Assessment and Monitoring Series

2007/2008 CEMP Assessment: Trends and concentrations of selected hazardous substances in sediments and trends in TBT-specific biological effects

OSPAR Commission
2008

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

This report presents scientific assessments of OSPAR marine monitoring data on hazardous substances in marine sediments and the biological effects arising from presence of the anti-fouling agent tributyl tin in the marine environment. The overall conclusion is that continued monitoring is needed before clear conclusions can be drawn on whether the widespread downward trends of hazardous substances in biota, that have been reported by OSPAR in 2005, 2006 and 2007 are also occurring in sediments and whether the effects of TBT are also reducing. The majority of measurements, however, show that both naturally occurring and man-made contaminants remain above long-term targets.

Continued monitoring of sediments is needed to establish trends

The first part of the assessment considers data on hazardous substances in sediments from the period 1985 to 2006. The substances monitored include metals (cadmium, mercury and lead), polycyclic aromatic hydrocarbons (PAHs) and poly-chlorinated biphenyls (PCBs), which have all been identifed by OSPAR as chemicals for priority action. Sediments are monitored because many contaminants have high affinity for particles, and bottom sediments can become a repository for a large proportion of the contaminants introduced to the sea.

Sufficient sediment data have been reported to enable the analysis of time series at 162 stations in the Greater North Sea (Region II) and 32 stations in the Celtic Seas (Region III). Time series were assessed when more than 3 years of measurements were available including at least one in the period 2002 to 2006. In both the North Sea and the Celtic Seas, the majority of trends detected were downward, but trends could be detected in only a small proportion of the total number of time series analysed (e.g. <7%). No time series could be analysed in Arctic Waters (Region I) or the Bay of Biscay/Iberian Coast (Region IV) as the number of years of measurements in these areas needs to be increased.

Hazardous substances remain above background levels in sediments

OSPAR has a long term objective of concentrations of hazardous substances in the marine environment near background values for naturally occurring substances and close to zero for man-made synthetic substances. OSPAR has adopted a set of background concentrations to represent these values. Comparison of the concentrations in the latest year of each time series with these backgorund concentrations shows that most naturally occurring and man-made contaminants remain above the long-term target of background, For example:

a. for cadmium, 90% of concentrations in sediments in the latest year of monitoring were above background levels;

b. for mercury and lead, over 95% of concentrations in sediments in the latest year of monitoring were above background levels;

c. for most PAHs, over 93% of concentrations in sediments in the latest year of monitoring were above background levels.

d. for CBS, almost 100% of concentrations in sediments in the latest year of monitoring were found to be above background levels

In contrast For the PAHs benzo(ghi)perylene and indeno[123-cd]pyrene approximately 50% of the concentrations in sediments in the latest year of monitoring were found to be at background levels.

Some evidence of decreasing TBT effects but further monitoring is needed

The second assessment in the report focussing on the biological effects of the antifouling agent tributyl tin (TBT) shows that in 24 out of 124 time series downward trends could be detected. Monitoring of TBT specific biological effects has been included in the CEMP to check for the result of European and world-wide bans on the use and presence of TBT in ships paints, which were introduced after the unwanted consequences of the use of the substance were recognised. Although the results of the assessment are partially encouraging, continued and more extensive monitoring is needed to confirm the trends across the OSPAR maritime area.

Next stop QSR 2010

Through these regular assessments the CEMP monitoring data that is reported to ICES by OSPAR Contracting Parties are kept under regular scrutiny. Errors and omissions in the data can be identified and corrected, and data assessment methods are being be progressively updated, tested and improved, to ensure that the assessment system is fully prepared for the Quality Status Report in 2010 and provides an up-to-date evidence base for policy making.

New aspects of the assessment included the development of new styles of data description, simplifying the tabulations of numerical data and its graphical presentation and new styles of data mapping. The assessment work also highlighted the need for work before the QSR 2010 to consolidate the set of assessment criteria available for CEMP assessments and for the development of methods for aggregated reporting on groups of contaminants.

Acknowledgement

This assessment was initially prepared by the OSPAR Working Group on Monitoring (MON) at its meeting from 4-7 December 2007 hosted by ICES in Copenhagen. The following participated in the meeting: Dr Ian Davies (Chair), Dr Patrick Roose (Belgium), Dr Martin Mørk Larsen (Denmark), Mr Martial Huet (France), Dr Michael Haarich (Germany), Dr Stefan Schmolke (Germany), Mr Brendan McHugh (Ireland), Mr Foppe Smedes (The Netherlands), Mr Norman Green (Norway), Dr Lucia Viñas Diguez (Spain), Ms Sara Danielsson (Sweden), Dr Rob Fryer (United Kingdom), Ms Marilynn Sørensen (ICES), Mr Jørgen Nørrevang Jensen (Denmark).

RÉCAPITULATIF

Ce rapport présente les évaluations scientifiques des données marines de surveillance continue d'OSPAR sur les substances dangereuses dans les sédiments marins, et les effets biologiques découlant de la présence du composé anti-salissures tributylétain (TBT) dans l'environnement marin. La conclusion générale est que la surveillance continue est nécessaire avant de pouvoir tirer des conclusions claires à savoir si la tendance générale à la baisse des substances dangereuse dans la biote, qui a été observée par OSPAR en 2005, 2006 et 2007 concerne aussi les sédiments ; et si les effets du TBT se réduisent aussi. Cependant, la majorité des mesures montre que les contaminants naturels et synthétiques persistent au delà des objectifs sur le long terme.

La surveillance continue des sédiments est nécessaire pour établir des tendances

La première partie de l'évaluation concerne les données sur les substances dangereuses dans les sédiments pour la période allant de 1985 à 2006. Les substances observées sont les métaux (cadmium, mercure et plomb), les hydrocarbures aromatiques polycycliques (HAP) et les polychlorobiphényles (PCB), qui ont tous été identifiés par OSPAR comme produits chimiques prioritaires. Les sédiments ont été observés car de nombreux contaminants ont une haute affinité pour les particules, et les sédiments du fond de la mer peuvent devenir le refuge d'une large proportion de contaminants introduits en mer.

Suffisamment de données sur les sédiments ont été reportées pour permettre l'analyse de séries temporelles de 162 stations en Mer du Nord au sens large (Région III). Les séries temporelles ont été évaluées lorsque plus de trois années de mesures étaient disponibles, incluant au moins une année dans la période 2002-2006. En Mer du Nord et en Mers celtiques, la majorité des tendances détectées sont décroissantes, mais ces tendances ne peuvent être détectées seulement que pour une petite proportion de l'ensemble des séries temporelles analysées (par exemple <7%). Aucune série temporelle n'a pu être analysée dans les Eaux Arctiques (Région I) ou dans le Golfe de Gascogne et les Côtes Ibériques (Région IV), car le nombre d'années de mesures dans ces zones ne sont pas suffisantes.

Les substances dangereuses restent au dessus des teneurs ambiantes dans les sédiments

OSPAR a pour objectif sur le long terme d'atteindre des concentrations en substances dangereuses dans l'environnement marin proche des teneurs ambiantes pour les substances naturelles, et proche de zéro pour les substances synthétiques. OSPAR a adopté un ensemble de teneurs ambiantes qui représentent ces valeurs. La comparaison des concentrations de la dernière année de chaque série temporelle avec ces teneurs ambiantes montre que la plupart des substances naturelles et synthétiques restent au dessus des objectifs sur le long-terme. Par exemple :

a. pour le cadmium, 90% des concentrations dans les sédiments de la dernière année de surveillance sont au dessus des teneurs ambiantes ;

b. pour le mercure et le plomb, plus de 95% des concentrations dans les sédiments dans la dernière année de surveillance sont au dessus des teneurs ambiantes

c. pour la plupart de HAP, plus de 93% des concentrations dans les sédiments dans la dernière année de surveillance sont au dessus des teneurs ambiantes

d. pour les PCB, presque 100% des concentrations dans les sédiments dans la derniere année de surveillance sont au dessus des teneurs ambiantes

A contrario, pour les HAP Benzo(g,h,i)pérylène et Indéno(123cd)pyrène environ 50% des concentrations dans les sédiments de la derniere année de surveillance sont au niveau des teneurs ambiantes.

Quelques preuves de la décroissance des effets du TBT, mais plus de surveillance est nécessaire

La seconde évaluation dans ce rapport se concentrant sur les effets biologiques du composé antisalissure TBT, montre que dans 24 des 124 séries temporelles, une tendance à la baisse a pu être observée. La surveillance des effets biologiques spécifiques du TBT a été incluse dans le Programme coordonné de surveillance continue de l'environnement (CEMP) pour vérifier les résultat de l'interdiction européenne et mondiale de l'utilisation et de la présence de TBT dans les peintures pour bateaux, qui ont été introduites après la reconnaissance des conséquences non désirées de l'usage de cette substance. Bien que les résultats de cette évaluation soient partiellement encourageants, une surveillance continue et plus vaste est nécessaire pour confirmer ces tendances à travers la zone maritime d'OSPAR.

Prochaine étape : le Bilan de santé 2010

A travers ces évaluations régulières, les données de surveillance du CEMP qui sont reportées au CIEM par les parties contractantes d'OSPAR, sont examinées minutieusement et régulièrement. Les erreurs ou l'absence de données peuvent être identifiés et corrigés ; les méthodes d'évaluation des données sont progressivement mises à jour, testées et améliorées, afin de s'assurer que le système d'évaluation est pleinement prêt pour le bilan de santé 2010, et fournissent des preuves à jour pour l'élaboration des politiques.

Les nouveaux aspects de l'évaluation inclus le développement de nouveaux formats de description de données, simplifiant la mise en table des données numériques et leurs représentations graphiques, ainsi que de nouveaux formats de cartographie. Le travail d'évaluation a aussi souligné la nécessite de travaux complémentaires avant 2010 pour consolider l'ensemble de critères d'évaluation disponibles pour les évaluations du CEMP et pour le développement de méthodes pour réaliser des rapports conjoints sur des groupes de contaminants.

Remerciements

Cette évaluation a été initialement présentée par le groupe de travail OSPAR sur la surveillance lors de sa réunion accueillie par le CIEM à Copenhague, du 4 au 7 décembre 2007. Les participants à cette réunion sont les suivants : Dr Ian Davies (président), Dr Patrick Roose (Belgique), Dr Martin Mørk Larsen (Danemark), Mr Martial Huet (France), Dr Michael Haarich (Allemagne), Dr Stefan Schmolke (Allemagne), Mr Brendan McHugh (Irlande), Mr Foppe Smedes (Pays-Bas), Mr Norman Green (Norvège), Dr Lucia Viñas Diguez (Espagne), Ms Sara Danielsson (Suède), Dr Rob Fryer (Royaume-Uni), Ms Marilynn Sørensen (CIEM), Mr Jørgen Nørrevang Jensen (Danemark).

1. Introduction

This report is the third 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) (OSPAR agreement 2007/1). It follows the first comprehensive trend assessment of CEMP data in 2005 (OSPAR Commission 2005a), and the annual CEMP assessment reports published in 2006 and 2007 (OSPAR Commission, 2006; OSPAR Commission 2007). The key methods used in these assessments, such as data screening procedures, quality assurance assessment, statistical methodology and methods used to develop assessment criteria are described in the CEMP assessment manual (OSPAR Commission, 2008).

The CEMP is the monitoring under the OSPAR Joint Assessment and Monitoring Programme where the national contributions overlap and are co-ordinated through adherence to commonly agreed monitoring guidelines, quality assurance tools and assessment tools. It covers temporal trend and spatial monitoring programmes for concentrations of selected chemicals and nutrients, and for biological effects.

The aim of the annual CEMP assessments is to provide updated information on the quality of the marine environment in relation to the hazardous substances monitoring under the CEMP. These assessments also 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 CEMP annual assessments focus on specific aspects under the CEMP. This report presents an assessment of trends in the concentrations of contaminants in sediment and status and trends in TBT-biological effects. The contaminants covered by the assessment are metals (cadmium, mercury, lead, nickel, copper, zinc, chromium, arsenic), TBT, organic contaminants (PCB congeners 118 and 153, the PAHs fluoranthene, benzo[a]pyrene, benzo[ghi]perylene, anthracene and phenanthrene and the pesticide HCB).

The assessment has been prepared by the OSPAR Working Group on Monitoring (MON) at its meeting in December 2007 and is based upon data reported by Contracting Parties to ICES and held in the ICES Environmental databases.

