supérieures aux objectifs à long terme. On a mis en évidence certains points chauds qui résultent de sources ponctuelles connues bien que l'on observe dans de telles zones de nombreuses tendances à la baisse.

The assessment generally supports the conclusion that the work of OSPAR is having a substantial beneficial effect on the quality of the marine environment of the North-East Atlantic. This is the first in a series of annual scientific assessments of data collected under the Coordinated Environmental Monitoring Programme that OSPAR has agreed to make during the period of preparation of the next Quality Status Report in 2010 in order to keep monitoring data under more regular scrutiny and provide a more up-to-date evidence base for policy making.

D'une manière générale, la présente évaluation confirme les conclusions à savoir que les travaux d'OSPAR ont des effets positifs importants sur la qualité du milieu marin de l'Atlantique du nord-est. Elle est la première d'une série d'évaluations scientifiques annuelles des données recueillies dans le cadre du Programme coordonné de surveillance continue de l'environnement (CEMP). OSPAR est convenue d'entreprendre ces évaluations pendant la période de préparation du prochain Bilan de santé, le QSR 2010, afin d'effectuer une surveillance plus stricte des données issues de la surveillance continue et de fournir des justifications plus récentes sur lesquelles pourra se fonder la prise de décisions politiques.

A total of 1570 time series of data were assessed, which were drawn from data collected at widely spaced monitoring stations in OSPAR Regions I, II, III and IV, and varied in length from 3 to 26 years. Most stations were in Region II, but the results are similar in all four regions. The hazardous substances assessed include metals, polycyclic aromatic hydrocarbons (PAH), chlorinated biphenyl (CBs), TBT and selected pesticides.

Au total, 1570 séries temporelles de données ont été évaluées. Ces données proviennent de stations de surveillance disséminées dans les Régions I, II, III et IV d'OSPAR et s'étendent sur 3 à 26 ans. La plupart des stations sont situées dans la Région II, mais on obtient des résultats similaires dans les quatre régions. Les substances dangereuses évaluées comprennent les métaux, les hydrocarbures aromatiques polycycliques (HAP), les biphényles chlorés (CB), le TBT et des pesticides sélectionnés.

Statistically significant trends, showing either increasing or decreasing concentrations, were found in 330 time series. The large majority (301 (90%)) showed downward trends. 29 (10%) showed increasing trends. The following results are particularly important for chemicals identified by OSPAR for priority action:

a. the large majority of the statistically significant trends of concentrations of mercury (27 out of 30), cadmium (49 out of 61) and lead (36 out of 41) in biota show decreasing concentrations;

b. all the statistically significant trends for lindane (64) and HCB (33), and the large majority of statistically significant trends for p,p'-DDE (26 out of 27) in biota show decreasing concentrations;

c. the large majority of statistically significant trends for CB 153 (representative of the CB group) (42 out of 45) in biota show decreasing concentrations. However, concentrations of PCBs in biota remain relatively high in most OSPAR regions suggesting that there may be a residual problem;

d. a limited number of statistically significant increasing (5) and decreasing (13) trends for PAH compounds in biota do not suggest the widespread downward trends visible for other contaminants[1];

[1] PAH compounds have a variety of sources, including wood-burning stoves, run-off from tarmac roads and municipal-waste incinerators. *Les composés de HAP proviennent de sources diverses,*

e. only a small number of trends of TBT in biota were significant, although all that were determined were downward. Continued monitoring is needed to develop a more comprehensive picture;

f. a substantial majority of the statistically significant trends of concentrations of metals in sediments were decreasing, particularly for cadmium (18 out of 19) and mercury (28 out of 33);

g. there were relatively fewer significant trends for PAH and CBs in sediment, although a majority of those that were determined (9 out of 13) were in fact decreasing.

On a observé des tendances statistiquement significatives, qui révèlent des teneurs soit en hausse soit en baisse, dans 330 séries temporelles. La grande majorité de ces séries (301 (90%)) révèlent des tendances à la baisse. Les autres 29 séries (10%) révèlent des tendances à la hausse. Les résultats suivants sont particulièrement importants pour les produits chimiques identifiés par OSPAR comme devant faire l'objet de mesures prioritaires:

a. la grande majorité des tendances statistiquement significatives des teneurs en mercure (27 sur 30), en cadmium (49 sur 61) et en plomb (36 sur 41) dans le milieu vivant révèlent des teneurs en baisse;

b. toutes les tendances statistiquement significatives pour le lindane (64) et le HCB (33), et la grande majorité des tendances statistiquement significatives pour le p,p'-DDE (26 sur 27) dans le milieu vivant révèlent des teneurs en baisse;

c. la grande majorité des tendances statistiquement significatives pour le CB 153 (représentatif du groupe des CB) (42 sur 45) dans le milieu vivant montrent des teneurs en baisse. Les teneurs en PCB dans le milieu vivant restent cependant relativement élevées dans la plupart des régions OSPAR ce qui semble indiquer qu'un problème persiste;

d. un nombre limité de tendances statistiquement significatives, à la hausse (5) et à la baisse (13) pour les composés de HAP dans le milieu vivant ne semble pas refléter la tendance générale à la baisse que l'on relève pour les autres contaminants[1];

e. un petit nombre seulement de tendances sont significatives pour le TBT dans le milieu vivant, bien que toutes celles qui ont été relevées soient à la baisse. Il faut poursuivre une surveillance continue afin d'obtenir un tableau plus complet;

f. une majorité importante de tendances statistiquement significatives des teneurs en métaux dans les sédiments sont à la baisse, en particulier en ce qui concerne le cadmium (18 sur 19) et le mercure (28 sur 33);

g. les HAP et les CB dans les sédiments présentent relativement moins de tendances significatives. La majorité de celles qui ont été relevées sont cependant à la baisse (9 sur 13).

For the large majority of time series, no statistically significant trends could yet be detected. The main reason for this is that the time series were too short: the dynamic nature of the marine environment produces much statistical "noise", which means that trends can only be detected over relatively long time series. Continued monitoring to extend the time series will help to clarify the position. Further monitoring is especially necessary to develop a more comprehensive picture in OSPAR Regions III and IV.

La grande majorité des séries temporelles ne présentent pas de tendances statistiquement significatives. Ceci s'explique principalement par le fait que ces séries sont trop courtes. En effet le dynamisme naturel du milieu marin produit beaucoup de «bruits» statistiques et on ne peut donc relever des tendances que pour des séries temporelles relativement longues. Une surveillance continue dans le but de prolonger les séries temporelles permettrait de clarifier cette situation. Il est particulièrement nécessaire de poursuivre la surveillance afin de développer un tableau plus complet dans les Régions III et IV d'OSPAR.

OSPAR has agreed a set of Background Concentrations, to represent the background levels of hazardous substances that would be expected in the absence of human-induced contamination. Comparison of the concentrations in the last year of each time series with these shows that in a large majority of cases concentrations of heavy metals and PAHs are above background levels. For example:

biota

a. for lead and cadmium, over 87% of concentrations in blue mussels in the last year of each time series were above background levels;

b. for mercury, 99% of concentrations in blue mussels in the last year of each time series were above background levels, as were 80% of concentrations of mercury in fish;

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notamment les poêles à bois, les écoulements de revêtement goudronné des routes et les incinérateurs de déchets municipaux.

c. for the PAHs benzo[a]pyrene and fluranthrene, 84% and 96% respectively of concentrations in blue mussels in the last year of each time series were above background levels;

sediments

d. for cadmium, 81% of concentrations in sediments in the last year of each time series were above background levels;

e. for lead and mercury, over 96% of concentrations in sediments in the last year of each time series were above background levels;

f. for the PAHs benzo[a]pyrene and fluranthrene, 92% and 97% respectively of concentrations in sediments in the last year of each time series were above background levels.

OSPAR est convenue d'une série de teneurs ambiantes qui représentent les niveaux ambiants des substances dangereuses auxquels on peut s'attendre en l'absence d'une contamination causée par l'homme. Si l'on compare les teneurs pour la dernière année de chaque série temporelle avec ces teneurs ambiantes on s'aperçoit que, dans la plupart des cas, les teneurs en métaux lourds et en HAP sont supérieures aux teneurs ambiantes. Par exemple:

Milieu vivant

a. dans le cas du plomb et du cadmium, plus de 87% des teneurs dans la moule pour la dernière année de chaque série temporelle sont supérieures aux niveaux ambiants;

b. dans le cas du mercure, 99% des teneurs dans la moule pour la dernière année de chaque série temporelle sont supérieures aux niveaux ambiants, il en est de même pour 80% des teneurs en mercure dans le poisson;

c. dans le cas des HAP benzo[a]pyrène et fluranthrène, 84% et 96% respectivement des teneurs dans la moule pour la dernière année de chaque série temporelle sont supérieures aux niveaux ambiants;

Sédiments

d. dans le cas du cadmium, 81% des teneurs pour la dernière année de chaque série temporelle sont supérieures aux niveaux ambiants;

e. dans le cas du plomb et du mercure, plus de 96% des teneurs pour la dernière année de chaque série temporelle sont supérieures aux niveaux ambiants;

f. dans le cas des HAP benzo[a]pyrène et fluranthrène, 92% et 97% respectivement des teneurs pour la dernière année de chaque série temporelle sont supérieures aux niveaux ambiants.

For CBs and TBT (which are man made synthetic substances), the ultimate OSPAR aim is concentrations close to zero. 98% of concentrations of CB153 in blue mussels in the latest year of time series were close to zero. No concentrations of CB153 in sediments in the latest year of sediment time series were close to zero.

Dans le cas des CB et du TBT (qui sont des substances synthétiques), l'objectif ultime d'OSPAR est de parvenir à des teneurs proches de zéro. 98% des teneurs en CB153 dans la moule pour la dernière année de la série temporelle sont proches de zéro. Aucune teneur en CB153 dans les sédiments pour la dernière année de la série temporelle n'est proche de zéro.

Although a high proportion of the statistically significant trends show decreases, some notable upward trends were observed, for example:

a. for mercury, cadmium and lead in biota and sediments at one Norwegian site close to a point source;

b. for cadmium in biota at some UK sites;

c. for mercury in biota at some Norwegian and UK sites;

d. for mercury, cadmium and lead in sediments in the inner German Bight;

e. for PAHs in sediment at one site off the coast of the Netherlands;

f. for PAHs in biota at individual sites in France and Norway.

Une proportion importante de tendances statistiquement significatives révèle des baisses, on observe cependant de nettes tendances à la hausse, par exemple:

a. pour le mercure, le cadmium et le plomb dans le milieu vivant et les sédiments, dans une station norvégienne proche d'une source ponctuelle;

b. pour le cadmium dans le milieu vivant, dans certaines stations du Royaume-Uni;

c. pour le mercure dans le milieu vivant, dans certaines stations norvégiennes et du Royaume-Uni;

d. pour le mercure, le cadmium et le plomb dans les sédiments, à l'intérieur du German Bight;

e. pour les HAP dans les sédiments, dans une station au large de la côte néerlandaise;

f. pour les HAP dans le milieu vivant, dans des diverses stations françaises et norvégiennes.

In general the results are consistent with the comprehensive trend assessment of CEMP data published in 2005 even though the assessment is based on a slightly modified selection of data from the ICES database. Many of the small differences in results can be attributed to these modifications, which are part of the work OSPAR is undertaking with ICES to improve assessment procedures and related data handling.

D'une manière générale, les résultats correspondent à ceux de l'évaluation exhaustive des tendances des données CEMP qui a été publiée en 2005. Cette évaluation se base cependant sur des données dont la sélection à partir de la base de données du CIEM a été légèrement modifiée. On peut attribuer plusieurs des différences mineures qui se trouvent dans les résultats à ces modifications qui font partie des travaux dont OSPAR est responsable avec le CIEM afin d'améliorer les procédures d'évaluation et le traitement des données correspondant.

1. Introduction

This report is the first in a series of annual assessments of trends and concentrations in data reported by OSPAR Contracting Parties under the Co-ordinated Environmental Monitoring Programme (CEMP). It follows the first comprehensive trend assessment of CEMP data in 2005 (publication number: 2005/235). That publication includes detailed background information to the assessments, such as data screening procedures, quality assurance assessment, statistical methodology, data assessment criteria and station lists and refers to key OSPAR agreements relevant to CEMP data assessments.

The CEMP can be described as that part of monitoring under the OSPAR Joint Assessment and Monitoring Programme where the national contributions overlap and are co-ordinated (reference number: 2005-5). It covers temporal trend and spatial monitoring programmes for concentrations of selected chemicals and nutrients, and for biological effects. Supporting documentation for the CEMP includes guidelines for monitoring, quality assurance tools and assessment tools.

The aim of this and future annual assessments is to test and further improve methodologies developed for trend assessments and to update information on the quality of the marine environment in relation to CEMP determinands. These assessments provide a framework for continuing improvements to methods and procedures for the next overall CEMP data assessment in 2008/2009, and for the report on the quality status of the OSPAR maritime area in 2010.