2. Assessment of contaminant concentrations in sediment

2.1 Selection of parameters

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

a. ***metals*.** Mercury, cadmium and lead are included in the OSPAR List of Chemicals for Priority Action. In addition, the assessment covers nickel (a priority substance under the Water Framework Directive), copper (an indicator for substitution of TBT by copper in anti-fouling products), zinc (assisting interpretation of trends in cadmium) and chromium and arsenic. All metals occur naturally in the marine environment, at a so called background level. Of the heavy metals, mercury, cadmium and lead are generally considered to be toxic without having any biological function. Mercury is considered the most toxic, especially due to the ability of some bacteria to form methylmercury, that can transfer across membranes and accumulates in organs with high fat contents. In the CEMP data, total mercury is mainly measured. Mercury interacts with the nervous system of mammals. Cadmium can be found in high concentrations in some marine top predators, especially in liver. Mammals can build cadmium into the bones, which at high concentrations results in fragile bones, known as Itai-Itai disease. Lead is generally not considered to accumulate in food chains. High lead concentrations can inhibit brain development in children. The other metals covered are either micronutrients (zinc and copper) or have other biological functions (arsenosucres, chromium, nickel).

b. ***tributyl tin (TBT) in sediments and TBT-specific biological effects.*** **TBT is included in the group of organic tin compounds on the OSPAR List of Chemicals for Priority Action.** Organotins were introduced as a very effective antifouling agent in ships paints in the 1960's, especially Tributyltin (TBT). Marketing of TBT for use on small vessels was banned in the mid 1980's, as unwanted effects on marine snails and bivalves were discovered, that impacted the reproduction of the more sensitive species (oysters, dogwhelks and other gastropods). The International Convention on the Control of Harmful Anti-fouling Systems on Ships (AFS Convention) adopted on 5 October 2001 bans the application of TBT based anti-fouling paints by 1 January 2003 and the presence of TBT on ships' hulls by 1 January 2008. The AFS Convention is implemented in EU by EU Regulation EC Community Regulation, (Regulation (EC) No 782/2003). Under the CEMP the effects of TBT in dogwhelks and other gastropod species are measured with a view to checking on the effect of these agreements and their implementation.

c. ***polycyclic aromatic hydrocarbons.*** PAHs are included as a group of substances on the OSPAR List of Chemicals for Priority Action. Of the PAHs, fluoranthene, benzo[a]pyrene, benzo[ghi]perylene, phenanthrene and anthracene have been selected for detailed presentation. Fluoranthene can be quantified well using the most regularly used analytical methods and was found at relatively high concentrations (compared to other PAHs) in the 2005 CEMP assessment (OSPAR Commission 2005a). Benzo[a]pyrene has recognised toxicological importance and is generally one of the more abundant PAHs. Benzo[ghi]perylene and phenanthrene are representatives of higher and lower condensed PAHs, respectively, and can be used to study the behaviour of PAHs in the environment. Phenanthrene and anthracene can be used to investigate differences in the pyrogenic or petrogenic origin of PAHs. Some PAH substances are naturally occurring from forest fires and oil seeping out from underground reservoirs. In the marine environment, wide spread distribution of PAHs can be attributed to shipping activities (burning of fossil fuels, oil spills from accidents, or rinsing of oil tanks at sea), but long range transport from burning of fossil fuels also occurs.

d. ***polychlorinated biphenyls***. PCBs are included as a group of substances on the OSPAR List of Chemicals for Priority Action. Of the PCBs, CB153 and CB118 have been selected for detailed presentation. CB 153 is generally present in the highest concentration and correlates well with other analysed PCBs. CB118 is representative of the more toxicologically relevant mono-ortho/planar PCBs. PCBs are man made substances, which are not naturally occurring. PCBs are highly accumulative in the marine food chain, and in the mid-70's were identified as a major problem for marine mammals and seabird reproduction, due to shell thickening of birds.

The assessment also covers the pesticide ***hexachlorobenzene.*** HCB is a priority hazardous substance under the Water Framework Directive. Lindane was not assessed because insufficient data were available.

2.2 Methods

The assessment was mainly prepared using the methods for data screening, treatment of quality assurance information, temporal trend assessment and assessment against Assessment Criteria used during the 2004/2005 CEMP Assessment (OSPAR Commission, 2005a) and further developed during the 2005/2006 CEMP assessment (OSPAR Commission, 2006). The methods are documented in the 2005 CEMP Assessment Report and are incorporated into a CEMP Assessment Manual (OSPAR Commission, 2008).

The assessment criteria used are the Background Assessment Concentrations (BACs) developed in relation to the agreed OSPAR Background Concentrations (BCs) for contaminants in sediment (OSPAR Agreement 2005/06) and derived using the variability in the CEMP data. The BACs for man-made substances, for which the BCs are zero, are constructed using a low but measurable concentration (LC), taken to be twice the Quasimeme constant error. New BACs were constructed for the PCBs and HCB, as the Quasimeme constant errors for these substances have reduced since the last sediment assessment. The BCs, LCs and BACs used in the assessment are given in Table 2.1.

Table 2.1: BCs, LCs and BACs for contaminants in sediment. Metal concentrations are expressed as mg kg^{-1} dry weight normalised to 5% aluminium. Organic concentrations are expressed as µg kg^{-1} dry weight normalised to 2.5% organic carbon.

		BC	BAC			LC	BAC
Metals	Arsenic	15	25	CBs	CB28	0.05	0.22
	Cadmium	0.2	0.31		CB52	0.05	0.12
	Chromium	60	81		CB101	0.05	0.14
	Copper	20	27		CB118	0.05	0.17
	Mercury	0.05	0.07		CB138	0.05	0.15
	Nickel	30	36		CB153	0.05	0.19
	Lead	25	38		CB180	0.05	0.10
	Zinc	90	122		Sum 7 CBs	0.20	0.46
PAHs	Naphthalene	5	8	Pesticides	Hexachlorobenzene	0.05	0.16
	Phenanthrene	17	32				
	Anthracene	3	5				
	Fluoranthene	20	39				
	Pyrene	13	24				
	Benzo[a]anthracene	9	16				
	Chrysene	11	20				
	Benzo[a]pyrene	15	30				
	Benzo[ghi]perylene	45	80				
	Indeno[123-cd]pyrene	50	103				

Environmental Assessment Criteria (EACs) were not used in this assessment. Further work is planned to address the problems with the proposed set of updated EACs that were identified during the 2004/05 assessment.

Time series were constructed of normalised concentrations from stations in the ICES Station Dictionary. Metal concentrations were normalised to 5% aluminium and organic concentrations were normalised to 2.5% organic carbon. Data were excluded if the concentrations could not be normalised. The sieving method was consistent within time series, but varied between time series.

Time series were assessed if they had at least three years of data, with some data reported between 2002 and 2006.

Time series with five or more years of data were assessed for temporal trends. Although all data in the time series were used in the statistical analysis, the focus was on changes in concentration in the last ten years (1997-2006). Throughout this report, the term ***trend*** refers to a **linear trend in log concentration in the last ten years (1997-2006), significant at the 5% level**.

All time series with three or more years of data were assessed against the BAC. Throughout the report, the phrase ***concentrations are at background*** means that the **upper confidence limit on the fitted concentration in the last year of monitoring is below the BAC**.

Samples collected between 2002 and 2006 that did not form part of a time series were used to provide greater spatial coverage by informally comparing the normalised concentrations to the BACs. Specifically, the upper 95% confidence limits of the normalised concentrations based on the analytical variability of the measurements – i.e. ignoring any field variability – were compared to the BAC.

For each group of parameters, a table shows, for each OSPAR Region and parameter, the number of time series, the number of upward and downward trends, and the number of time series where concentrations are at background.

For each parameter, some text draws out the main conclusions and a map shows the results of the assessment. The main part of the map shows the results for each time series. The symbol denotes:

- a significant upward trend (upward triangle)
- significant downward trends (downward triangle)
- no trend (square)

- insufficient data to assess trends (circle)

The colour denotes whether the mean concentration in the final year was:

- significantly below the BAC; i.e. concentrations were at background (green)
- below the BAC but not significantly so (amber)
- above the BAC (red)

The inset reproduces these data but also plots the normalised concentrations for the data from 2002 to 2006 that did not form part of a time series (see above). These data are coloured green, amber and red if the concentration was significantly below the BAC, below the BAC but not significantly so, or above the BAC, based on the analytical variability of the measurement.

2.3 Overview of data

The assessment covers data from 1985 to 2006. There were 162 stations with time series in the Greater North Sea (Region II), 32 in the Celtic Seas (Region III), Time series were mostly from Germany, Ireland, the Netherlands, and the UK (Figure 2.1). A full trend assessment was not possible for data from Arctic Waters (Region I) due to lack of time series data and no assessment was possible for the Bay of Biscay/Iberian Coast (Region IV) due to a lack of normaliser concentrations. Not all contaminants could be assessed at each station. Iceland has opted out of the sediment monitoring programme as following baseline surveys they concluded that regular monitoring of metals, PAHs and PCBs in sediments around Iceland was not necessary.

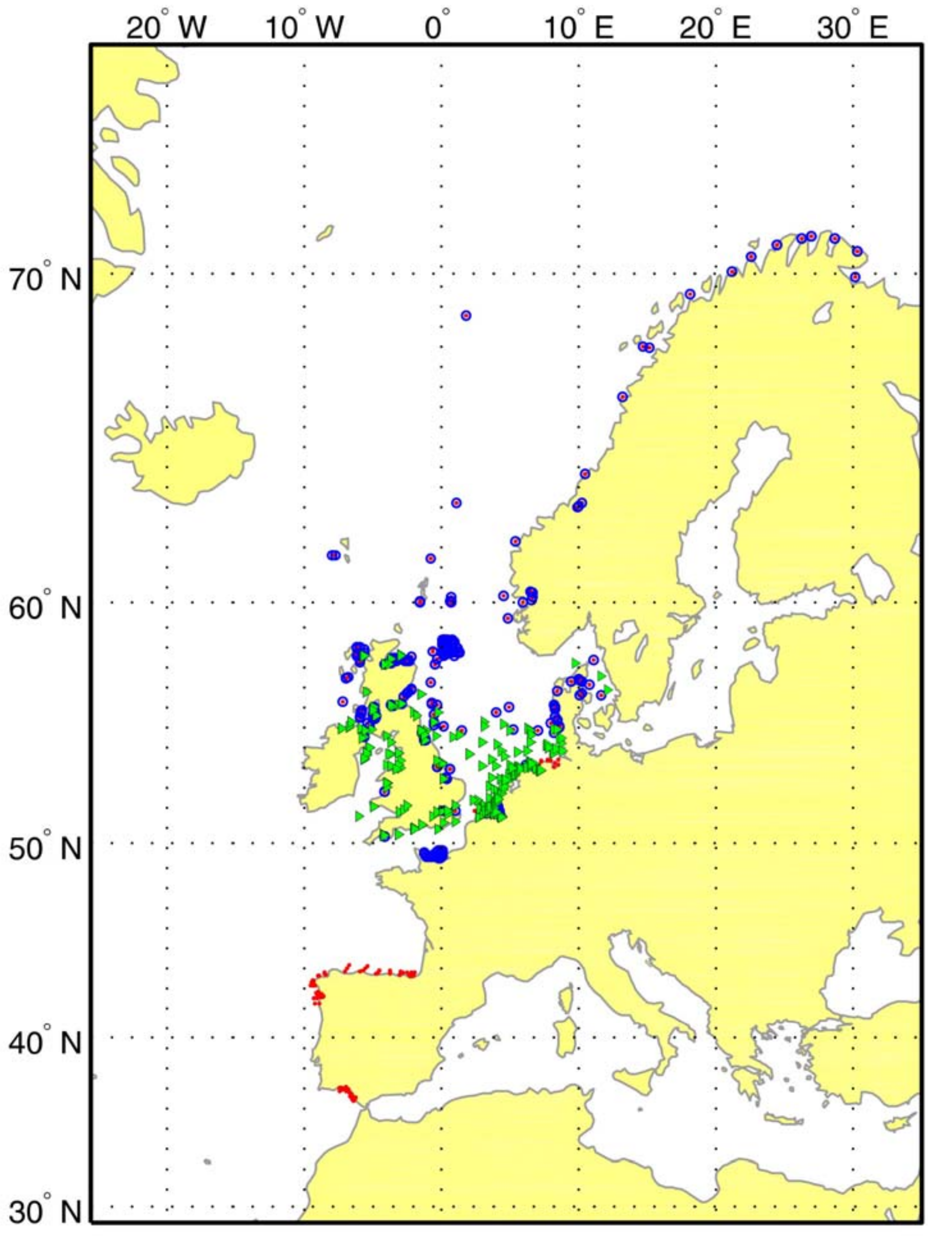

Figure 2.1. Availability of sediment data. Green triangles indicate stations with time series. Blue circles indicate sediment samples from 2002 – 2006 that did not form part of a time series, but were used to provide greater spatial coverage. Red dots indicate sediment samples from 2002 – 2006 that were reported to the ICES data base but not used because concentrations could not be normalised.