The annual assessments will focus on specific items or contaminants under the CEMP. The present assessment concentrates on trends in the concentrations in biota and sediment of metals (cadmium, lead and mercury), TBT, organic contaminants (PCB congener 153, the PAHs fluoranthene and benzo[a]pyrene) and pesticides (lindane, p,p'-DDE and HCB).

The assessment has been prepared by the OSPAR Working Group on Monitoring (MON) and is based upon data reported by Contracting Parties to ICES and held in the ICES Environmental databases. For practical reasons the assessment does not include data reported to ICES in ICES Environmental Reporting Format 3.2. Work is underway to enable these data to be included in future assessments.

2. Overview maps of stations from which data was assessed

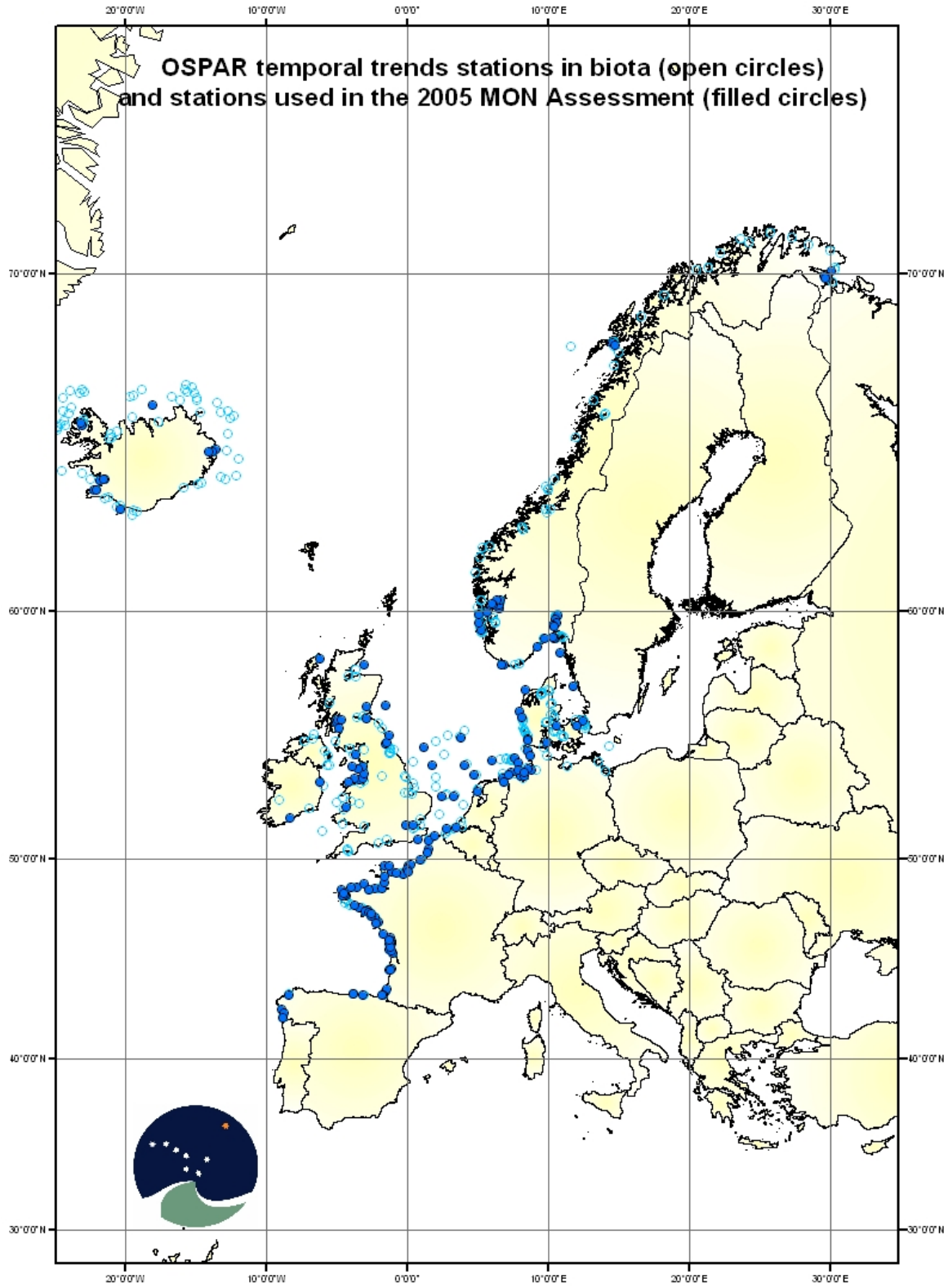

Figure 2.1. Overview map showing CEMP temporal trend monitoring stations for contaminants in biota. Filled circles indicate those stations on which this assessment report is based.

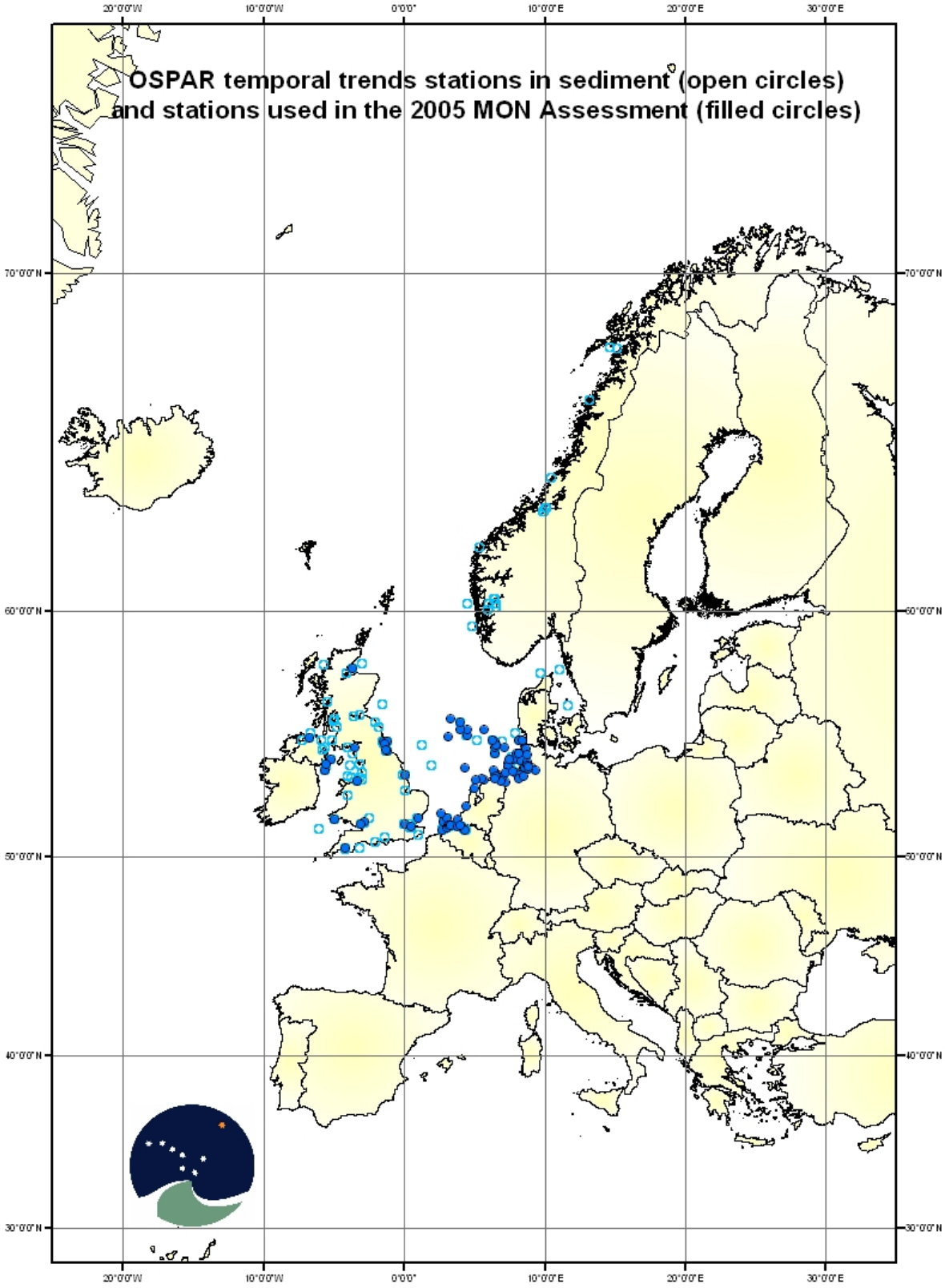

Figure 2.2. Overview map showing CEMP temporal trend monitoring stations for contaminants in sediment. Filled circles indicate those stations on which this assessment report is based.

3. Methods and preparation of the assessment

3.1 Selection of parameters for assessment

The assessment covers the following hazardous substances which are included as mandatory determinands under the CEMP:

a. ***mercury, cadmium and lead in biota and sediment*.** These three heavy metals are included in the OSPAR List of Chemicals for Priority Action;

b. ***tributyl tin (TBT) in biota.*** TBT is included in the group of organic tin compounds on the OSPAR List of Chemicals for Priority Action

c. ***the PAHs fluoranthene and benzo[a]pyrene in biota and sediment*.** PAHs are included as a group of substances on the OSPAR List of Chemicals for Priority Action. Fluoranthene has been selected for assessment because it can be quantified well using the most regularly used analytical methods and was found at relatively high concentrations (compared to other PAH compounds) in the 2005 CEMP assessment. Benzo[a]pyrene has been selected because of its recognised toxicological importance, and it is generally one of the more abundant PAHs;

d. ***the polychlorinated biphenyl congener CB153* in biota and sediment**. PCBs are included as a group of substances on the OSPAR List of Chemicals for Priority Action. CB153 was selected to represent PCBs because it is generally present in the highest concentration and correlates well with other analysed PCBs.

The assessment also covers the following pesticides:

a. **lindane (γ-HCH) in biota**: the group of hexachlorocyclohexane isomers is included in the OSPAR List of Chemicals for Priority Action. During 2005/2006, OSPAR is reviewing whether monitoring of lindane in biota should be included as a component of the CEMP;

b. **p,p'-DDE in biota**: p,p'-DDE is a metabolite of the pesticide DDT which is frequently used as a marker for DDT contamination;

c. **Hexachlorobenzene in biota (HCB)**: HCB is a priority hazardous substance under the Water Framework Directive.

3.2 Methods used for assessment

This annual assessment was mainly prepared using the methods for data screening, treatment of quality assurance information, choice of bases, temporal trend assessment and assessment against background concentrations developed for the 2004/05 CEMP Assessment (OSPAR Commission, 2005a)[2].

For biota, the assessment was performed as described in Annex 4 of the 2004/05 CEMP assessment. This included the approaches used for treatment of quality assurance (QA) information and trend assessment.

For sediment the following developments were incorporated in the assessment:

a. after extractions of data from the ICES database were received, station names were added where the coordinates agreed well with those of previous years. It was not possible to assign station names to all samples reported for 2004;

b. a new method for calculating the uncertainty of normalised concentrations was applied. The method had been developed intersessionally and was presented at the ICES Annual Science Conference 2005 (Smedes *et al*, 2005)[3]. The method recognises that parameters used in the normalisation procedure are correlated and leads in general to a lower estimate of uncertainty.

In sediment assessments, metal and organic contaminant data were used only if supporting aluminium and organic carbon data (respectively) were available for normalisation.

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[2] *OSPAR Commission (2005a) 2005 Assessment of data collected under the Co-ordinated Environmental Monitoring Programme (CEMP). OSPAR Commission 2005, 115pp + appendices*

[3] Pragmatic estimation of uncertainty in normalized concentrations of contaminants in sediments, F.Smedes, I.M. Davies and R. Fryer, ICES CM 2005/Z:04

All data for contaminant concentrations in sediment used in this assessment have been normalised, i.e recalculated to a reference sediment composition to make data comparable between years and comparable with assessment criteria. Metal concentrations are normalised to a standard sample containing 5% aluminium, and organic contaminants to 2,5% organic carbon. The normalised concentrations can be considered to represent the concentrations of contaminants in the fine fraction of sediments, whether they are muddy or sandy. The concentration in the whole sample is generally much lower through dilution by sand.

The background concentrations (BCs) and background assessment concentrations (BACs) adopted by OSPAR in OSPAR Agreement 2005/06 were used in the assessment. BCs and BACs have not yet been established for metals in biota, so the Background Reference Concentrations (BRCs) from OSPAR Agreement 1997/14 were used instead. No updated values for Environmental Assessment Criteria (EACs) were available for use in the assessment. Further work has been arranged to address the problems with the proposed set of updated EACs identified during the 2004/05 assessment.

3.3 Presentation of assessments

The assessments of each parameter are summarised in two pages, one each for sediment and biota, preceded by an explanatory text. Each page contains the same three components in tabular and graphical form.

First, a table shows, by OSPAR region and species group (for biota), the number of time series, the number of significant linear trends and the number of time series where the mean concentration in the final year is significantly below the BAC (or BRC).

Secondly, a figure shows the mean concentration in the final year of each time series, by OSPAR region. Time series for which the mean concentration is significantly below the BAC (BRC) are shown by filled circles; open circles indicate mean concentrations that are not significantly below the BAC (BRC).

Finally, selected time series are shown graphically. Time series were selected either because they showed a significant change in concentration in the last ten years (1995 – 2004) or because the upper confidence limit on the mean concentration in the final year exceeded the BAC (BRC). When it was not possible to plot all time series, only those which were most significant or showed the highest levels were given.

In the explanatory texts on the assessment, the following phrases have been used to explain statistical results:

a. "*trends"* refer to linear trends, significant at the 5% level,

b. "*mean concentrations are at background"* or "*mean concentrations are close to zero"* means that the upper confidence limit on the fitted mean concentration in the last year of monitoring is below the BAC.

4. Assessment of selected contaminants

4.1 Trends of metals and organometal(s)

Metals are naturally occurring substances. BACs have been established for sediment and BRCs for blue mussel and for mercury in fish. The blue mussel is the most common species for which data are held in the ICES databases. Although it is only collected in coastal areas, it accounts for half the stations sampled under the CEMP. Two other mollusc species have been analysed, both of which are coastal. Data were also available for seven fish species, including both flatfish and roundfish, some of which represent more open sea areas.

The following overview highlights time trends with the steepest slopes, any corroborating trends, and places with the highest concentrations. All time series with upward trends had mean concentrations above the BAC (BRC) by the final monitoring year. Some time series with downward trends had mean concentrations at background by the final monitoring year (e.g. lead in blue mussels from Færder, mercury in cod from Varangerfjorden and in flounder from Sande, all Norway, mercury in flounder from Inner Elbe, Germany, and five cadmium time series in blue mussels from France).

4.1.1 Cadmium in sediments and biota

A total of 219 biota time series, covering ten species, were available from all regions. Mean concentrations were at background at 12% of blue mussel stations. 201 sediment time series were available from regions II and III, with mean concentrations at background at 19% of the stations.

For biota, there were trends in 28% of time series, mostly downwards. The high percentage of trends may be attributed to the long time series collected for metals and the large changes in inputs that have occurred over the time span of the data. A downward trend in the annual discharges of cadmium of 5% was reported by RID 2005, and atmospheric deposition of cadmium decreased by 25% between 1998 and 2002 (CAMP 2005).

Focussing on changes in concentration in the last ten years, there were downward trends at 15 French, ten Norwegian, two UK, one Irish and one Icelandic station. The steepest decrease was 42%/year in flounder at Strandebarm (western Norway) in Region II. The downward trends were in Pacific oysters at five French stations in Region IV; in blue mussels in the Clyde (UK) and St Bees, Cumbria (UK) and Dublin Bay (Ireland) in area III; in blue mussel at Mjófjördur (Iceland) and cod at Varangerfjord (Norway) in Region I; and in 19 French and Norwegian stations in Region II.

The steepest upward trends in the last ten years were 34%/year in plaice offshore the Tay and Forth estuaries (UK) in Region II, 20%/year in cod in inner Sørfjord (Norway) in Region I, 19%/year in blue mussels in Roskilde Fjord (Denmark) and 14%/year in flounder from the Belgian coastal shelf. There were also upward trends, of between 4 and 8%/year, at Gressholmen and Solbergstrand (Norway), Ems Estuary and Dogger Bank (Netherlands), Hvalfjördur (Iceland), and Vigo (Spain)

For sediment, there were trends in 9% of time series, all but one downwards. Nine of the downward trends were in the open sea, in the German Bight (5), the Irish Sea and north of Ireland. However, the trends in the Irish Sea were thought to result from changes in the analytical technique. The remaining downward trends were at near shore stations in the UK (Tamar and Tyne Estuary) and the Netherlands (the Schelde Estuary). The only upward trend was in the Elbe Estuary.

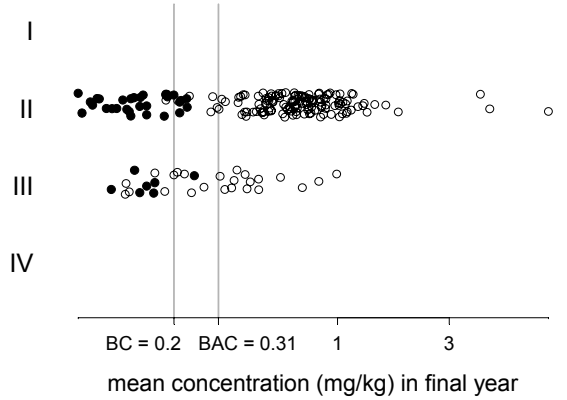
The highest concentrations in sediments and biota are generally found in coastal areas. The main exception to this is the Dogger Bank where (Al-normalised) concentrations are high compared to the surrounding area. A disused dumping site for metaliferrous waste from titanium dioxide production explains the higher sediment concentrations in the central German Bight. Dumping ceased in 1989.

The highest concentrations in blue mussels are found in region 2, at Byrkjenes, Kvalnes and Eitrheimsneset (Norway), which are characterised by metallurgical industry point sources. High concentrations are also found in the Thames and Medway (UK). In region I, there are high concentrations at Mjófjördur, Dvergasteinn, Alftafjördur and Grimsey (Iceland), which can be attributed to geological factors. The Pacific oysters from the Gironde (France) in Region IV have higher concentration than the blue mussels from Norway. Pacific oysters from Marennes (France) also have high concentrations.

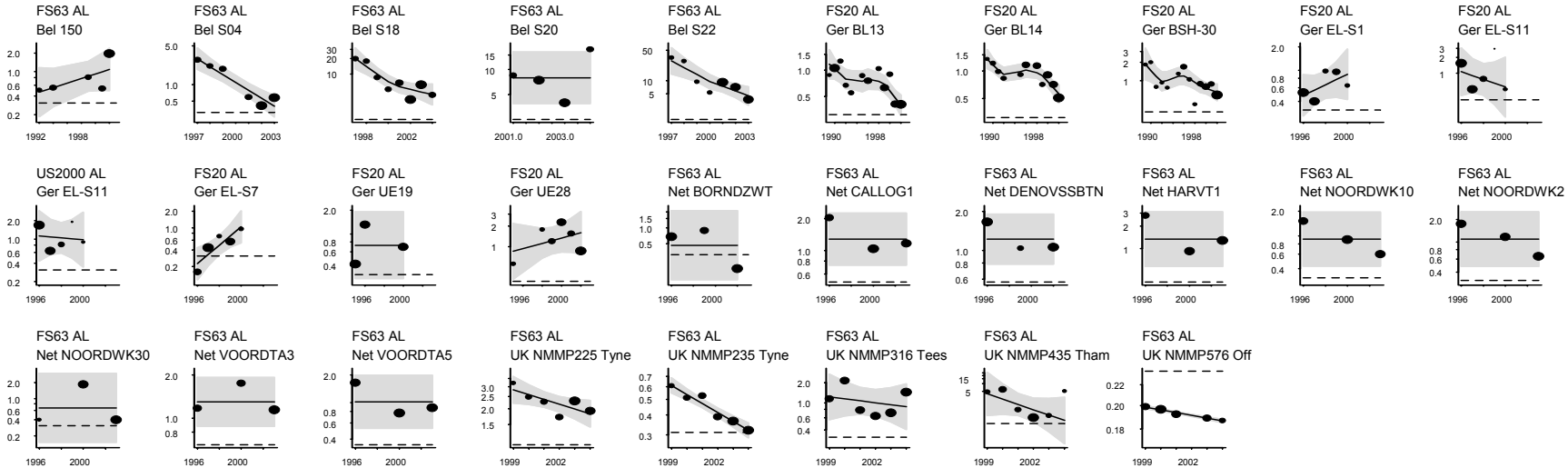
Inner Sørfjord (Norway), an industrial area, has the highest concentrations found in both cod and flounder. High concentrations are also found in plaice offshore from the Tay and Forth estuaries and Cardigan Bay and in common dab at the Dogger Bank (all UK). In flounder, concentrations from the Belgian continental shelf and Great Belt (Denmark) are above average.

Cadmium in sediment

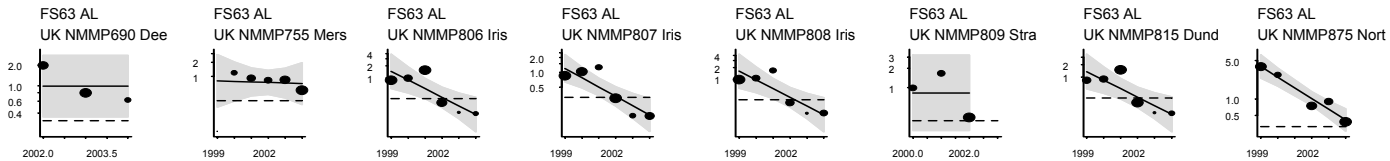
normaliser	region	Number of time series				trends		UCL<
		3-4	5-6	7+	total	up	down	BAC
AL	II	98	48	24	170	1	13	31
	III	13	18	0	31	0	5	7
		111	**66**	**24**	**201**	**1**	**18**	**38**



region II

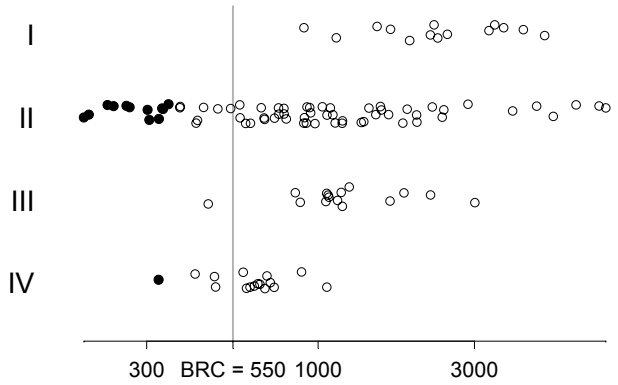


region III



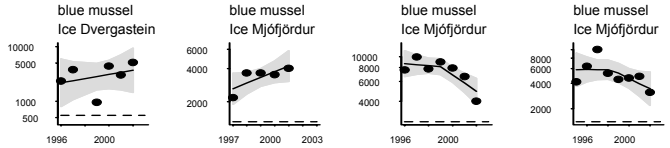
Cadmium in biota

	region	Number of time series				trends		UCL<
		3-4	5-6	7+	total	up	down	BRC
blue mussel	I	0	3	11	**14**	2	2	0
	II	23	6	38	**67**	5	19	12
	III	7	7	1	**15**	0	3	0
	IV	2	1	13	**16**	1	1	1
		32	**17**	**63**	**112**	**8**	**25**	**13**
other molluscs	II	1	0	7	**8**	0	2	
	IV	0	0	22	**22**	0	14	
		1	**0**	**29**	**30**	**0**	**16**	
fish	I	0	0	4	**4**	0	1	
	II	12	13	30	**55**	4	7	
	III	11	7	0	**18**	0	0	
		23	**20**	**34**	**77**	**4**	**8**	

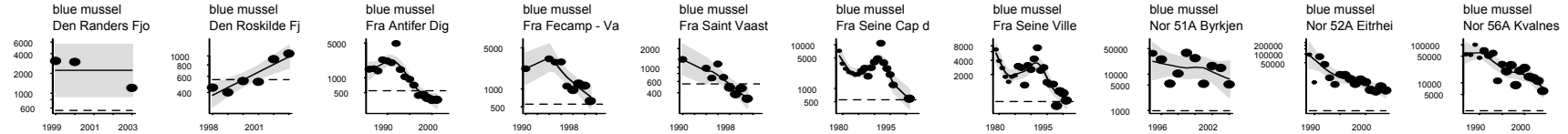


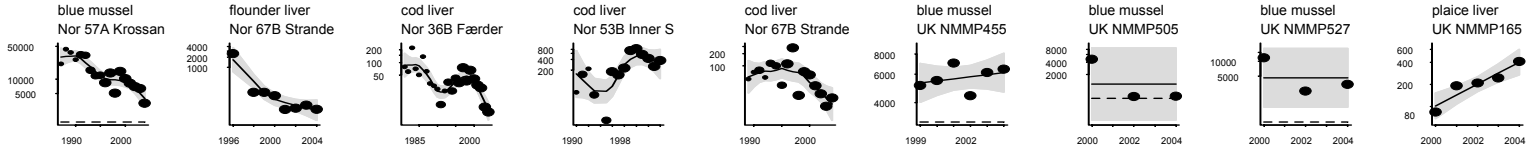
mean concentration (ug/kg) in blue mussels in final year

region I

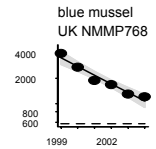


region II





region III



4.1.2 Mercury in sediments and biota

A total of 223 biota time series, covering 10 species, were available from all regions. Of these mean concentrations are at background at only 1% of the 112 stations where blue mussel were sampled and at 20% of fish stations. Of the 199 sediment stations from region II and III, 3% had mean concentrations at background.