2.4 Metals and organometal(s)

Between 183 and 191 time series were available for the eight metals.

Concentrations were at background at 15% of stations for cadmium, 3% for mercury, and 4% for lead. For the non-priority metals, the proportions were 38% for arsenic, 4% for chromium, 34% for copper, 32% for nickel, and 10% for zinc.

There were a total of 30 upward and 87 downward trends. Except for arsenic, the majority of trends for each metal were downward. There were 61 trends for the priority metals: 32 for mercury, 22 for cadmium and 7 for lead. One station in the Scheldt had downward trends for all three priority metals. Table 2.3 shows the 23 stations with trends in at least two metals.

Table 2.2: Summary of metal assessments with numbers of time series (n), upward trends (up), downward trends (down) and time series with concentrations at background (back)

	Region II				Region III				total			
	n	up	down	back	n	up	down	back	n	up	down	back
Cadmium	158	3	8	20	32	4	7	8	190	7	15	28
Mercury	154	1	26	4	29	0	5	1	183	1	31	5
Lead	159	1	4	3	32	0	2	5	191	1	6	8
Arsenic	158	2	1	50	30	2	0	22	188	4	1	72
Chromium	158	3	5	7	32	1	3	0	190	4	8	7
Copper	159	4	6	59	32	1	2	6	191	5	8	65
Nickel	159	7	8	57	32	0	1	4	191	7	9	61
Zinc	159	1	7	16	32	0	2	3	191	1	9	19

Table 2.3: Stations with trends is at least two metals. The symbols are the same as those on the summary maps (see Point 17).

region	country	station	Cd	Hg	Pb	As	Cr	Cu	Ni	Zn
II	Belgium	120					▼ (orange)			▼ (red)
II	Belgium	700		▼ (red)	▼ (orange)				▼ (green)	
II	Belgium	S18	▼ (red)	▼ (red)	▼ (red)		▼ (red)	▼ (red)	▼ (red)	▼ (red)
II	Belgium	S22	▼ (red)	▼ (red)			▼ (red)	▼ (red)	▼ (red)	▼ (red)
II	Germany	L1		▼ (red)					▼ (red)	
II	Germany	L2	▼ (red)	▼ (red)						
II	Germany	STG16	▼ (red)	▼ (red)						
II	Germany	Ti13		▼ (red)					▼ (red)	
II	Germany	URST1			▲ (red)				▼ (red)	
II	Germany	WB1	▼ (green)	▼ (red)				▼ (green)		
II	UK	Anglia: Medway				▲ (orange)		▲ (red)	▲ (red)	
II	UK	Anglia: Blackwater	▲ (red)				▲ (red)	▲ (red)		
II	UK	Humber		▼ (red)					▲ (red)	
II	UK	Wash		▼ (red)				▲ (red)		
II	UK	Outer Moray Firth					▲ (green)		▲ (green)	
II	UK	Inner Moray Firth	▼ (green)		▼ (green)	▼ (green)	▼ (green)	▼ (green)	▼ (green)	▼ (green)
II	UK	Tees		▼ (orange)				▼ (green)		
II	UK	Tyne		▼ (red)						▼ (red)
II	UK	Tamar		▲ (red)		▲ (red)				▲ (red)
III	UK	Clyde: Cloch Point	▲ (orange)			▲ (orange)				
III	UK	Clyde: Ailsa Craig	▼ (green)		▼ (orange)		▼ (red)	▼ (green)	▼ (orange)	▼ (green)
III	UK	Solway Firth	▼ (green)				▼ (red)	▼ (green)		
III	UK	Liverpool Bay				▲ (green)	▲ (red)			

2.4.1 Cadmium

A total of 190 time series were assessed, 158 in Region II and 32 in Region III.

Concentrations were at background at 13% of stations in Region II, 25% of stations in Region III, and 15% overall. Typically, concentrations were at background at stations in the open North Sea, the North of Scotland and the Irish Sea, but above background at coastal stations and stations in the inner German Bight.

There were 8 downward trends in Region II and 7 in region III. However the trends in Region III and one of the trends in Region II (Moray Firth) were spurious, attributable to decreasing limits of detection. The remaining downward trends in Region II were off the Belgian coast and in the Scheldt (9-17% per year) and at German stations off the Frisian isles, at Lister Tief / Isle of Sylt, and in the Western German Bight (3-4% per year).

There were 7 upward trends in Regions II and III, all at UK stations (7-23% per year): in the Channel, the Blackwater, Severn and Tamar estuaries, the Celtic Deep, the Irish Sea and the Clyde. The trends in the Severn and the Celtic Deep are consistent with increases in cadmium inputs to the Severn area as indicated by RID data (OSPAR Commission, 2005b).

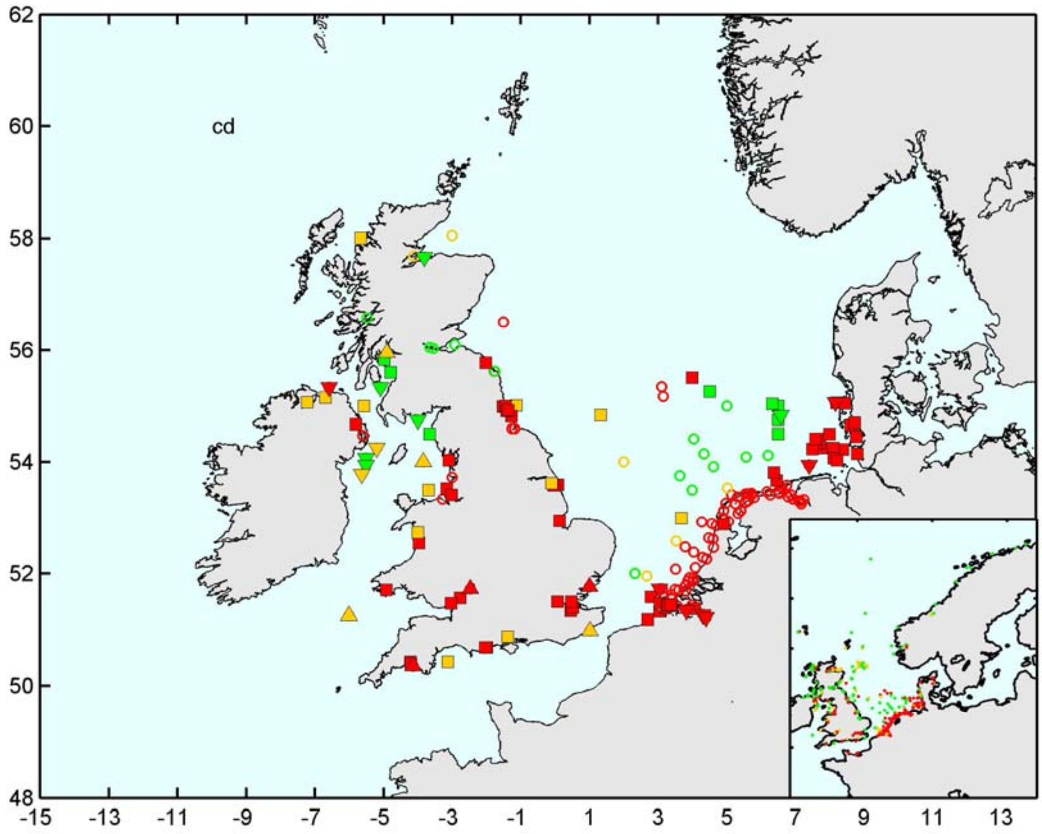

Figure 2.2 Assessment results for cadmium in sediments. Time series: (Triangles up=upward trend, triangles down=downward trend, circles = no trend). Mean cadmium concentrations in the final year: green = at background; red = above background

2.4.2 Mercury

A total of 183 time series were assessed, 154 in Region II and 29 in Region III.

Concentrations were at background at four stations in Region II, all in or near the Dogger Bank, and one station in Region III, in the Dyfi estuary in Wales.

There was only one upward trend, in the Tamar estuary, UK (11% per year).

There were 31 downward trends: e.g. in Liverpool Bay and off the Cumbrian Coast of the UK (8-17% per year), in the Tyne, Humber and Wash estuaries on the East Coast of the UK (7-14% per year), in Belgian coastal waters and the Scheldt Estuary (6-9% per year), and at many stations in the German Bight (1-3% per year).

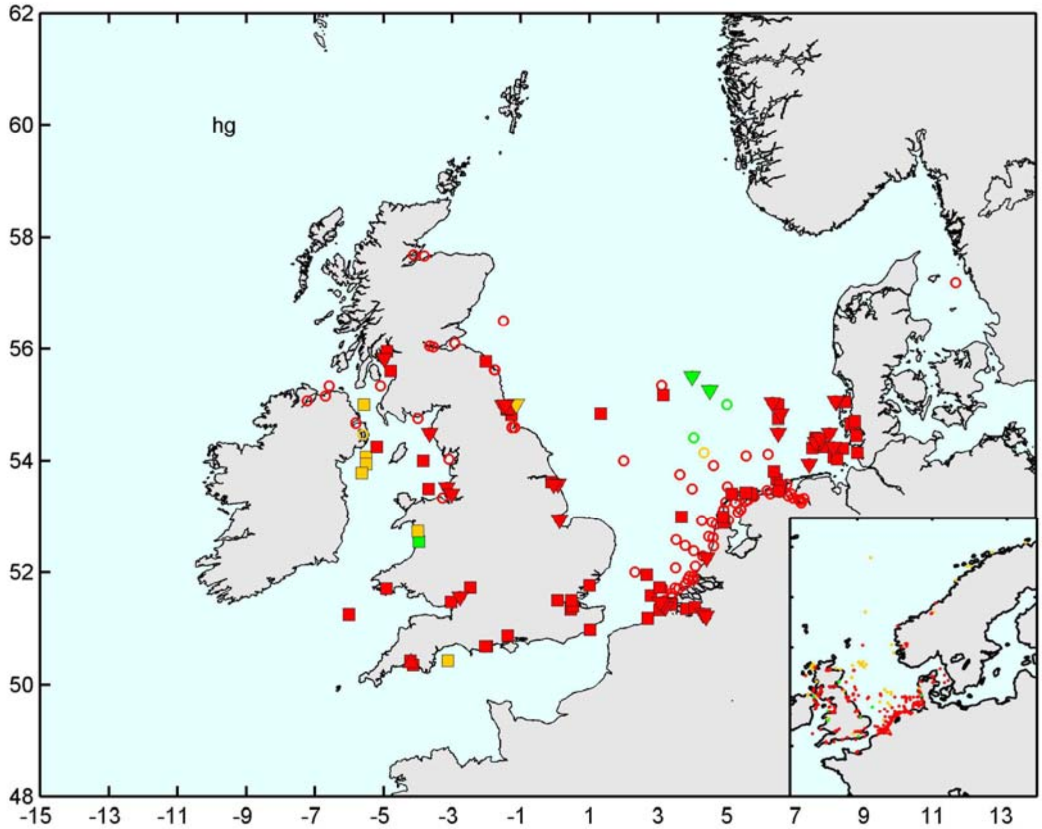

Figure 2.3 Assessment results for mercury in sediments. Time series: (Triangles up=upward trend, triangles down=downward trend, circles = no trend). Mean cadmium concentrations in the final year: green = at background; red = above background

2.4.3 Lead

A total of 191 time series were assessed, 159 in Region II and 32 in Region III.

Concentrations were at background at 2% of stations in Region II, 16% of stations in Region III, and 4% overall. Concentrations were at background in the Celtic Deeps, the North of Ireland and the North of Scotland.

There was only one upward trend, at a station in the Inner German Bight (1% per year), near a historic dumping site of metaliferrous waste from titanium dioxide production. Although dumping was stopped in 1989, it may contribute to the high concentrations in sediments in areas of the German Bight.

There were 2 downward trends in Region III, both in the Clyde (5-22% per year), and 4 downward trends in Region II, to the west of the Dutch Coast (2% per year), in Belgian coastal waters and the Scheldt Estuary (5-6% per year), and in the Moray Firth (20% per year).

Annual riverine input and direct discharge data for lead show a significant downward trend of 5% per annum (OSPAR Commission, 2005b), and atmospheric deposition of lead decreased by 50% between 1998 and 2002 (OSPAR Commission, 2005c). These decreases do not seem to be reflected in a greater number of downward trends in sediments.

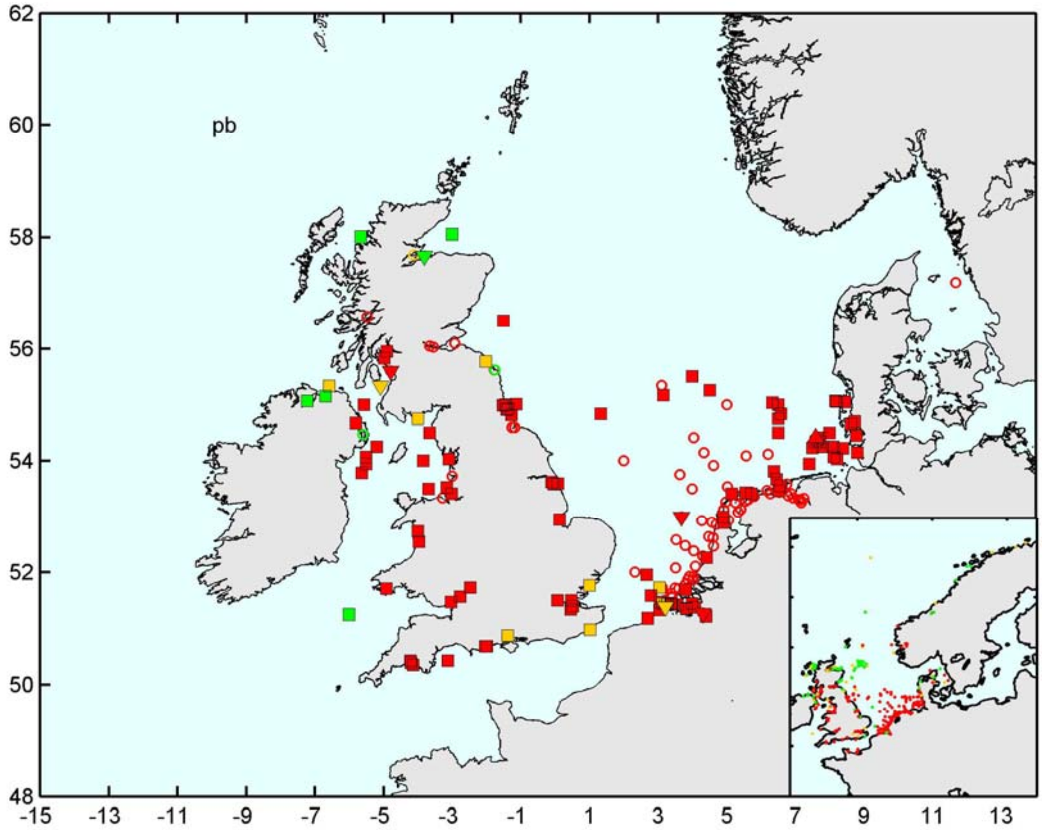

Figure 2.4 Assessment results for lead in sediments. Time series: (Triangles up=upward trend, triangles down=downward trend, circles = no trend). Mean cadmium concentrations in the final year: green = at background; red = above background

2.4.4 Other metals

Arsenic

A total of 188 time series were assessed. Concentrations were at background at 32% of stations in Region II, 73% in Region III, and 38% overall. Concentrations were at background at most stations on the Welsh coast and in the Irish sea, but above background at most stations in the Scheldt, the German Bight and the central North sea.

There were 2 upward and 1 downward trends in Region II, and 2 upward trends in Region III.

Chromium

A total of 190 time series were assessed. Concentrations were at background at 4% of stations in Region II, 0% in Region III, and 4% overall.

There were 3 upward and 5 downward trends in Region II, and 1 upward and 3 downward trends in Region III.

Copper

A total of 191 time series were assessed. Concentrations were at background at 37% of stations in Region II, 19% of stations in Region III, and 34% overall. Concentrations were generally at background in the Irish Sea, the Central North Sea and some Scottish coastal stations. Concentrations were generally above background at coastal stations.

There were 4 upward and 6 downward trends in Region II, and 1 upward and 2 downward trends in Region III.

Nickel

A total of 191 time series were assessed. Concentrations were at background at 34% of stations in Region II, 12% of stations in Region III, and 32% overall. These included stations in the Scheldt, the central North Sea, the Moray Firth and the Western Irish Sea. Concentrations were generally above background in the German Bight and in coastal areas near industrial processes.

There were 7 upward and 8 downward trends in Region II, and 1 downward trend in Region III.

Zinc

A total of 191 time series were assessed. Concentrations were at background at 10% of stations in Region II, 9% of stations in Region III, and 10% overall. Most coastal stations had concentrations above background

There were 1 upward and 7 downward trends in Region II, including several downward trends in the Scheldt Estuary. There were 2 downward trends in Region III.

2.5 PCBs

Between 92 and 112 time series were available for the seven congeners CB28, CB52, CB101, CB118, CB138, CB153, and CB180, and the sum of the 7 CBs, which is routinely used as an “indicator” of the total CB burden in marine matrices.

The most elevated concentrations (Sum 7CBs) were generally found in sediments influenced by industrial processes, with the highest mean concentrations in the Severn, UK (30-50 µg kg^{-1}).

There were downward trends at two stations in the Thames estuary (CB28 and CB180 at one station, CB138 at the other), to the north of Rottumerplaat in the Netherlands (CBs 101, 118, 138, 153, and 180 and Sum 7CBs), and to the north of Terschelling in the Netherlands (CB101) (Table 2.4).

There were upward trends in Belfast Lough (CBs 138 and 153) and Southampton Water (CBs 28, 138 and 153) in the UK.

CB101 concentrations were at background at a station on the Dogger Bank; all other concentrations were above background.

Table 2.4: Summary of PCB assessments with numbers of time series (n), upward trends (up), downward trends (down) and time series with concentrations at background (back)

	Region II				Region III				total			
	n	up	down	back	n	up	down	back	n	up	down	back
CB28	79	1	1	0	18	0	0	0	97	1	1	0
CB52	72	0	0	0	20	0	0	0	92	0	0	0
CB101	88	0	2	1	21	0	0	0	109	0	2	1
CB118	88	0	1	0	20	0	0	0	108	0	1	0
CB138	93	1	2	0	19	1	0	0	112	2	2	0
CB153	93	1	1	0	19	1	0	0	112	2	1	0
CB180	76	0	2	0	16	0	0	0	92	0	2	0
Sum 7CBs	89	0	1	0	10	0	0	0	99	0	1	0

2.5.1 CB 153

A total of 112 time series were assessed, 93 from Region II and 19 from Region III.

Mean concentrations were all above background, typically between 1 and 2 µg kg^{-1}.

There were two upward trends, in Southampton Water (35% per year) and Belfast Lough (40% per year) in the UK.

There was one downward trend, at Rottumerplaat in the Netherlands (3% per year).

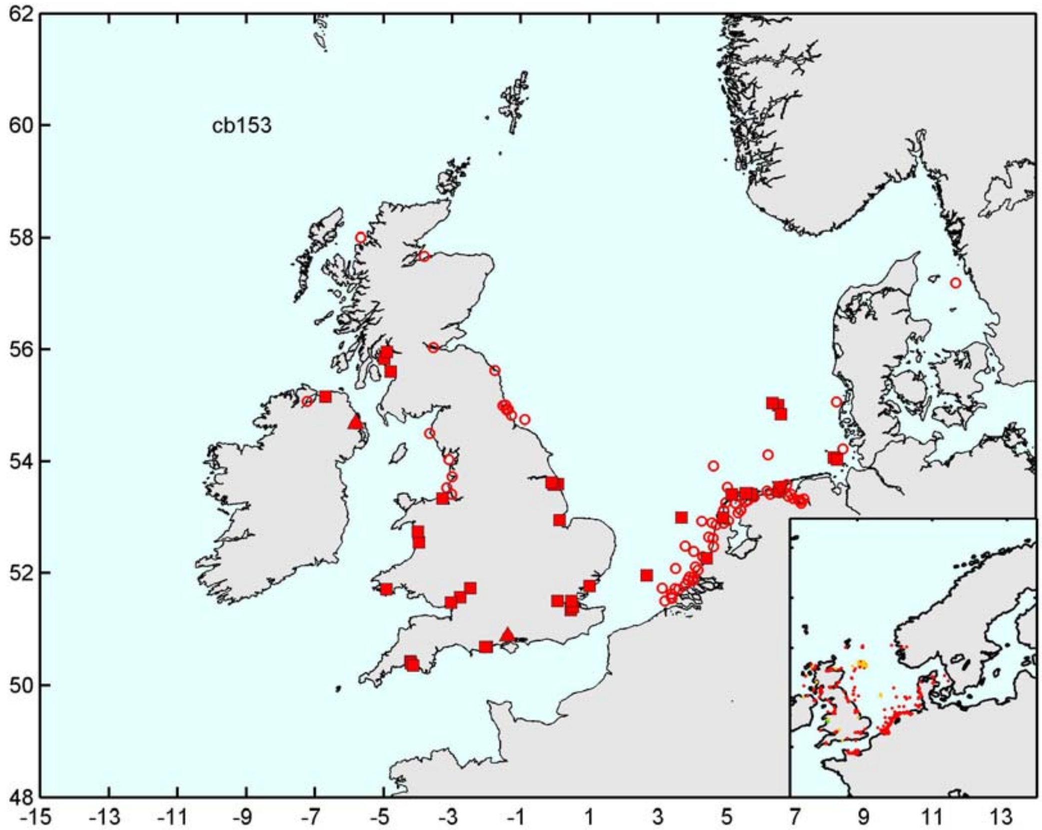

Figure 2.5 Assessment results for CB153 in sediments. Time series: (Triangles up=upward trend, triangles down=downward trend, circles = no trend). Mean cadmium concentrations in the final year: green = at background; red = above background

2.5.2 CB 118

A total of 108 time series were assessed, 88 from Region II and 20 from Region III.

Mean concentrations were all above background, typically between 0.6 and 1.3 µg kg^{-1}.

There were no upward trends.

There was one downward trend, at Rottumerplaat in the Netherlands (4% per year).

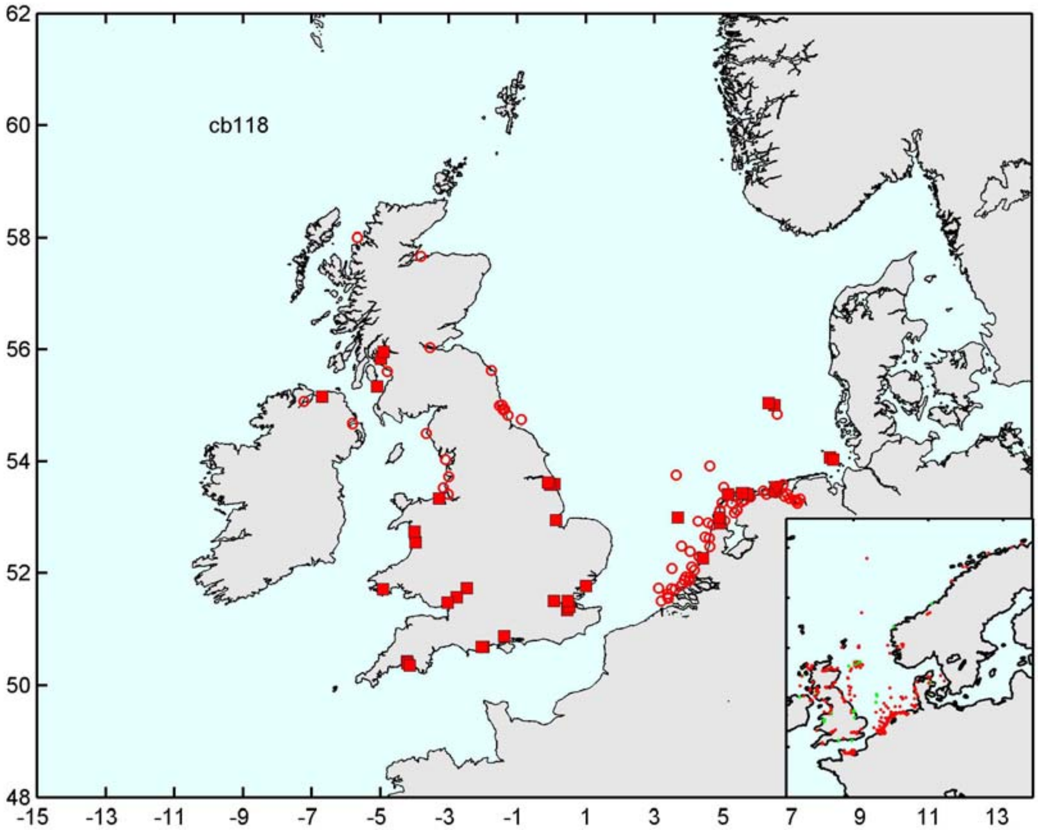

Figure 2.6 Assessment results for CB118 in sediments. Time series: (Triangles up=upward trend, triangles down=downward trend, circles = no trend). Mean cadmium concentrations in the final year: green = at background; red = above background

2.5.3 Other congeners and sum 7CBs

CB 28 in sediment

A total of 97 time series were assessed. There was one downward trend in the Thames (73% per year) and one upward trend in Southampton Water (43% per year). Mean concentrations were all above background, typically between 0.6 and 1.3 µg kg^{-1}.