Upward trends in sediment were found in the Elbe (4 stations) and in the Tamar (UK). Downward trends were found in 17 stations in the German Bight. Direct discharges and riverine inputs of mercury to the south-eastern North Sea reduced by 68% between 1990 and 2002, although the decreases mostly occurred before 1997 (OSPAR Commission, 2005b[4]). Information on deposition of Hg is not available (OSPAR Commission 2005c[5]). Other downward trends were found outside the Schelde Estuary (Belgium), in the Tyne (UK) where sewage interception and treatment has improved, and in the Humber and Mersey (UK).

In biota, there were 21 downward trends over the past ten years: from nine French stations (6 in Region IV and 3 in Region II); from five Norwegian stations, from three UK stations in Region III (Mersey, Ribble and Clyde); in the Elbe (Germany); on the Belgian continental shelf and at Pontevedra in Spain. There were seven upward trends in the same period, the steepest of which was 17%/year in flounder from Inner Sørfjord in Norway in Region I, and industrial area contaminated by a metallurgical industrial point source. The other upward trends were at Esepvær, Ullerø and Gressholmen (Norway), Marennes (France), the Wadden Sea (Denmark) and 40km offshore from the Scheldt (Netherlands).

Mean sediment concentrations are at background in the southeast Dogger Bank (Germany) and offshore Terschelling (Netherlands). The highest sediment concentrations are generally found in estuarine or coastal areas, e.g. offshore the Tay and Forth estuaries and Thames (UK).

Mean concentrations in blue mussel are at background only in the Bay de la Fresnaye (France). The highest concentrations in blue mussel are in the Norwegian inner Sørfjord (Byrkjenes), followed by the Medway, Morecambe Bay, and Thames (UK), the Wadden Sea and the Sound (Denmark), and Pontevedra (Spain).

The inner Sørfjord and Oslo areas (Norway) have the highest concentrations in cod. Concentrations in flounder in the inner Sørfjord are three times higher than the next highest concentrations in the Mersey and Thames (UK). Morecambe Bay (UK) has the highest concentration in plaice, 50% above the concentrations found at Hvide Sande (Denmark). For common dab, Liverpool Bay, the Mersey and the Isle of Man (UK) have higher concentrations than other areas, including Netherlands and Norwegian stations. These fish species are the most commonly used in monitoring programmes, allowing results to be compared on a larger geographic scale.

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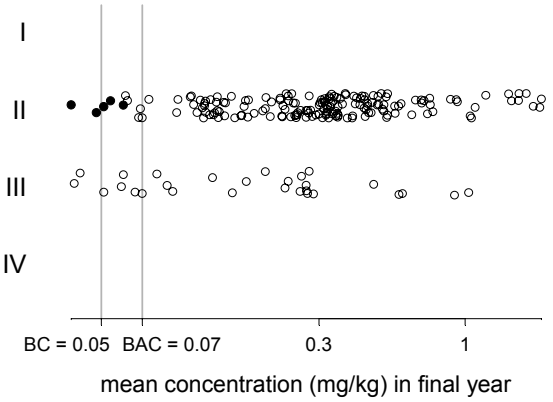
4 OSPAR Commission (2005a) 2005 Assessment of data collected under the OSPAR Comprehensive Study on Riverine Inputs and Direct Discharges for the period 1990 – 2002. OSPAR Commission 2005, 39pp + appendices.

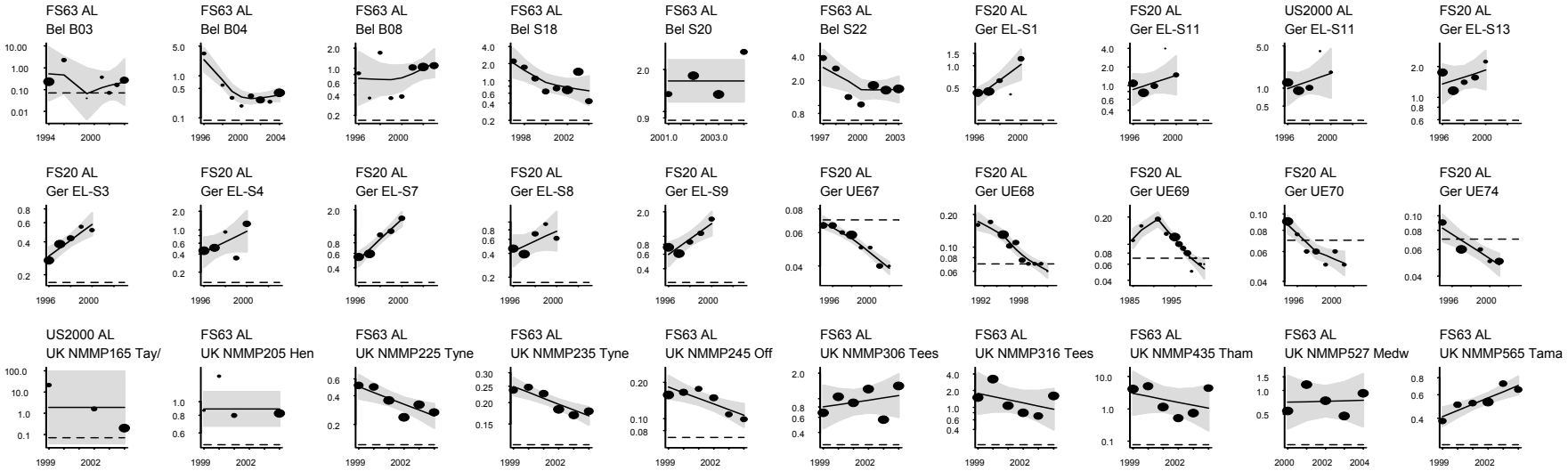
5 *OSPAR Commission (2005a). Assessment of trends in atmospheric concentration and deposition of hazardous pollutants to the OSPAR maritime area: Evaluation of the CAMP network. OSPAR Commission 2005, 96pp*

Mercury in sediment

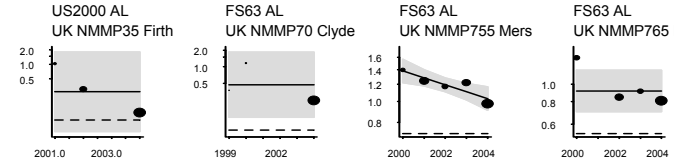
normaliser	region	number of time series				trends		UCL<
		3-4	5-6	7+	total	up	down	BAC
AL	II	93	42	36	171	5	27	5
	III	17	11	0	28	0	1	0
		110	**53**	**36**	**199**	**5**	**28**	**5**



region II

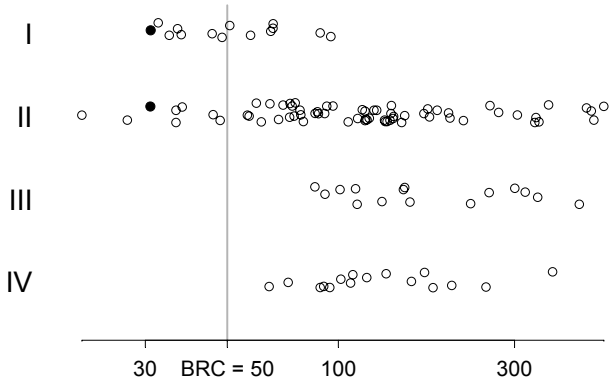


region III

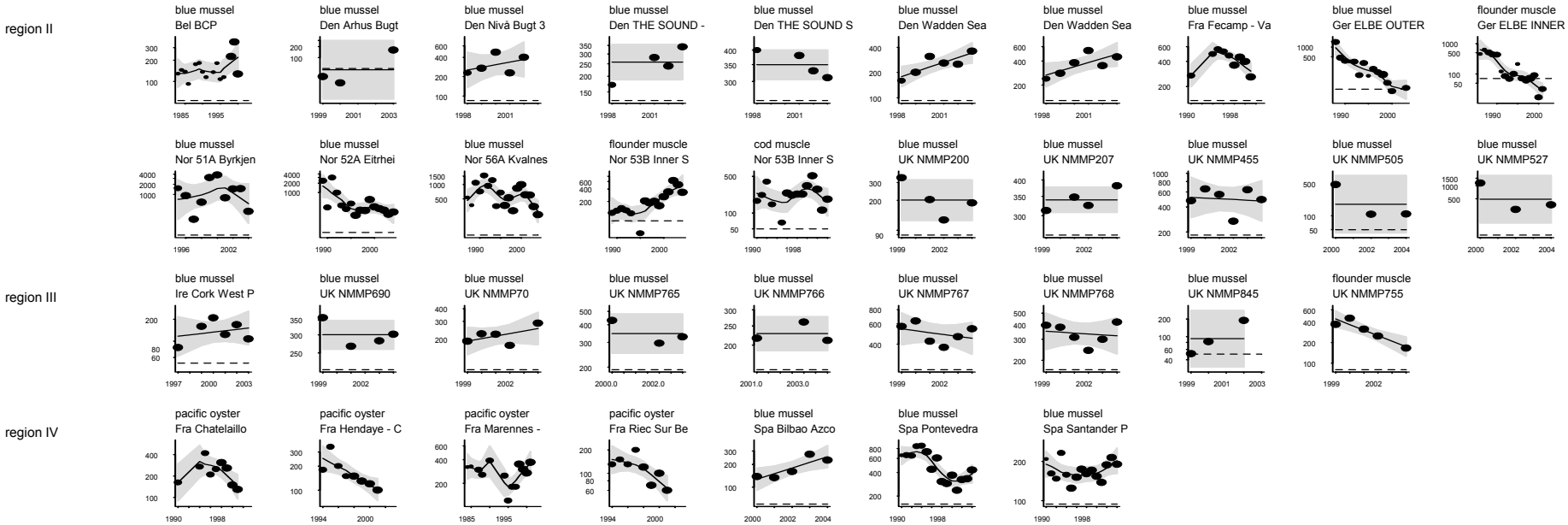


Mercury in biota

	region	Number of time series				trends		UCL<
		3-4	5-6	7+	total	up	down	BRC
blue mussel	I	0	3	11	14	0	0	0
	II	23	6	38	67	1	7	1
	III	7	8	0	15	0	1	0
	IV	2	1	13	16	0	2	0
		32	**18**	**62**	**112**	**1**	**10**	**1**
other molluscs	II	1	0	7	8	0	0	
	IV	0	0	22	22	0	3	
		1	**0**	**29**	**30**	**0**	**3**	
fish	I	0	0	4	4	0	1	3
	II	14	14	31	59	2	11	13
	III	7	10	1	18	0	2	0
		21	**24**	**36**	**81**	**2**	**14**	**16**



mean concentration (ug/kg) in blue mussels in final year



4.1.3 Lead in sediments and biota

A total of 218 biota time series, covering ten species, were available from all regions. Mean concentrations are at background at 12% of the 114 blue mussel stations. Of the 205 sediment stations from region II and III, 4% had mean concentrations at background.

There were trends in 19% of biota time series, mostly downwards.

Focussing on changes in concentration in the last ten years, there were downward trends in 12 time series in Norwegian fjords (regions I and II), seven pacific oyster and blue mussel stations in France (regions II and IV), flounder from the Ribble and Thames (UK), herring from Fladen in the central Kattegat (Sweden), and blue mussel from Vigo and Santander Pedrena (Spain), The steepest downward trends were in flounder in the Ribble (UK, 42%/year), the Thames (UK, 29%/year) and Strandebarm (Norway, 33%/year). Cod concentrations at Strandebarm also decreased by 14%/year.

Upward trends over the last ten years were found in blue mussels from the Wadden Sea (Denmark) and Roskilde Fjord (Denmark, 21%/year), in flounder from the Elbe (Germany), in plaice offshore from the Tay and Forth estuaries (UK, 18%/year), and in common dab offshore from the Humber estuary (UK, 45%/year).

There were trends in 5% of sediment time trends; 2% were upward. The upward trends were all in the northern German Bight, off the mouth of the Elbe River. Annual riverine input and direct discharge data for lead show a significant downward trend of 5%/year (OSPAR Commission, 2005b), and atmospheric deposition of lead decreased by 50% between 1998 and 2002 (OSPAR Commission, 2005c). The downward trends were found off the western German Bight, the Schelde Estuary (Belgium) and at Milford Haven, the Firth of Clyde and the Moray Firth (UK).