CB 52 in sediment

A total of 92 time series were assessed. There were no trends. All 92 CB52 time series were above background for CB52. Mean concentrations were all above background, typically between 0.4 and 1.1 µg kg^{-1}.

CB 101 in sediment

A total of 109 time series were assessed. There were two downward trends, at Rottumerplaat (4% per year) and Terschelling (4% per year) in the Netherlands. CB101 concentrations were at background at one station in the Dogger Bank, but otherwise above background, typically between 0.6 and 1.3 µg kg^{-1}.

CB 138 in sediment

A total of 112 datasets were assessed. There were two upward trends, in Southampton Water (36% per year) and in Belfast Lough (36% per year). There were two downward trends, in the Thames (18% per year) and at Rottumerplaat in the Netherlands (3% per year). Mean concentrations were all above background, typically between 0.6 and 1.7 µg kg^{-1}.

CB 180 in sediment

A total of 92 datasets were assessed. There were two downward trends, in the Thames (52% per year) and at Rottumerplaat in the Netherlands (3% per year). Mean concentrations were all above background, typically between 0.5 and 1.0 µg kg^{-1}.

Sum7 CBs in sediment

A total of 99 time series were assessed. There was one downward trend, at Rottumerplaat in the Netherlands (4% per year). Mean concentrations were all above background, typically between 3 and 9 µg kg^{-1}.

2.6 PAHs

Between 32 and 116 time series were available for the ten PAHs.

There were downward trends at six stations, at Rottumerplaat (eight PAHs) and Tershelling (seven PAHs) in the Netherlands, at two stations in the Thames (six and one PAH respectively), in the Inner Moray Firth (two PAHs) and in the North Minch (two PAHs) (Table 2.6).

There were upward trends at 5 stations, in the Dee estuary in North Wales (4 PAHs), in Southampton Water (three PAHs), in the Tamar and Medway estuaries (one PAH each) and in the Inner Centre German Bight (one PAH) (Table 2.6).

Table 2.5: Summary of PAH assessments with numbers of time series (n), upward trends (up), downward trends (down) and time series with concentrations at background (back)

	Region II				Region III				total			
	n	up	down	back	n	up	down	back	n	up	down	back
Anthracene	93	1	3	3	12	1	0	0	105	2	3	3
Benzo[a]anthracene	99	0	3	4	11	1	0	0	110	1	3	4
Benzo[a]pyrene	99	2	3	11	12	1	0	0	111	3	3	11
Benzo[ghi]perylene	102	1	1	45	10	0	1	1	112	1	2	46
Chrysene	74	0	2	5	0	0	0	0	74	0	2	5
Fluoranthene	100	0	3	3	12	0	0	0	112	0	3	3
Indeno[1,2,3-cd]pyrene	103	2	1	53	13	0	1	1	116	2	2	54
Naphthalene	22	0	1	1	10	0	0	0	32	0	1	1
Phenanthrene	100	0	4	8	12	0	0	0	112	0	4	8
Pyrene	100	0	3	4	12	1	0	0	112	1	3	4

2.6.1 Anthracene in sediment

A total of 105 time series were assessed, 93 from Region II and 12 from Region III.

Concentrations were at background at three stations, all in Region II.

There were two upward trends, in the Tamar (15% per year) and the Dee, North Wales (25% per year).

There were three downward trends, at Rottumerplaat in the Netherlands (5% per year), in the Thames (24% per year) and the Inner Moray Firth (12% per year).

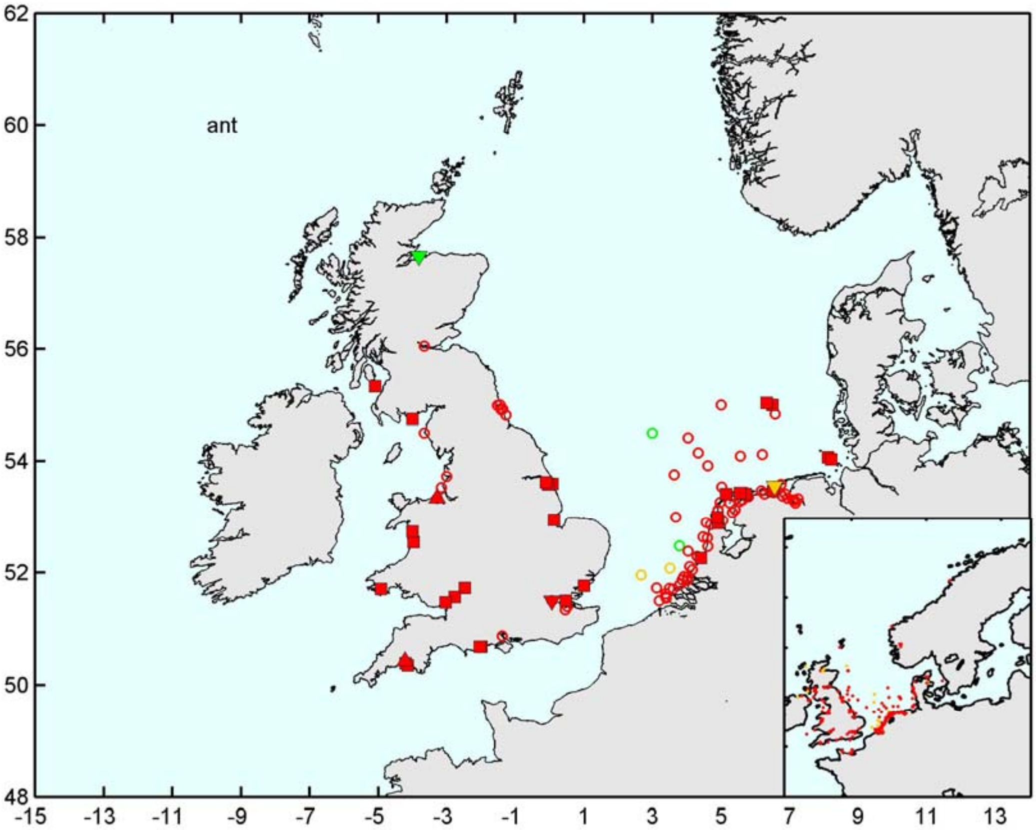

Figure 2.7 Assessment results for anthracene in sediments. Time series: (Triangles up=upward trend, triangles down=downward trend, circles = no trend). Mean cadmium concentrations in the final year: green = at background; red = above background

2.6.2 Benzo[a]pyrene

A total of 111 time series were assessed, 99 from Region II and 12 from Region III.

Concentrations were at background at 11 stations, all in Region II.

There were three upward trends, in the Inner Centre German Bight (8% per year), Southampton Water (16% per year), and the Dee estuary in North Wales (50% per year).

There were three downward trends, at Rottumerplaat in the Netherlands (4% per year), at Terschelling in the Netherlands (2% per year), and in the Thames (24% per year).

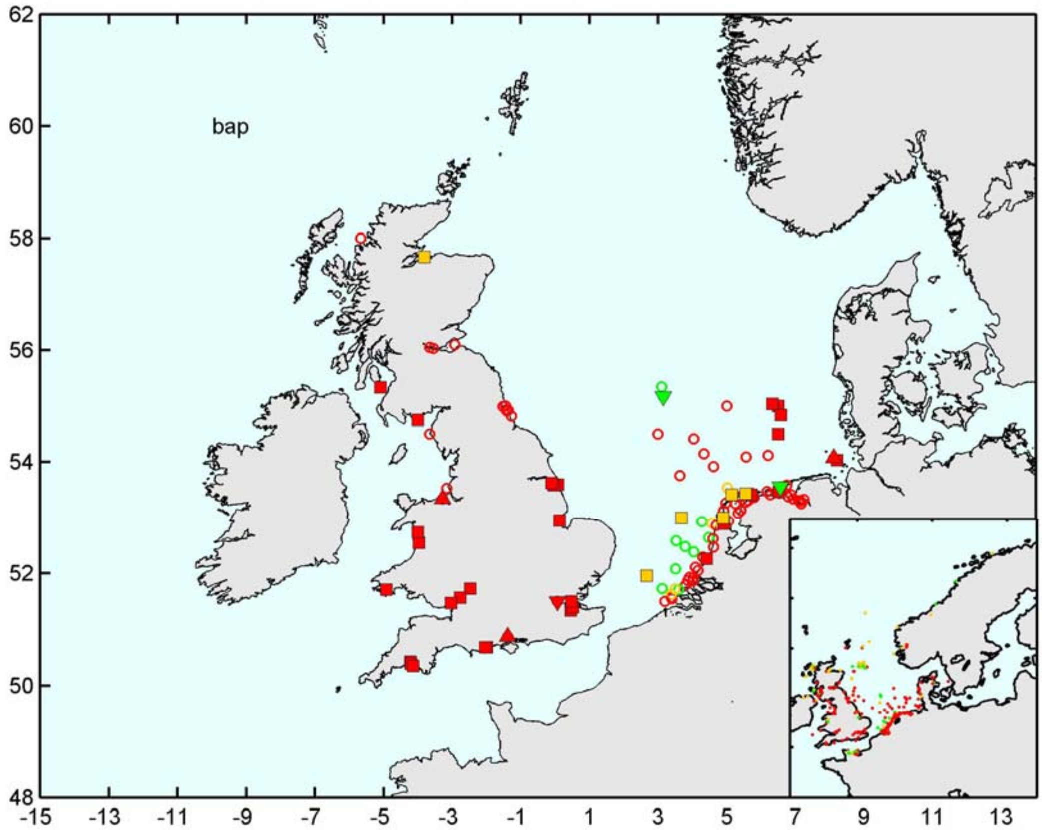

Figure 2.8 Assessment results for benzo[a]pyrene in sediments. Time series: (Triangles up=upward trend, triangles down=downward trend, circles = no trend). Mean cadmium concentrations in the final year: green = at background; red = above background

2.6.3 Benzo[ghi]perylene

A total of 102 time series were assessed, 102 from Region II and 10 from Region III.

Concentrations were at background at 45 stations in Region II and one station in Region III.

There was one upward trend, in Southampton Water (25% per year).

There were two downward trends, at Rottumerplaat in the Netherlands (3% per year) and in the North Minch (15% per year).