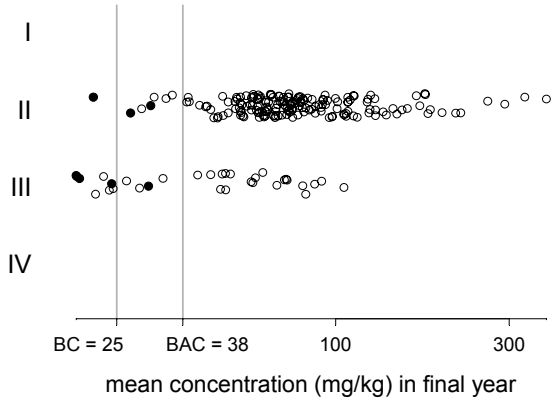
The highest sediment concentrations are generally found in coastal areas, except for the Dogger Bank where concentrations are high compared to the surrounding area. An old dumping site of metaliferrous waste from titanium dioxide production explains the high concentrations in sediments in the central German Bight. Dumping was stopped in 1989.

The highest concentrations in blue mussel are in the inner Sørfjord at Byrkjenes, Eitrheimsneset, Kvalnes (Norway) and Cork Harbour West Channel (Ireland). These stations are influenced by metallurgical industrial point sources.

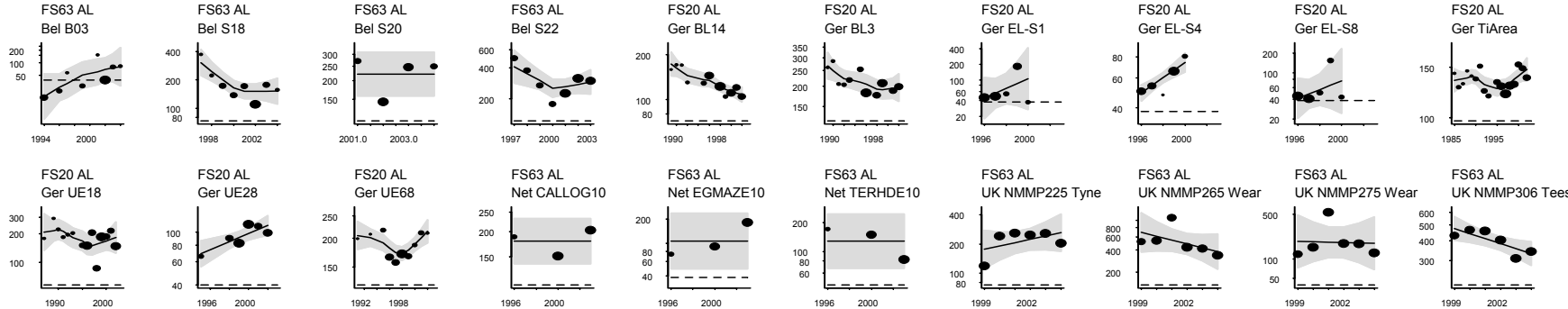
For fish, the inner Sørfjord (industrial area) and Oslo (harbour) (Norway) both have high concentrations in cod and flounder, only exceeded by concentrations in flounder from the Mersey (UK), The highest concentrations in plaice were in Morecambe Bay (UK).

Lead in sediment

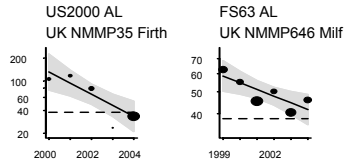
normaliser	region	number of time series				trends		UCL<
		3-4	5-6	7+	total	up	down	BAC
AL	II	88	49	36	173	4	4	3
	III	13	19	0	32	0	2	5
		101	**68**	**36**	**205**	**4**	**6**	**8**



region II

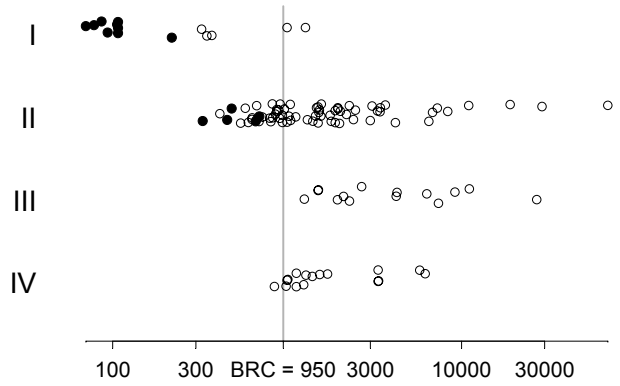


region III



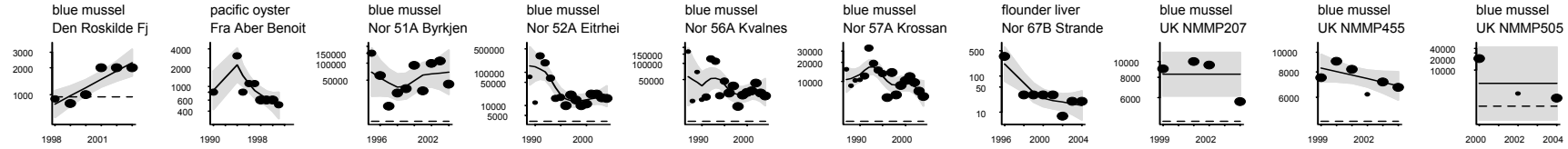
Lead in biota

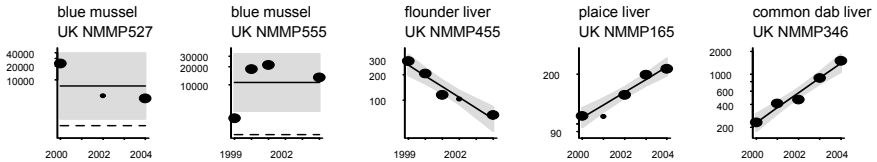
	region	number of time series				trends		UCL<
		3-4	5-6	7+	total	up	down	BRC
blue mussel	I	2	3	9	14	0	3	9
	II	26	6	38	70	3	12	5
	III	6	7	1	14	0	0	0
	IV	2	1	13	16	0	5	0
		36	**17**	**61**	**114**	**3**	**20**	**14**
other molluscs	II	1	0	7	8	0	1	
	IV	0	0	22	22	0	1	
		1	**0**	**29**	**30**	**0**	**2**	
fish	I	0	0	4	4	0	3	
	II	13	13	26	52	2	10	
	III	11	7	0	18	0	1	
		24	**20**	**30**	**74**	**2**	**14**	



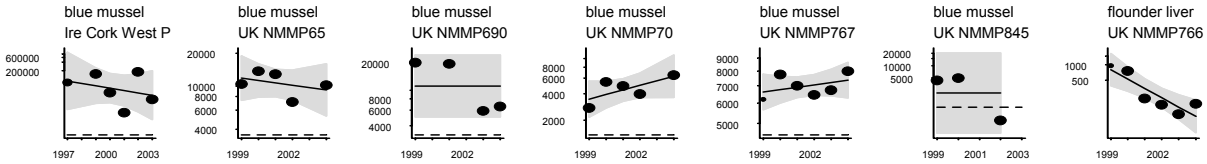
mean concentration (ug/kg) in blue mussels in final year

region II

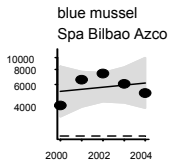




region III



region IV



4.1.4 TBT in biota

Tributyltin has been used widely as an antifouling agent in bottom paints for boats. Use on pleasure craft and small boats was forbidden in the early 1990s due to unwanted biological effects on bivalve molluscs and marine snails. More recently, marketing and use restrictions were introduced within the EU aiming to cease use within all anti-fouling systems.

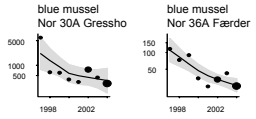
The prohibition of use of TBT by the International Convention on the Control of Harmful Anti-fouling Systems on Ships, adopted by the International Maritime Organisation (IMO) in October 2001, has not yet entered into force.

There are 29 time series for TBT in blue mussels, with 2 downward trends at Færder and Gressholmen (Norway). Concentrations range between 3,7 and 1020 (median 98) µg/kg TBT.

Tributyltin in biota

	region	number of time series				trends		UCL<
		3-4	5-6	7+	total	up	down	BAC
blue mussel	I	1	0	0	1	0	0	
	II	20	6	2	28	0	2	
		21	**6**	**2**	**29**	**0**	**2**	

region II



4.2 Trends of PAHs in biota and sediments

4.2.1 Fluoranthene in sediments and biota

Fluoranthene was selected from the PAHs because it is present in the highest concentrations and it is relatively easy to quantify.

PAH monitoring sites are unevenly distributed throughout the OSPAR regions, with biota monitoring sites mainly in Denmark, France, the UK and Spain, and sediment monitoring sites mainly in the UK and the Netherlands.

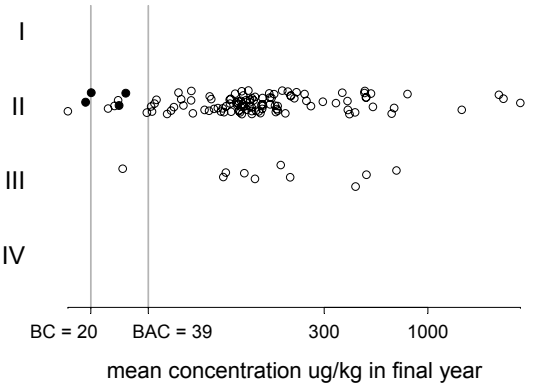
Only a few fluoranthene time series show trends and these are generally downwards. Downward trends in sediments are found in the Netherlands (2) and the UK (1). In the Netherlands, one time series in sediment close to the coast shows an upward trend over a 15-year period (six data points). This may be due to an increased use of diesel fuel in the densely populated Randstad area. Downward trends in biota are mainly found at sites in France and Spain, showing an overall decrease of 50-80 % over a 5-10 year period.

Mean concentrations in the final year in both biota and sediments are typically above the BACs. Mean concentrations are at background in only 3% of time series. For biota, these are in France and for sediments, they are in the Netherlands.

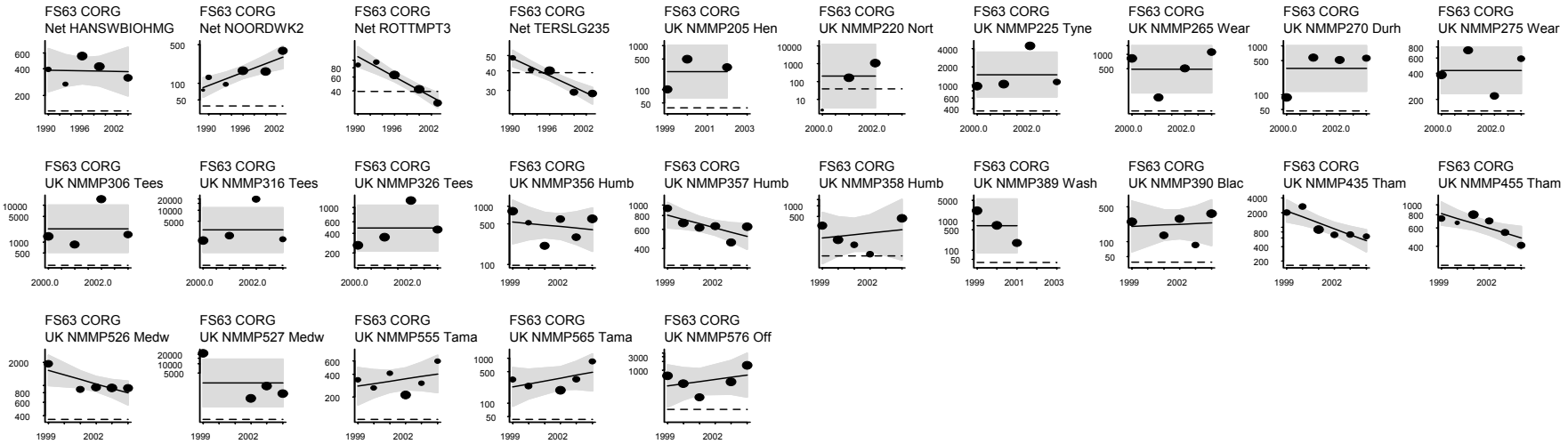
The highest concentrations in sediments are in UK stations near the Tyne, Tees and Medway (all l Region I). The highest concentrations in biota are found in Tamar (UK) in region II and Ribble (UK) in Region III, Denmark (Roskilde Fjord) and France (Seine Cap de la Hève) in Region II.

Fluoranthene in sediment

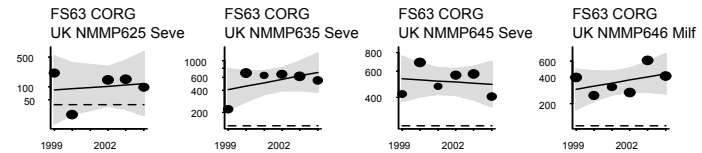
normaliser	region	number of time series				trends		UCL<
		3-4	5-6	7+	total	up	down	BAC
carbon	II	76	31	5	112	1	3	4
	III	2	8	0	10	0	0	0
		78	**39**	**5**	**122**	**1**	**3**	**4**



region II

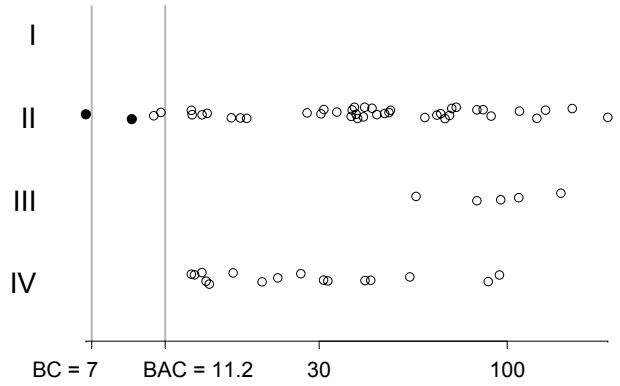


region III



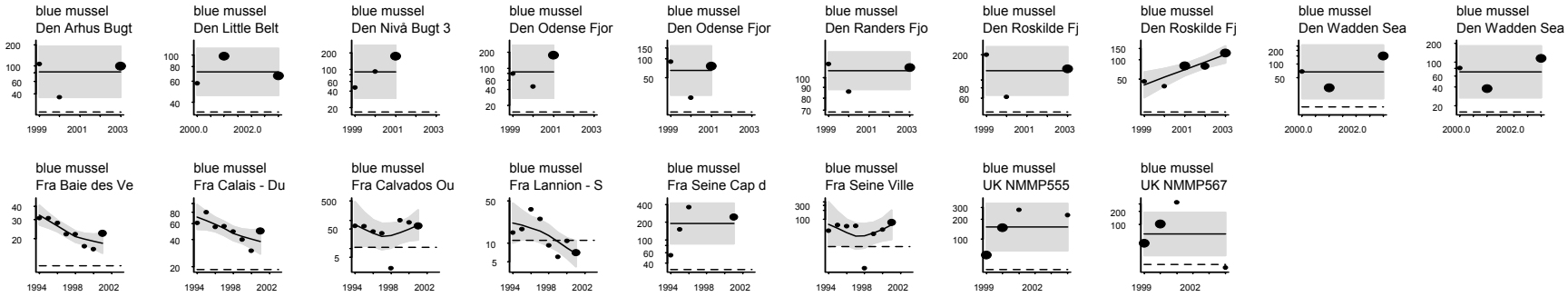
Fluoranthene in biota

	region	number of time series				trends		UCL<
		3-4	5-6	7+	total	up	down	BAC
blue mussel	II	21	2	19	42	1	4	2
	III	3	2	0	5	0	0	0
	IV	2	7	7	16	0	2	0
		26	**11**	**26**	**63**	**1**	**6**	**2**
other molluscs	II	1	0	7	8	0	0	
	IV	0	2	20	22	0	1	
		1	**2**	**27**	**30**	**0**	**1**	

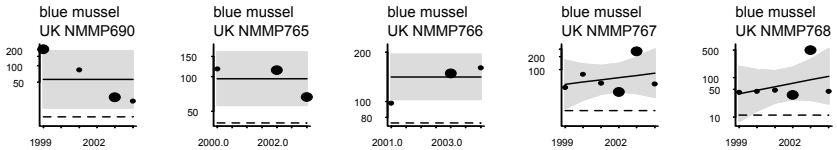


mean concentration (ug/kg) in blue mussels in final year

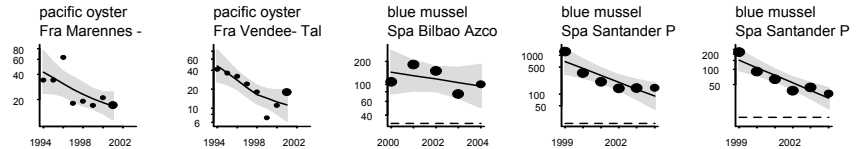
region II



region III



region IV



4.2.2 Benzo[a]pyrene in sediments and biota

Benzo[a]pyrene was selected for assessment because it is the most toxic of the more abundant PAHs, although perhaps not generally as accurately determined as fluoranthene.

A limited number of trends were detected in the benzo[a]pyrene time series in sediment and biota.

Concentrations are, in general, above the BAC (where available) in both sediment and biota.

In sediment, four downward trends were detected; two in the Netherlands and two in the UK. The only upward trend was found at a near-coast station in the Netherlands (already mentioned under fluoranthene). This may be due to an increased use of diesel fuel in the densely populated Randstad area.

Ten trends were detected in biota; four in blue mussels and six in Pacific oysters. In blue mussel, three upward trends were detected, two in France and one in the Oslo harbour in Norway. One downward trend was detected in the UK (Cumbria Coast).

Pacific oysters were only analysed in France, five downward and one upward trend were detected. However, a more detailed analysis of the time series plots strongly suggests that some of the changes in concentrations should not be interpreted as a regular trend. They strongly suggest some event in the field or during the data acquisition process.

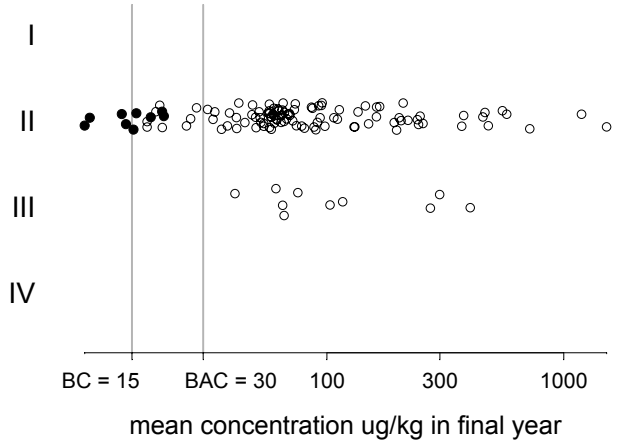
Eighteen sediment stations show concentrations well above the BAC; these are all in the UK except one station off Noordwijk on the Dutch coast.

Biota stations with concentrations well above the BAC are in Denmark near large cities and shipping routes, in France, UK (Mersey) and Spain near industrialised and/or harbour areas.

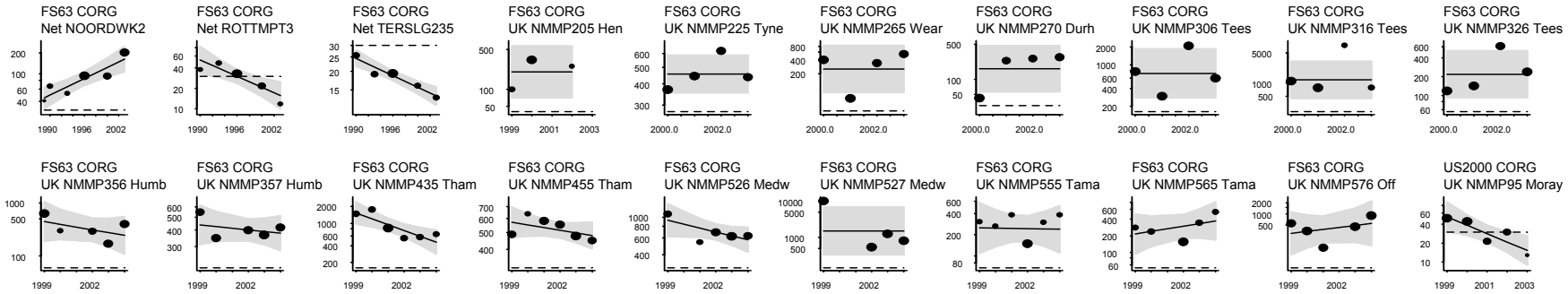
Mean concentrations are at background at 7,5% of sediment stations, mainly in Germany, the Netherlands and the UK, and at 18% of biota stations, in France and Spain.

Benzo[a]pyrene in sediment

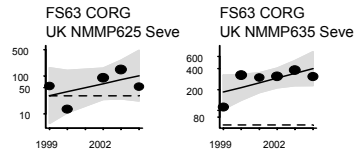
normaliser	region	number of time series				trends		UCL<
		3-4	5-6	7+	total	up	down	BAC
carbon	II	76	30	4	110	1	4	9
	III	4	6	0	10	0	0	0
		80	**36**	**4**	**120**	**1**	**4**	**9**



region II

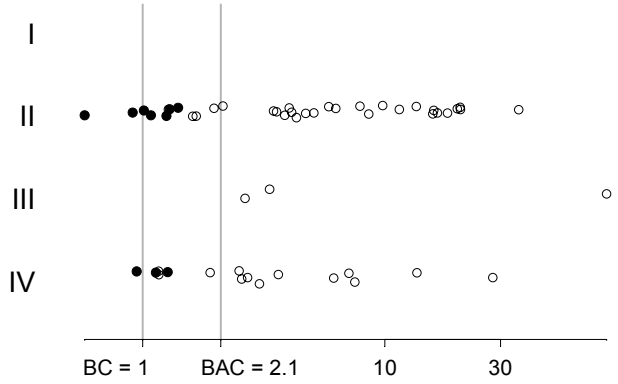


region III



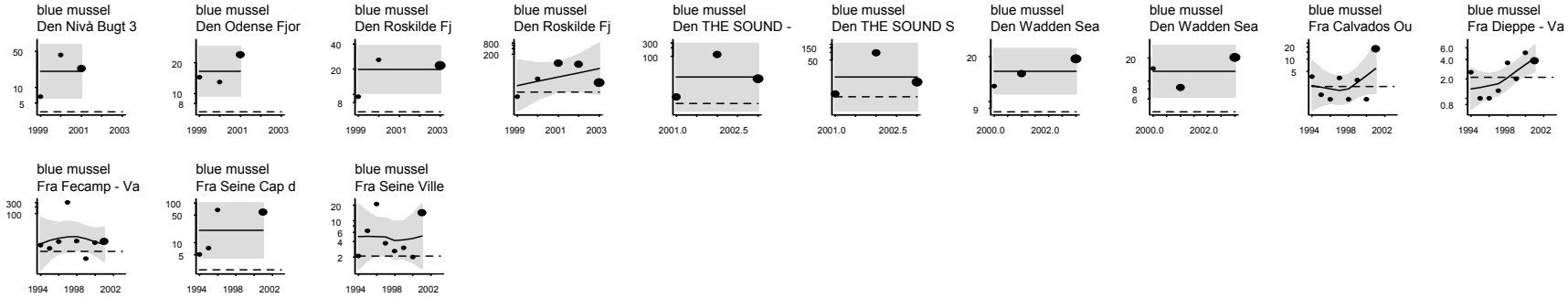
Benzo[a]pyrene in biota

	region	number of time series				trends		UCL<
		3-4	5-6	7+	total	up	down	BAC
blue mussel	II	15	1	19	35	2	0	7
	III	1	2	0	3	0	1	0
	IV	2	7	7	16	1	0	3
		18	**10**	**26**	**54**	**3**	**1**	**10**
other molluscs	II	1	0	7	8	0	0	
	IV	0	2	20	22	1	5	
		1	**2**	**27**	**30**	**1**	**5**	

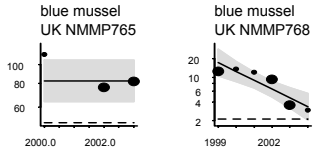


mean concentration (ug/kg) in blue mussels in final year

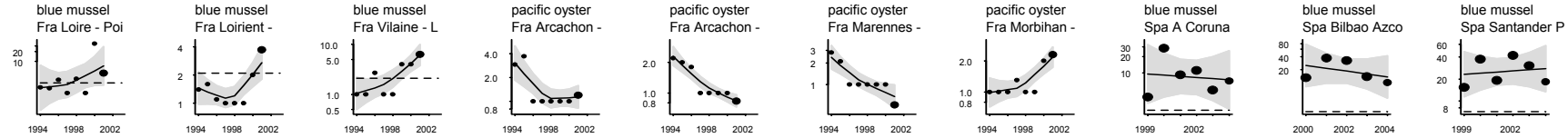
region II



region III



region IV



4.3 Trend of PCBs

CB153 in sediments and biota

CB153 is selected to represent the CBs because it is generally present in the highest concentration and generally correlates well with the concentrations of other CBs.

Biota data are available for all four OSPAR regions for both fish and molluscs, while sediment data are only available for Regions II and III. About half of the biota time series cover seven or more years, while most sediment time series cover less than seven years. Generally, trends in biota are downward. About 25% of time series (of more than five years) show downward trends, 38% of which are in fish and 14% in blue mussels from region II. In sediments, there is no general pattern for either region II or III. There were two downward trends, both in the Dutch Wadden Sea area, and two upward trends, one on the Dutch coast and one near Southampton Harbour (UK).