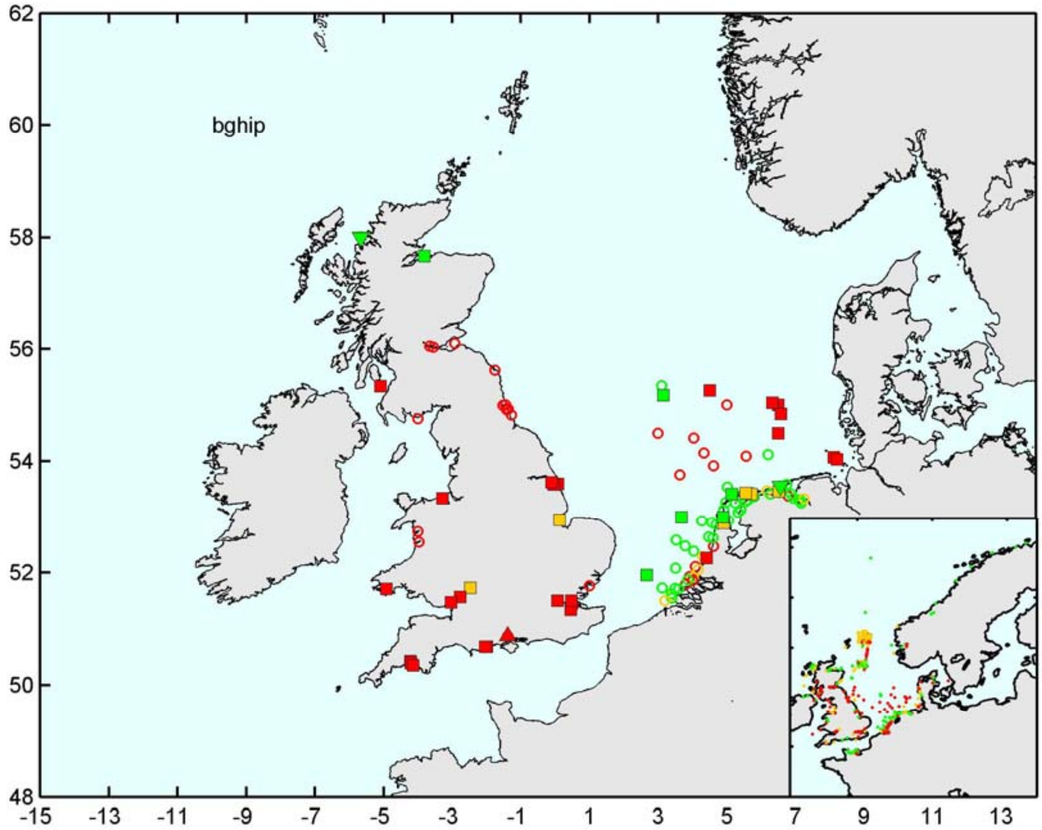

Figure 2.9 Assessment results for benzo[ghi]perylene in sediments. Time series: (Triangles up=upward trend, triangles down=downward trend, circles = no trend). Mean cadmium concentrations in the final year: green = at background; red = above background

2.6.4 Fluoranthene

A total of 112 time series were assessed, 100 from Region II and 12 from Region III.

Concentrations were at background at 3 stations, all in Region II.

There were no upward trends.

There were three downward trends, at Rottumerplaat in the Netherlands (4% per year), at Terschelling in the Netherlands (2% per year) and in the Thames (28% per year).

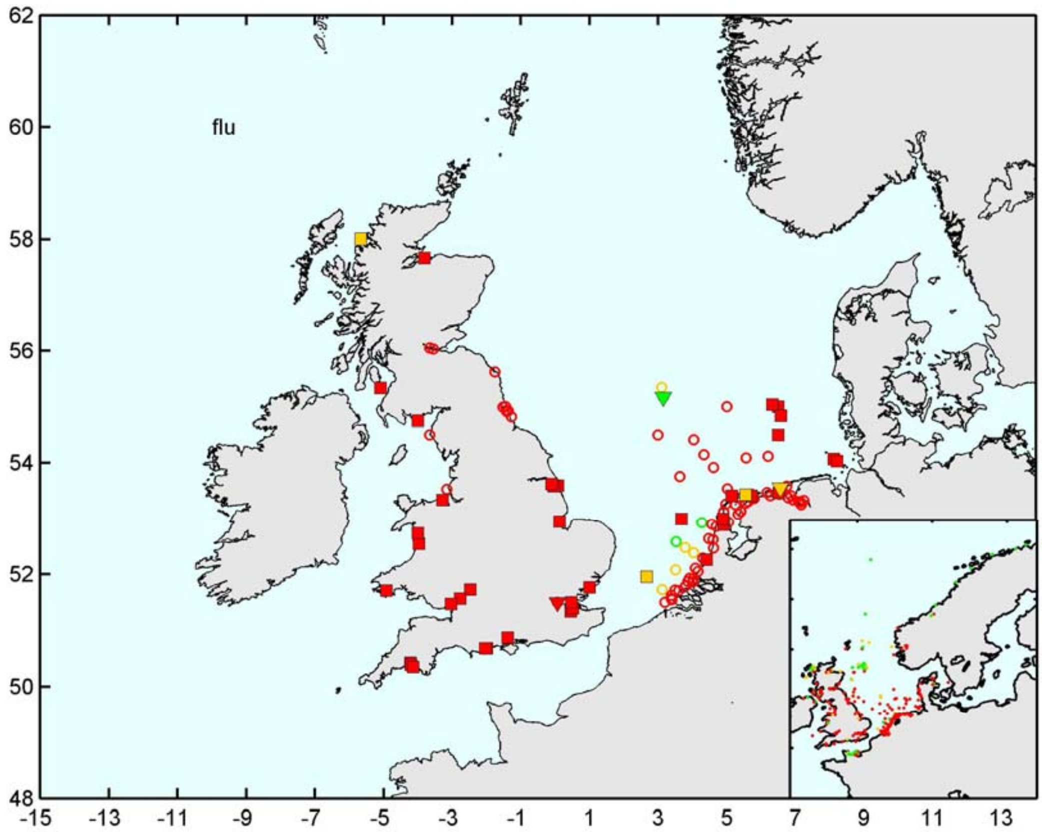

Figure 2.10 Assessment results for fluoranthene in sediments. Time series: (Triangles up=upward trend, triangles down=downward trend, circles = no trend). Mean cadmium concentrations in the final year: green = at background; red = above background

2.6.5 Phenanthrene

A total of 112 time series were assessed, 100 from Region II and 12 from Region III.

Concentrations were at background at 8 stations, all in Region II.

There were no upward trends.

There were four downward trends, at Rottumerplaat in the Netherlands (5% per year), at Terschelling in the Netherlands (3% per year) and at two stations in the Thames (14 and 16% per year).

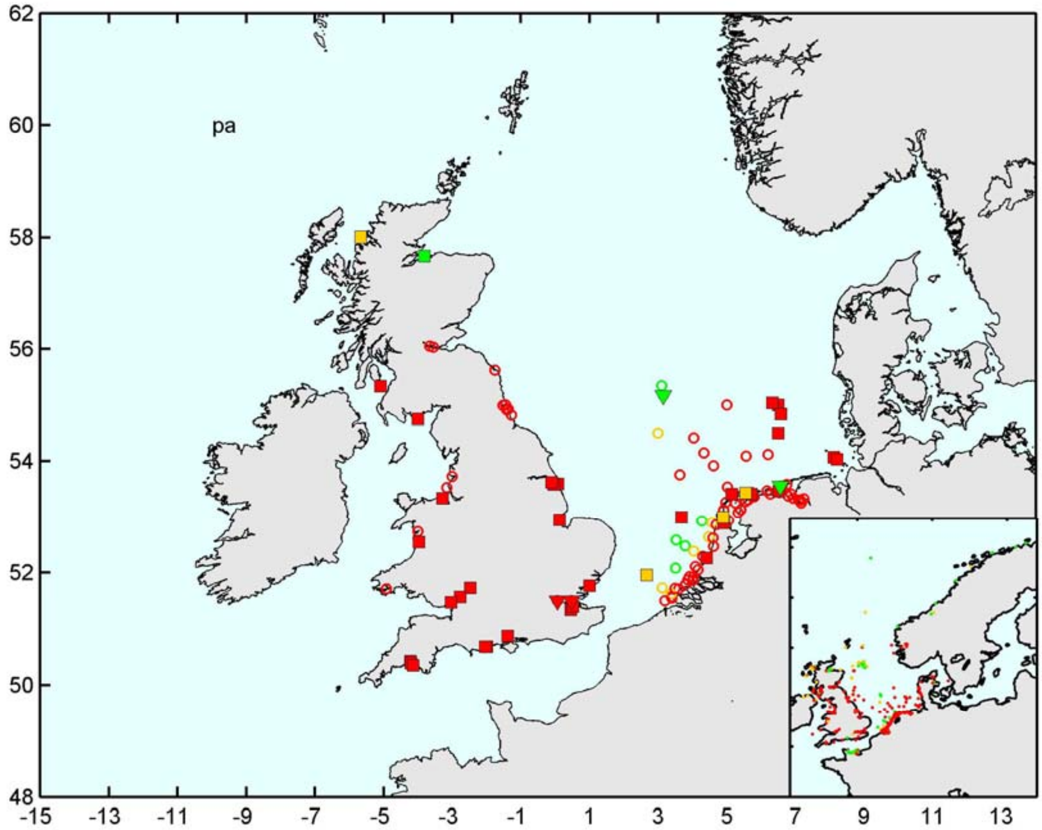

Figure 2.11 Assessment results for phenanthrene in sediments. Time series: (Triangles up=upward trend, triangles down=downward trend, circles = no trend). Mean cadmium concentrations in the final year: green = at background; red = above background

2.6.6 Other PAHs

Benzo[a]anthracene

A total of 110 time series were assessed. Concentrations were at background at 4 stations, all in Region II. There was one upward trend, in the Dee, North Wales (43% per year). There were three downward trends, at Rottumerplaat, Netherlands (4% per year), at Terschelling, Netherlands (2% per year) and in the Thames (25% per year).

Chrysene

A total of 74 time series were assessed, all from Region II. Concentrations were at background at 5 stations. There were two downward trends, at Rottumerplaat, Netherlands (5% per year), and at Terschelling, Netherlands (3% per year).

Indeno[1,2,3-cd]pyrene

A total of 116 time series were assessed. Concentrations were at background at 53 stations in Region II and 1 station in Region III. There were two upward trends, in the Medway, UK (11% per year) and Southampton Water (25% per year). There were two downward trends, at Terschelling, Netherlands (1% per year) and in the North Minch (14% per year).

Naphthalene

A total of 32 time series were assessed. Concentrations were at background at 1 station in Region II. There were no upward trends and one downward trend, in the Inner Moray Firth (14% per year).

Pyrene

A total of 112 time series were assessed. Concentrations were at background at 4 stations, all in Region II. There was one upward trend, in the Dee, North Wales (44% per year). There were three downward trends, at Rottumerplaat, Netherlands (4% per year), at Terschelling, Netherlands (3% per year) and in the Thames (25% per year).

2.7 Other substances

Apart from HCB, which is not on the OSPAR list of Chemicals for Priority Action, no substance had sufficient data to be assessed for temporal trends. Some substances had sufficient data that might allow for an informal spatial overview, but without time series, it is not possible to construct BACs against which to assess the data.

Lindane: only 4 time series were available for the whole OSPAR area. There are sufficient data for an informal spatial overview, but no BAC against which to assess the data.

No time series were available for brominated flame retardants (PBDE), dioxins, coplanar PCBs, but there are sufficient data for an informal spatial overview.

There were no data in the ICES database for PFOS, so an assessment of this substance will depend on Contracting Parties submitting data, or on other sources of information being made available. In the latter case, a lead country will have to take charge of the assessment.

A total of 53 HCB time series were available, all from Region II (49 from the Netherlands and 4 from Germany). Concentrations were above background at all stations, with the most elevated concentrations at stations influenced by the Rhine at Noordwijk and by industrial processes at Bocht van Watum and Heringsplaat noordoost in the mouth of the Ems Dollard estuary. There was one downward trend, at Terschelling (Netherlands).

Table 2.6: Stations with any trends in PAHs, PCBs or HCB. The symbols are the same as those on the summary maps (see Point 17).

region	country	station	Anthracene	Benzo[a]anthracene	Benzo[a]pyrene	Benzo[ghi]perylene	Chrysene	Fluoranthene	Indeno[1,2,3-cd]pyrene	Naphthalene	Phenanthrene	Pyrene	CB 28	CB 52	CB 101	CB 118	CB 138	CB 153	CB 180	Sum 7 CBs	HCB
II	Germany	Inner German Bight (KS11)			▲ red																
II	Netherlands	Rottumerplaat	▼ orange	▼ orange	▼ green	▼ green	▼ green	▼ orange			▼ green	▼ orange			▼ red	▼ red	▼ red	▼ red	▼ red	▼ red	
II	Netherlands	Terschelling (TERSLG235)		▼ green	▼ green		▼ green	▼ green	▼ green		▼ green	▼ green									
II	Netherlands	Terschelling (TERSLG4)													▼ red						▼ red
II	UK	Medway							▲ red												
II	UK	Thames (Woolwich)	▼ red	▼ red	▼ red			▼ red			▼ red	▼ red	▼ red						▼ red		
II	UK	Thames (Mucking)									▼ red						▼ red				
II	UK	Inner Moray Firth	▼ green							▼ green											
II	UK	Tamar	▲ red																		
II	UK	Southampton Water			▲ red	▲ red			▲ red				▲ red				▲ red	▲ red			
III	UK	Inner Belfast Lough															▲ red	▲ red			
III	UK	Dee, North Wales	▲ red	▲ red	▲ red							▲ red									
III	UK	The North Minch				▼ green			▼ green												

3. Assessment of TBT and TBT-specific Biological Effects

TBT is included in the group of organic tin compounds on the OSPAR List of Chemicals for Priority Action. Organotins were introduced as a very effective antifouling agent in ships paints in the 1960's, especially Tributyltin (TBT). Marketing of TBT for use on small vessels was banned in the mid 1980's, as unwanted effects on marine snails and bivalves were discovered, that impacted the reproduction of the more sensitive species (Oysters and *Nucella Lapillus*). The International Convention on the Control of Harmful Anti-fouling Systems on Ships (AFS Convention) adopted on 5 October 2001 bans the application of TBT based anti-fouling paints by 1 January 2003 and the presence of TBT on ships' hulls by 1 January 2008. The AFS Convention is implemented in EU by EU Regulation EC Community Regulation, (Regulation (EC) No 782/2003).