Highest concentrations were found in fish liver at coastal stations influenced by industrial processes. The Inner Elbe, Outer Weser, Western Scheldt, Mersey and Norwegian Inner Sørfjord and Oslo City Harbour area all show elevated concentrations.

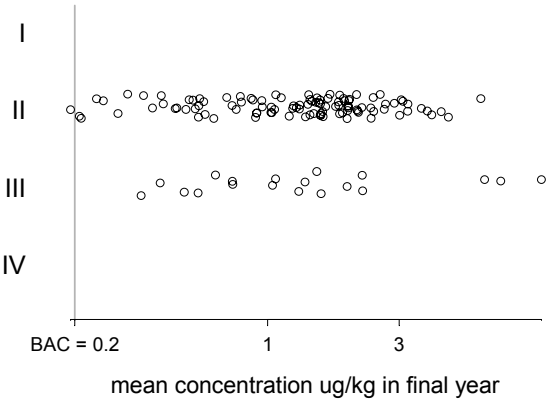
High concentrations were also found in blue mussels at several places in the Seine river basin. Concentrations were at background or approaching the BAC in blue mussels in region I. In regions II, III and IV most concentrations were above the BAC. Concentrations in sediments are above the BAC at all stations in both regions. Highest concentrations were found at UK stations in the Severn and Mersey and at some Dutch coastal stations (Noordwijk, Terneuzen and two stations at Haringvliet potentially influenced by the Rhine outflow).

Organic carbon content data are missing for many time series, making normalisation impossible. Most sediment sampling stations are in coastal regions resulting in a very uneven coverage of the OSPAR area.

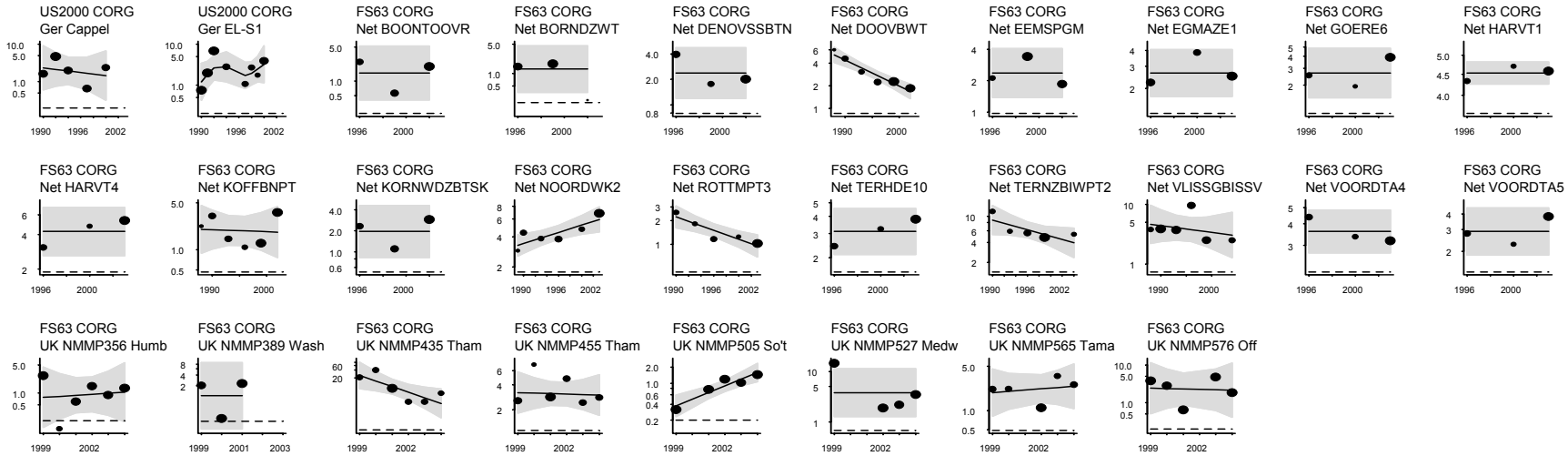
There is a general decrease in concentrations in biota, but this does not mean that background concentrations are likely to be reached in the near future, as concentrations are still relatively high in most OSPAR regions. Given that concentrations are generally not decreasing in sediments, background concentrations are again unlikely to be reached in the near future.

CB153 in sediment

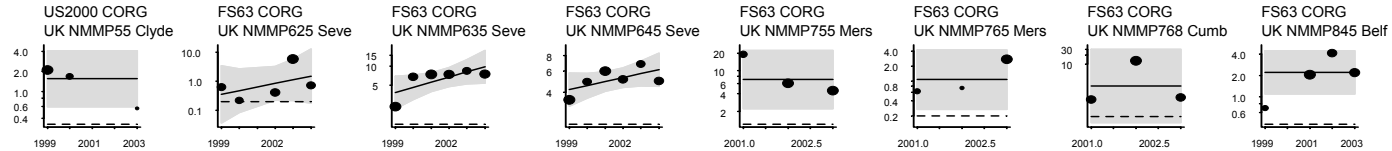
normaliser	region	number of time series				trends		UCL<
		3-4	5-6	7+	total	up	down	BAC
carbon	II	65	37	4	106	2	2	0
	III	12	7	0	19	0	0	0
		77	**44**	**4**	**125**	**2**	**2**	**0**



region II

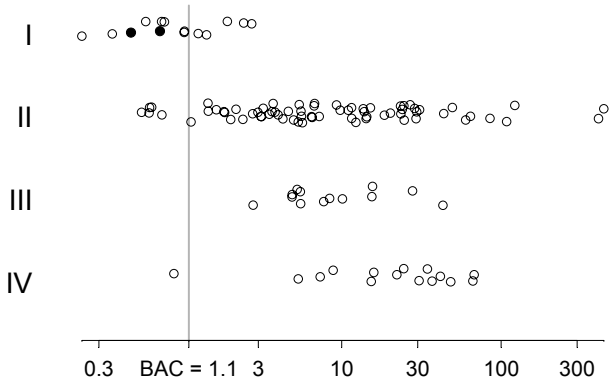


region III



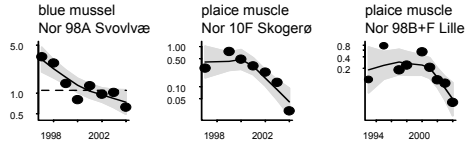
CB153 in biota

	region	number of time series				trends		UCL<
		3-4	5-6	7+	total	up	down	BAC
blue mussel	I	0	3	11	14	1	5	2
	II	22	12	35	69	0	6	0
	III	4	8	1	13	0	1	0
	IV	1	3	11	15	0	6	0
		27	**26**	**58**	**111**	**1**	**18**	**2**
other molluscs	II	1	3	4	8	0	0	
	IV	0	4	18	22	0	6	
		1	**7**	**22**	**30**	**0**	**6**	
fish	I	0	0	8	8	0	2	0
	II	17	8	43	68	2	16	0
	III	9	6	0	15	0	0	0
		26	**14**	**51**	**91**	**2**	**18**	**0**

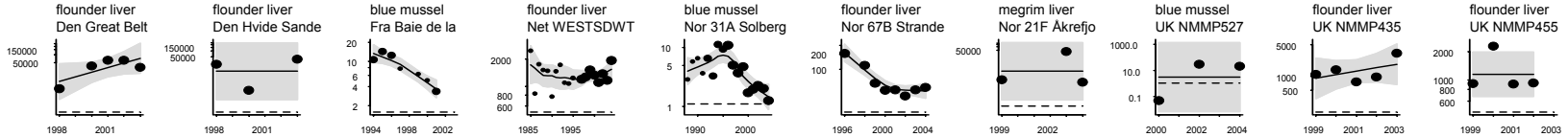


mean concentration (ug/kg) in blue mussels in final year

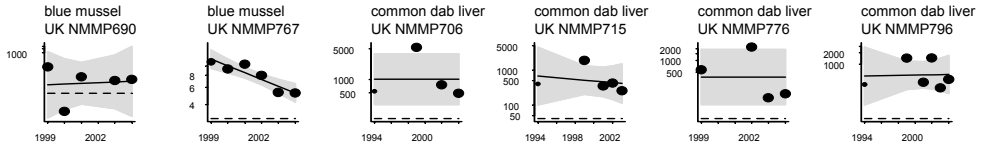
region I



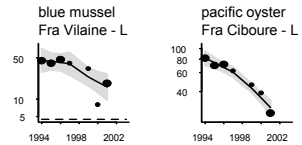
region II



region III



region IV



4.4 Trends in pesticides

4.4.1 p,p'-DDE in biota

From the available database, p,p'-DDE was selected to represent the DDTs. DDE is generally found in higher concentrations in biota and it is generally possible to quantify DDE more accurately than DDT.

Generally, DDE concentrations in biota show downward trends, as would be expected following the ban on the use of DDT.

There are only downward trends in northern regions (I, II) of the convention area. In these regions, about 10% of mollusc and 30% of fish time series show a downward trend. There are no time series for fish in regions III or IV.

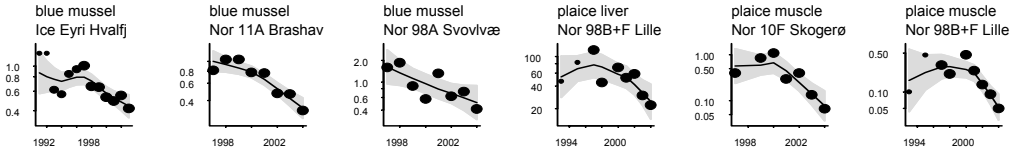
An upward trend was detected in the Calvados Ouistreham area of France.

The highest concentrations in both fish liver and muscle tissue were in cod, megrim and flounder from Norwegian sites (Sørfjord, Åkrefjord and Oslo City area). The highest concentrations in molluscs were in blue mussels from Norway (Kvalnes), followed by sites from the UK and France (Mersey, Ribble, Seine, Villerville) and a second site in Norway (Krossanes).

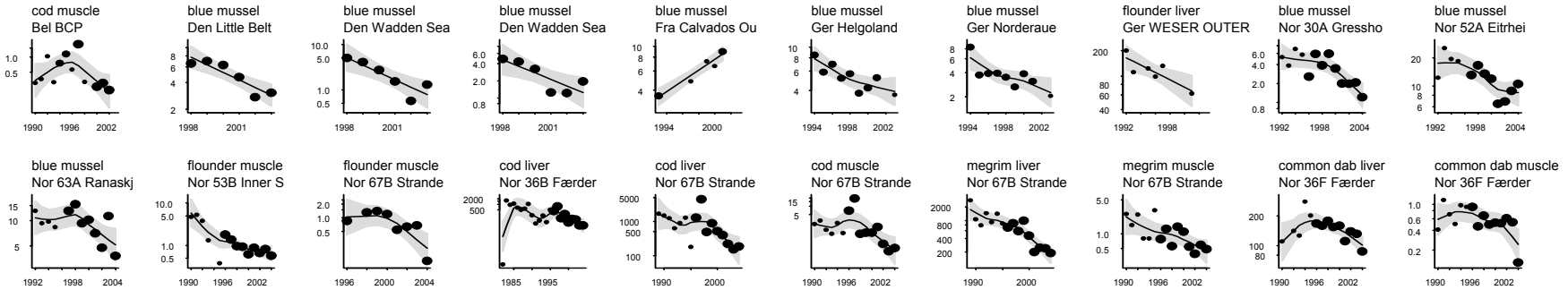
p,p'-DDE in biota

	region	number of time series				trends		UCL<
		3-4	5-6	7+	total	up	down	BAC
blue mussel	I	0	3	11	14	0	3	
	II	33	11	19	63	1	7	
	III	6	4	0	10	0	0	
	IV	8	0	0	8	0	0	
		47	**18**	**30**	**95**	**1**	**10**	
other molluscs	II	8	0	0	8	0	0	
	IV	21	0	0	21	0	0	
		29	**0**	**0**	**29**	**0**	**0**	
fish	I	0	0	8	8	0	2	
	II	7	3	31	41	0	14	
		7	**3**	**39**	**49**	**0**	**16**	

region I



region II



4.4.2 γ-HCH in biota

From the available database, γ-HCH was selected to represent the HCHs.

Generally, γ-HCH concentrations in biota show downward trends as would be expected following the ban.

The table below indicates some differences between molluscs and fish. For region II, about two thirds of the fish time series show downward trends but only one third of the mollusc time series show a similar trend.

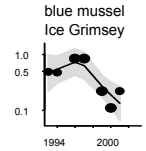
BACs have not been established for γ-HCH.