This section provides a first coordinated assessment of the data reported by Contracting Parties on TBT-specific effects in dogwhelks and other gastropods and TBT in sediments.

3.1. Assessment methodology

The assessment of VDSI used the methodology developed by Fryer & Gubbins (2007) for *Nucella lapillus* and Fryer & Gubbins (2006) for other species, the only difference being that PCI in *Buccinum* was scaled to lie between 0 and 1 by dividing by 3.5, and ISI in *Littorina* and VDSI in *Neptunea* and *Nassarius* were scaled to lie between 0 and 1 by dividing by 4. Essentially, each time series was modelled as a linear logistic function of time, the significance of the trend was assessed; and the upper one-sided 95% confidence limit on the fitted line in the final year of the time series was used to make a precautionary classification of the data using the provisional JAMP assessment criteria for TBT specific biological effects in OSPAR Agreement 2004-15). Only time series with at least four years of data were assessed for temporal trends.

As only time series with at least four years of data were used for the trend assessment, the number of time series for biological effects which were available for assessment came down to 134 time series; this includes monitoring data from Denmark, France, the Netherlands, Norway, Sweden and the United Kingdom. For 24 of these there is a significant downward trend. Only 4 have a significant upward trend, two of which are in *Littorina* in the Netherlands, where ISI increased from 0 to 0.04 and to 0.08 respectively over a four year period. In 84 of the remaining 106 time series, the estimated trend was downwards, albeit non-significant.
The levels of imposex in the 5 key gastropod species monitored in the OSPAR/ICES area are related to a 6-class assessment scheme A-F. For colour presentation in the maps the colour code below is suggested for the different classes. In this scheme, green also means that the OSPAR EcoQO on imposex in dogwhelks and other related gastropods is met. It should be taken into account that the EcoQO only applies to the species in the white columns.

Table 3.1: Six class assessment scheme for TBT- specific biological effects in dogwhelks and other gastropods

Assessment class	*Nucella* VDSI	*Nassarius* VDSI	*Buccinum* PCI	*Neptunea* VDSI	*Littorina* ISI
A	< 0.3	< 0.3[1]	< 0.3[1]	< 0.3	< 0.3[2]
B	0.3 - <2.0			0.3 - <2.0	
C	2.0 - < 4.0	0.3 - <2.0	0.3 - <2.0	2.0 - <4.0[3]	
D	4.0 - 5.0	2.0 – 3.5	2.0 - <4.0		0.3 - < 0.5
E	>5.0[4]	> 3.5[4]	4.0[4]		0.5 - 1.2
F					> 1.2

[1] This species cannot be used to distinguish between class A and class B. The assessment class is therefore by definition B.
[2] This species cannot be used to distinguish between classes A, B and C. The assessment class is therefore by definition C.
[3] This species cannot be used to distinguish between class C and higher classes. If a VSDI of 4.0 is reached, additional observations are required to determine the assessment class e.g. by using another species If a VDSI of 4.0 is observed, the assessment class is by definition F
[4] These species cannot be used to distinguish between classes E and F. Therefore, additional observations are required to determine the assessment class e.g. by using another species. If the VDSI (*Nassarius*) or the PCI (Buccinum) is >3.5, the assessment class is therefore by definition F.

This way any graphical representation immediately allows to asses if the EcoQO is met. Possibly, a distinction in the intensity of the colour could still be made between classes A and B, and E and F. Biological effects monitoring stations for which the times series were not long enough could still be included in the analysis by applying the assessment classes (and therefore colours) above to the value of the last year of monitoring (excluding data that is older than 5 years. In a map these could then represented by a smaller symbol as illustrated in Figure 3.1. This figure illustrates that the predominant assessment classes at the sites for which temporal trend data are available are classes B, C and D, and that the intensity of TBT effects is decreasing at many stations. A weakness in the presentation is that in areas where stations are concentrated, many of the symbols can be obscured. To illustrate the data available for these areas, maps are required on larger scales, as shown in Figure 3.2 for Brittany (France) and for Shetland (Scotland, UK). In these expanded presentations, the high density of stations can be adequately resolved, and both classes and trends illustrated. TBT and its effects are mainly related to shipping and activities associated with shipping. It is therefore suggested that, when available, major ports, shipyard and shipping lanes should be included in the analysis.

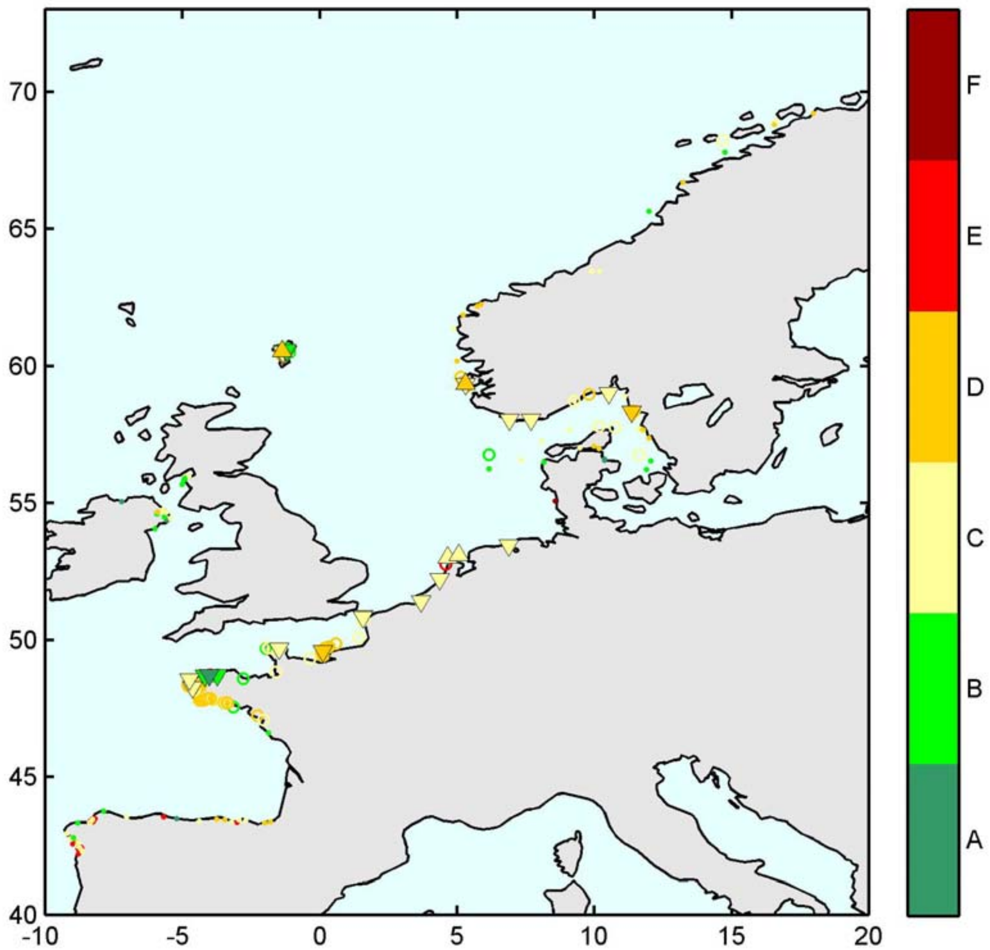

Figure 3.1 Overview of trends in TBT-biological effects. Upward-pointing triangle indicates an increasing trend in effect; downward triangle indicates decreasing trend. Colour coding refers to the assessment classes described in Table 3.2

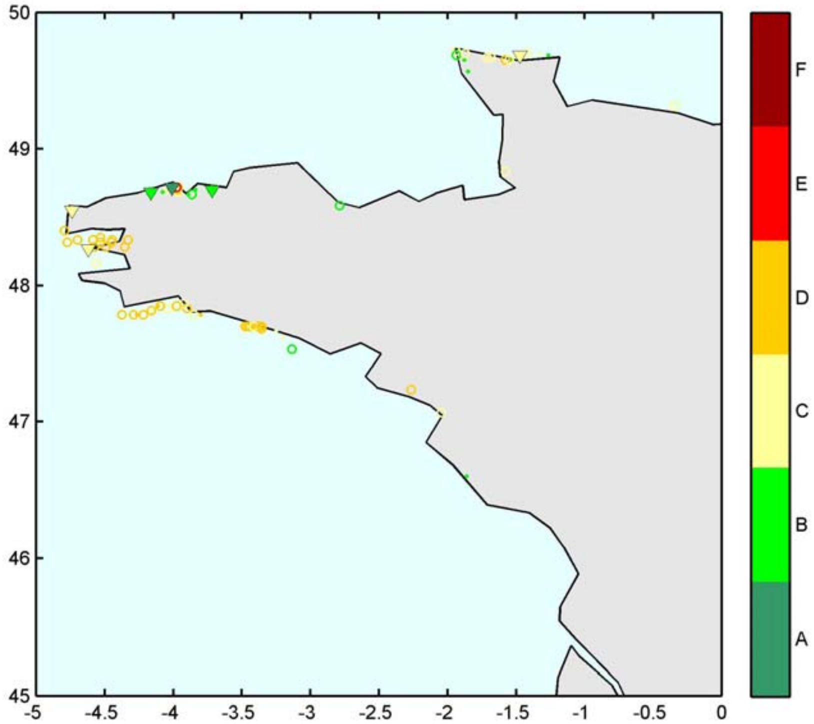

Figure 3.2 - Trends in TBT-biological effects in Brittany (France). Upward-pointing triangle indicates an increasing trend in effect; downward triangle indicates decreasing trend. Colour coding refers to the assessment classes described in Table 3.2

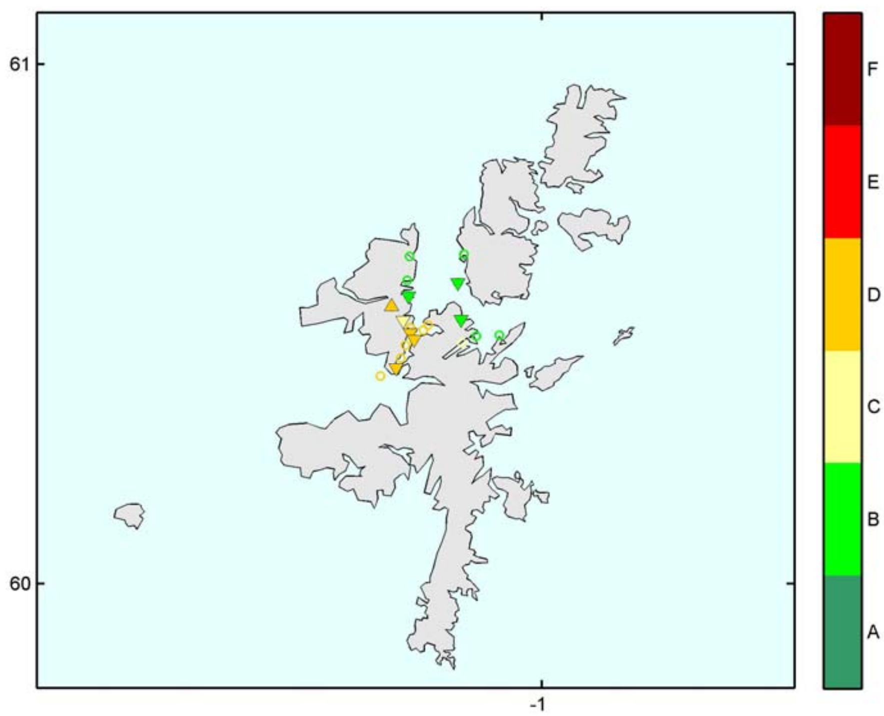

Figure 3.3 - Trends in TBT-biological effects in the Shetland Islands, Scotland, and UK. Upward-pointing triangle indicates an increasing trend in effect; downward triangle indicates decreasing trend. Colour coding refers to the assessment classes described in Table 3.2

For concentrations in sediment of TBT only 1 dataset was available with 5 years of data and this one yielded no significant trend. Concentration data was furthermore only available for Denmark, the Netherlands and the UK, although other countries (e.g. Belgium) have submitted data. Contracting Parties are encouraged to submit additional data on TBT in sediment prior to the 2008 assessment. In the absence of sufficiently long time series, the data should still be evaluated in a similar manner as above. This will be further discussed below.