The highest concentrations in fish were in flounder liver from the outer riverine areas of Weser, Jade and Elbe, in flounder muscle from the Elbe river estuary and a Belgian station and in herring muscle from Sweden (Väderöarna and Fladen). High concentrations in molluscs were in Pacific oysters at French sites (Marennes - Mus de Loup, Brest - Elorn Rive Gauche and Paimpol - Beg Nod) and in blue mussels from the French and Belgian coast (Douarnenez – Kernel, Calais - Dunkerque – Oye).

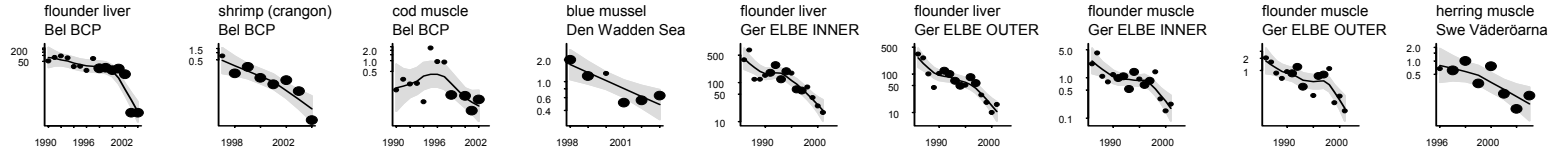
Gamma-HCH in biota

	region	number of time series				Trends		UCL<
		3-4	5-6	7+	total	up	down	BAC
blue mussel	I	1	4	9	14	0	2	
	II	18	6	37	61	0	22	
	III	3	1	1	5	0	2	
	IV	1	0	7	8	0	0	
		23	**11**	**54**	**88**	**0**	**26**	
other molluscs	II	1	1	6	8	0	1	
	IV	0	1	21	22	0	4	
		1	**2**	**27**	**30**	**0**	**5**	
fish	I	0	0	8	8	0	4	
	II	7	1	37	45	0	29	
		7	**1**	**45**	**53**	**0**	**33**	

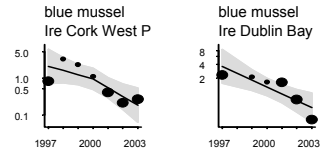
region I



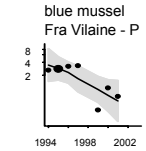
region II



region III



region IV



4.4.3 HCB in biota

HCB concentrations generally show downward trends.

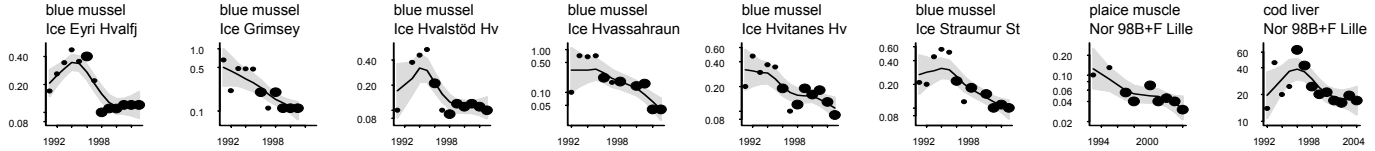
BACs have not been established for HCB.

For HCB, about 25% of all mollusc time series and almost 50% of fish time series in region I and II showed downward trends. In region III, only mollusc time series were available, but none showed any trends. The highest concentrations were in fish liver from coastal stations in Norway (megrim from Åkrefjord, cod from Varangerfjorden, Ullerø area, Oslo City area, Lille Molla and Inner Sørfjord), Germany (flounder from inner and outer Elbe river estuary) and The Netherlands (flounder and dab from the West Frisian coast and the Doggerbank), and in fish muscle of flounder from Belgium and Germany (inner Elbe estuary) and herring from Swedish waters (Väderöarna and Fladen). High concentrations in blue mussels were found at many sites in the Southern North Sea around the coasts of the UK, Germany and Denmark. Stations with lower concentrations are in Norwegian and Icelandic waters.

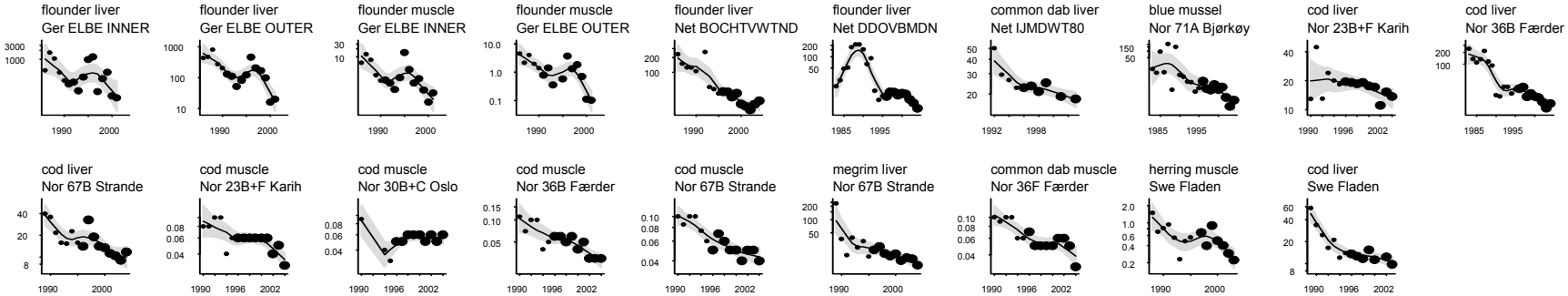
Hexachlorobenzene in biota

	region	number of time series				trends		UCL<
		3-4	5-6	7+	total	up	down	BAC
blue mussel	I	0	3	11	14	0	6	
	II	20	5	19	44	0	8	
	III	7	3	1	11	0	0	
		27	**11**	**31**	**69**	**0**	**14**	
fish	I	0	0	8	8	0	2	
	II	7	1	43	51	0	27	
		7	**1**	**51**	**59**	**0**	**29**	

region I



region II



5. Summary and Conclusions

5.1 Summary of the results

Temporal trends in concentrations were investigated in a selection of contaminants monitored in the CEMP in OSPAR regions I-IV as a step to streamlining the assessment process. Cadmium, mercury, lead, the PAHs fluoranthrene and benzo[a]pyrene, and the PCB congener CB153 were assessed in sediment and biota. TBT and the pesticides p,p'-DDE (a metabolite of DDT), γ-HCH (lindane) and HCB in biota. These contaminants were chosen either because of their relevance as part of the mandatory CEMP or their toxicity and/or representativeness for a group of contaminants (e.g. PAHs or PCBs). Other contaminants can, and should, be considered in future assessments. The distribution of sampling sites (Figures 1 and 2) indicates a need for better coverage.

The selection meant that 1570 time series were assessed, or 11% of those available (Table 5.1.). Approximately 21% (330) of these time series showed trends; of which over 90% were downwards. The highest proportion (37%) of trends were detected for lindane, all downwards. High concentrations of contaminants were generally found near known point-sources such as industry (e.g. Sørfjord (Norway), Roskilde (Denmark), Ponteverdra (Spain)), harbours (e.g. Oslo) or river outflows (e.g. Seine, Rhine, Elbe, Thames). But many downward trends were also found in such areas. Although downward trends are positive signs and underline the effectiveness of measures taken, the latest measurements in most time series are still well above background concentrations. Notable upwards trends were in the German Bight (lead) and the Sørfjord (mercury and cadmium).

Some time series may be strongly influenced by methodological factors and future assessments should maintain vigilance to identify such cases and ensure that they do not give rise to misleading assessments. Background assessment criteria need to be developed for TBT and selected pesticides so that concentrations observed in field samples can be assessed against OSPAR's objectives.

Table 5.1 Overview of time series considered and results from those selected

	Trend	Region I	Region II	Region III	Region IV	Total
Numbers of Time-series considered						
Metals	biota	111	694	181	190	1176
	sediment	0	4321	650	0	4971
Organics	biota	111	1243	120	598	2072
	sediment	0	5726	609	0	6335
Numbers of Time-series selected						
	Upward	3	23	0	3	29
	Downward	36	204	11	50	301
	None	104	754	149	233	1240
	Total datasets	143	981	160	286	1570

5.2 Future development of annual assessments

For future annual assessments of CEMP data, it is proposed to develop the following aspects of the work:

a. **Extending the range of hazardous substances**. For 2006/2007 it is planned to cover the following in addition to the substances covered by the current assessment:

   (i) the metals zinc and copper;

   (ii) α-HCH;

   (iii) CB118;

   (iv) an extended range of PAHs;

   An examination will be made to determine the possibilities of covering imposex, organic lead compounds, methyl-mercury, polybrominated diphenyl ethers, short chained chlorinated paraffins, and dioxins in future assessments. This will involve an assessment of the extent of

available data in the ICES database and the possibilities for developing appropriate assessment criteria (e.g. background concentrations).

b. **Application of Environmental Assessment Criteria.** If available, EACs will be considered in future for application in assessments to provide additional information on the potential risk posed by the concentrations contaminants observed in the marine environment.

c. **Assessment of regional trends**. A quantitative approach for assessing regional trends is being developed which will be trialled in future assessments.

d. **Development of a visual tool for assessing spatial trends**: The integration of spatial information with trend characteristics is one of the main technical problems in the process of illustrating and assessing regionally distributed trend information. Ideally, the spatial distribution of contaminant concentrations, the location of sampling stations, the temporal trends and their significance should be combined in one presentation. During the 2005/6 assessment of CEMP data, a combined view of all these parameters was trialled. This tool will be developed further during the future annual assessments. The approach shown in Figure 5.1 below provides the reader with a rapid overview of the assessment results. Elevated lead concentrations on the Doggerbank and in the north eastern part of the inner German Bight are clear. Downward trends were observed off the East – Frisian Coast, in the southern part of the Shelde estuary, at the Moray Firth and off the Welsh Coast. The only upward trends were found in the north eastern part of the German Bight, which is also an area of elevated lead concentrations. The interpolated colour contour map should be interpreted carefully. In particular, the colouring in areas without any sampling sites is uncertain, e.g. the spatial structure of the region of elevated lead concentrations on the Doggerbank, especially the southern and northern extensions, are primarily an effect of the interpolation between scarce sampling sites (delaunay triangulation), rather than any measured concentrations.

e. **Use of the station dictionary for data extractions**. A dictionary of monitoring stations for the CEMP station is being compiled to assist with the screening and extraction of monitoring data from the CEMP database. It is intended to introduce this into the assessment process in time for the 2006/2007 assessment.

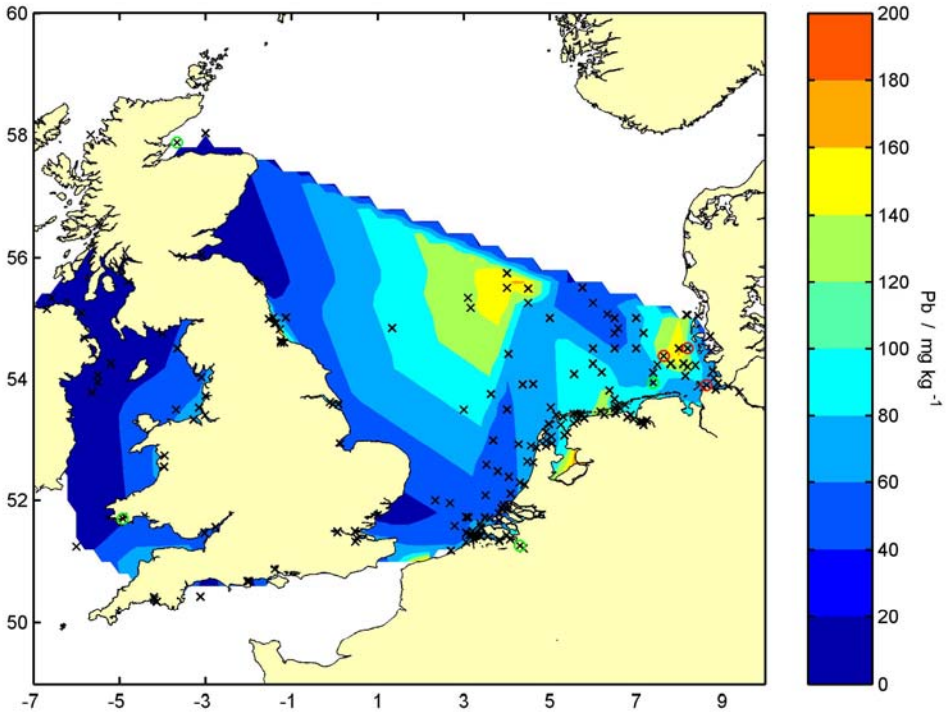


Figure 5.1: **Lead (Al-normalised) concentrations in surface sediments in OSPAR regions II and III. All sampling sites are indicated by black crosses. Significant upward (red) and downward (green) trends are added to the related stations, as circles.**