Based upon the preliminary assessment presented here it can be inferred that a more comprehensive assessment of the OSPAR area would probably show that the entire coastal area is, to different degrees, impacted by TBT and particularly so in the vicinity of major harbours, shipyards and areas with a lot of ship activity (shipping lanes, oil terminals, etc.). Typically for TBT there might be significant local variation (e.g. Shetland Islands) ranging from a good to a bad status within miles because of local conditions such as predominant currents or enclosed water bodies. These should be discussed in the detailed assessment but, perhaps with the exception of a clear cut case, not become part of the overall assessment of the status of the OSPAR area.

Although there is a direct relation between the amount of TBT in the environment and its effects, an appropriate correlation model is not available that would allow a straightforward comparison between TBT levels and their effects in the different organisms. The way forward is to define concentrations that can be linked to the same assessment classes as those defined for the biological effects. This was already done by Gibbs et al. (1988) by linking the effects to the concentration of TBT in water. These results were used as a basis for the deriving the classes for levels in water. In the original table concentrations were expressed as ng Sn/l and converted to ng TBT/l by multiplying by 2.5. The threshold levels in organisms were calculated from those in water by using the bioconcentration factor derived by OSPAR (1998). The values in sediment were based on the experimental results from Strand (2003). The resulting classes and concentration levels can be found in Table 3.2 below. The class separation between classes D and E was based on expert judgement (alternative apply the same ratio as for water and biota) and is also the value for action level 2 for dredged spoil in HELCOM (HELCOM, 2004).

The integrated assessment would consist of assigning the assessment classes in the table below and plotting the classes for both biological effects and chemical monitoring on the same map. As an illustration, this has been done for the dataset from the Netherlands that contains both levels in sediment and ISI indices for *Littorina littorea*. The colour coding conforms to the classes in the table and the striped symbols are the biological effect monitoring stations. Triangular shapes are, as for the other graphs, associated with locations for which a significant trend has been observed. The sediment data would classify the entire region as class C, which seems to be confirmed by the biological effects monitoring with the exception of one station that falls in class E. The latter has no serious impact on the overall classification as local differences in imposex in relation to local sources of TBT are not uncommon for this type of observation, and can lead to localised areas of high imposex development, for example in the immediate vicinity of a harbour. . Although this approach has to be confirmed for other regions in a more elaborate assessment of the CEMP data, provided more data become available, these preliminary results support the suggested approach. Moreover, similar studies of an integrated assessment of TBT levels and effects by Strand (2003) and Strand et al. (2006) support this approach. It also shows that an integrated assessment is a necessity. In the example below, without chemical measurement it would have been impossible to estimate the assessment class of the area as *Littorina* is not sufficiently sensitive to TBT to distinguish between the classes A, B and C. Similar situation may occur at high imposex levels for the other species were it becomes impossible to distinguish between classes D and E (*Neptunea*) or E and F (the others).

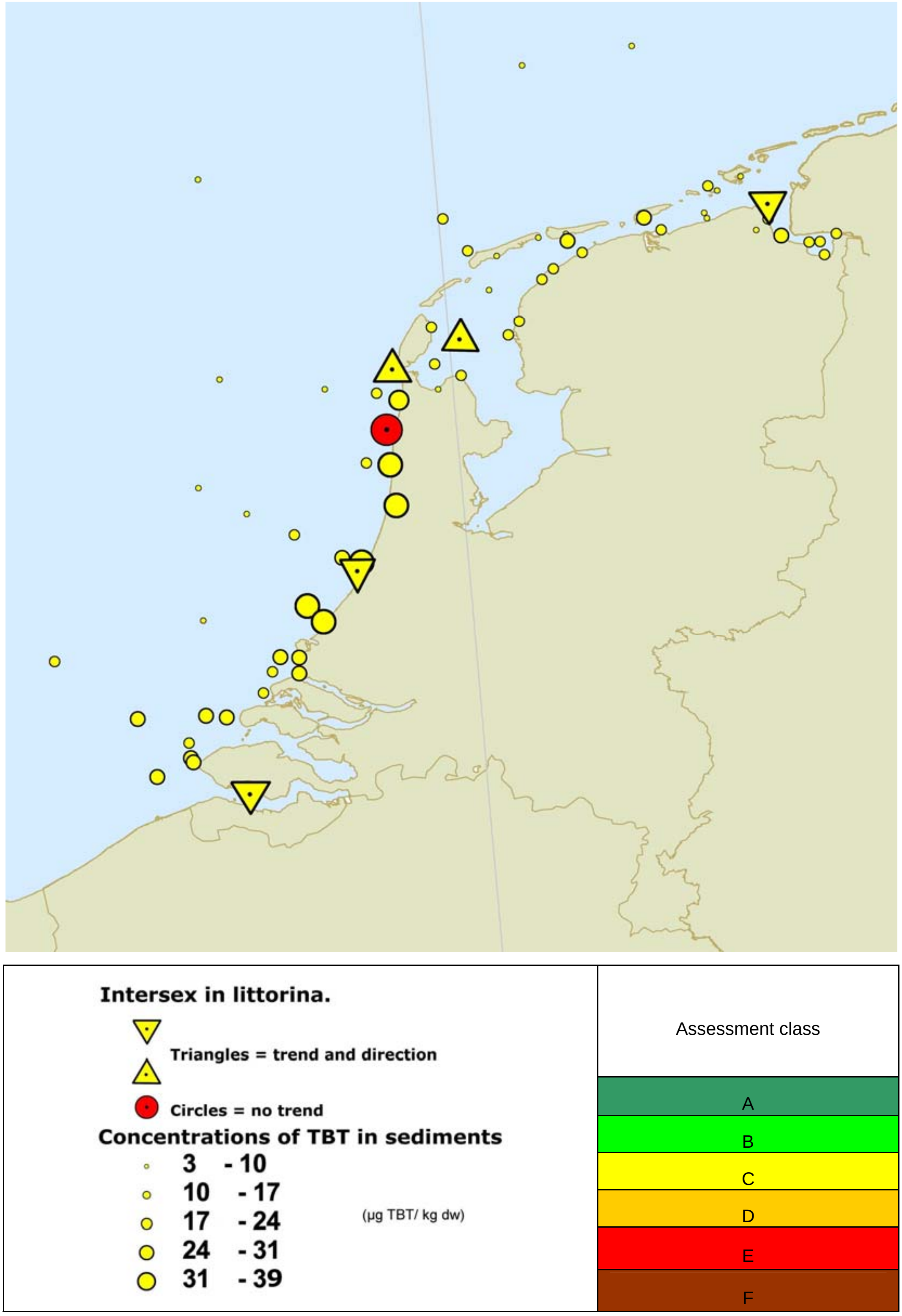

Figure 3.4 Integrated assessment of TBT concentrations in sediment and intersex in *Littorina*. The colour coding conforms to the classes in Table 3.2 and the striped symbols are the biological effect monitoring stations. Triangular shapes are associated with locations for which a significant temporal trend has been observed.

Table 3.2: Integrated assessment classes linking TBT effects in gastropod species with concentrations of TBT in water and sediment, and comparisons with EACs and EQSs in biota and water.

Assessment class	*Nucella*	*Nassarius*	*Buccinum*	*Neptunea*	*Littorina*	*TBT Water*	*TBT mussel*	*TBT sediment*	*EAC water*	*EAC mussel*	*EAC sediment*	*EQS (water)*	
												AA	*MAC*
	VDSI	VDSI	PCI	VDSI	ISI	(ng TBT/l)	(µg TBT /kg dw)	(µg TBT/ kg dw)	(ng TBT/l)	(µg TBT/ kg dw)	(µg TBT/ kg dw)	(ng TBT/l)	(ng TBT/l)
A	< 0.3	< 0.3[1]	< 0.3[1]	< 0.3		<0.025	< 3	n.d.			0.01		
B	0.3 - <2.0			0.3 - <2.0	< 0.3[2]	0.025-0.25	3-30	< 2	0.1	12		0.2	
C	2.0 - < 4.0	0.3 - <2.0	0.3 - <2.0	2.0 - 4.0[3]		0.25-5	30 - <600	2 - <50					1.5
D	4.0 - 5.0	2.0 – 3.5	2.0 - 3.5		0.3 - < 0.5	5-7.5	600 - < 900	50-<200					
E	>5.0[4]	> 3.5[4]	>3.5[4]		0.5 - 1.2	7.5-37.5	900 - 4200	200 -500					
F					> 1.2	>37.5	>4200	>500					

4. Summary and Conclusions

4.1 Summary of the results

This is one of 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. Through these assessment exercises the monitoring data held in the ICES data system on behalf of OSPAR are kept under regular scrutiny. Errors and omissions in the data can be identified and corrected, and data assessment methods can be progressively updated, tested and improved, to ensure that the assessment system is fully prepared for the Quality Status Report in 2010 and provides an up-to-date evidence base for policy making – particularly important at this time as arrangements for QSR2010 are implemented, and the EU Marine Strategy Framework Directive is finalised.

New aspects of the assessment included the development of new styles of data description, simplifying the tabulations of numerical data and its graphical presentation. New styles of data mapping were implemented, and considerable effort was expended during the assessment meeting to discussion and investigation of ways in which data could be integrated across contaminants, stations and regions in preparation for the QSR2010. Integration of biological effects data and contaminant concentrations was achieved for the effects (imposex, intersex) of tributyltin, and its concentrations in sediment, water and biota into a single assessment system based around 6 classes of increasing degree of effect/concentration.

The assessment concentrated on aspects of the CEMP data which would potentially contribute to the QSR 2010. For example, emphasis was given to data on contaminant concentrations in sediment, and thereby balances the 2006-2007 assessment that emphasised contaminants in biota. Temporal trends were sought in data collected within the last ten years (i.e. the period of greatest significance to QSR 2010) whereas previous assessments had covered longer periods.

The assessment concentrated on sediments rather than biota, to take advantage of developments in ICES database procedures and MON data handling and assessment methods that had been updated intersessionally. As in the previous report, the data assessment highlighted the need for revised assessment criteria. Although background concentrations, and background assessment concentrations, had been developed for a range of contaminants, the introduction of new determinants (for example, alkylated PAHs) indicated that additional BCs and BACs would be required for QSR 2010. The assessment also noted the continuing lack of a comprehensive and reliable suite of EACs for priority contaminants in sediment. Intersessional work to fill this gap will be essential if a three-category traffic-light system of assessment of contaminant concentrations is to be implemented.

Temporal trend assessment was undertaken on time series of data containing at least three years of data, with some data reported between 2002 and 2006. Time series with five or more years of data were assessed for temporal trends. Although all data in the time series were used in the statistical analysis, the focus was on changes in concentration in the last ten years (1997-2006), such that the statistical analysis sought linear trend in log concentration in the last ten years (1997-2006), significant at the 5% level. These criteria proved to be too restrictive, and will need to be revised to ensure that the full range of CEMP data is reflected in the QSR 2010.

Information on status was provided through comparison of the fitted concentrations in the final year of time series with Background Assessment Concentrations, and described on a Regional basis. These data were supplemented by samples collected between 2002 and 2006 that did not form part of a time series, to provide greater spatial coverage. Further work is required to improve the integration of these data across contaminants and stations.

The report contains many examples of significant temporal trends in monitoring data, often indicating that concentrations of contaminants or their effects are decreasing. The full interpretation of the underlying reasons for these changes requires detailed knowledge of local environmental circumstances, local contaminant input patterns etc, that are not available to the assessment group. In general, Contracting Parties have also encountered difficulty in ascribing specific causes to the observed trends. It is likely that integration of trends in contaminant concentrations and inputs for the QSR2010 will have to be undertaken at a broad regional scale rather than station by station local explanations.

The assessment group expressed the view that the current assessment exercise had provided a valuable opportunity to test recent developments in assessment methods and data integration opportunities. The exercise had highlighted aspects of the data selection, assessment and presentation processes that require improvement prior to QSR 2010.

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