OSPAR COMMISSION

CEMP 2011 assessment report

Monitoring and Assessment Series

2012

OSPAR Convention

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. The Contracting Parties are: Belgium, Denmark, the European Union, Finland, France, Germany, Iceland, Ireland, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Convention OSPAR

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. Les parties contractantes sont : l'Allemagne, la Belgique, le Danemark, l'Espagne, 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, la Suisse et l'Union européenne.

Acknowledgement

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Executive Summary

Concentrations of cadmium, mercury and lead in fish, shellfish and sediments have generally fallen since 1990, particularly in Region II, where downward trends are clear at both polluted and less polluted sites. As much of the reduction in inputs of metals occurred before 2000, changes in environmental concentrations have been relatively small since 1998 as concentrations approach, but do not reach background levels in large parts of the OSPAR area.

Metals in biota – The picture for mercury and cadmium is more mixed with concentrations in fish and shellfish having fallen in some locations but risen in others (particularly cadmium at Dogger Bank and estuarine sites in the UK and both mercury and cadmium along the continental Channel/southern North Sea coastline). Concentrations of cadmium, lead and mercury are generally at background level but only occasionally exceed EU food standards. Cadmium trends are upwards for a number of hotspots in Region II. Temporal trends in mercury concentrations are both upward and downward.

Metals in sediments – Concentrations of cadmium are in general near background level. Concentrations above the upper assessment criterion (ERL) are mainly confined to coastal areas in Region II, in particular around estuaries of large rivers. High concentrations of mercury and lead occur above the upper assessment criterion in Regions II and III indicating the possibility of adverse biological effects. Temporal trends in mercury and lead concentrations are predominantly downward.

Organic contaminants in biota – Concentrations of PAHs are above EAC, in particular around estuaries and in heavily populated and/or industrial areas. The failure to achieve background concentrations of PAHs in mussels is evidence of continuing widespread contamination, possibly mediated through atmospheric transport. Concentrations of *p,p*'DDE are found over all Northern Europe; this may be the result of using background assessment concentrations as assessment criterion. The ban on the use of *gamma*-HCH has resulted in a general reduction in concentrations across the OSPAR Convention Area. All trends are downward for *gamma*-HCH.

Organic contaminants in sediments - Concentrations of PCBs are widespread and are on the whole above EAC at coastal stations. Concentrations of PAHs are above EAC in particular around estuaries and in heavily populated and/or industrial areas. Trends in PCBs and PAHs are for the most part downward.

Récapitulatif

Dans l'ensemble, les teneurs en cadmium, en mercure et en plomb dans le poisson, les mollusques et crustacés et les sédiments ont baissé depuis 1990, en particulier dans la Région II, où l'on relève des tendances à la baisse claires aussi bien dans les sites pollués que dans ceux qui sont moins pollués. Les apports de métaux ont diminué principalement avant 2000, les modifications des teneurs dans le milieu marin ont donc été relativement faibles depuis 1998 car les teneurs s'approchent des teneurs ambiantes, sans toutefois les égaler, dans de grandes parties de la zone OSPAR.

Métaux dans le milieu vivant – La situation est moins claire dans le cas du mercure et du cadmium, les teneurs dans le poisson et les mollusques et crustacés ayant baissé dans certains sites mais augmenté dans d'autres (il s'agit en particulier du cadmium dans les sites de Dogger Bank et estuariens du Royaume-Uni ainsi que du mercure et du cadmium le long des côtes de la manche continentale / de la mer du Nord méridionale). Les teneurs en cadmium, en mercure et en plomb sont en général égales aux teneurs ambiantes mais elles dépassent, occasionnellement seulement, les normes alimentaires de l'UE. Les tendances pour le cadmium sont à la hausse dans un certain nombre de points chauds de la Région II. Les tendances temporelles des teneurs en mercure sont aussi bien à la hausse qu'à la baisse.

Métaux dans les sédiments – Les teneurs en cadmium sont en général proches des teneurs ambiantes. Les teneurs dépassant le critère supérieur d'évaluation (ERL) ont été relevées principalement dans les zones côtières de la Région II, en particulier à proximité des estuaires des grands fleuves. On relève de hautes teneurs en mercure et en plomb, dépassant le critère supérieur d'évaluation, dans les Régions II et III, ce qui indique la possibilité d'effets biologiques préjudiciables. Les tendances des teneurs en mercure et en plomb sont essentiellement à la baisse.

Contaminants organiques dans le milieu vivant – Les teneurs en HAP sont supérieures aux EAC, en particulier à proximité des estuaires et dans les zones très peuplées et/ou industrielles. Le fait que l'on ne soit pas parvenu à égaler les teneurs ambiantes en HAP dans la moule prouve une contamination persistante généralisée, éventuellement facilitée par le transport atmosphérique. Les teneurs en p,p'DDE se trouvent dans l'ensemble de l'Europe septentrionale; ceci pourrait être dû au fait que l'on utilise les teneurs d'évaluation ambiantes comme critère d'évaluation. L'interdiction d'utiliser le gamma-HCH a entraîné une réduction générale des teneurs dans l'ensemble de la zone de la Convention OSPAR. Toutes les tendances sont à la baisse pour le gamma-HCH.

Contaminants organiques dans les sédiments – Les teneurs en PCB sont généralisées et sont dans l'ensemble supérieures aux EAC dans les stations côtières. Les teneurs en HAP sont supérieures aux EAC, en particulier à proximité des estuaires et dans les zones très peuplées et/ou industrielles. Les tendances des PCB et des HAP sont pour la plupart à la baisse.

1. Introduction

The 2011 assessment of data collected under the OSPAR Coordinated Environmental Monitoring Programme (CEMP) was prepared by the OSPAR Working Group on Monitoring and Trends and Effects of Substances in the Marine Environment (MIME) at, and following, its meeting in December 2011 and is based upon data reported by Contracting Parties to ICES and held in the ICES Environmental databases.

The CEMP is the monitoring under the OSPAR Joint Assessment and Monitoring Programme where the national contributions overlap and are coordinated 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. Monitoring under the CEMP aims to indicate the extent of contamination of fish, shellfish and sediments with hazardous substances and the intensity of their biological effects. The purpose is to support OSPAR assessments of the effectiveness of measures to reduce releases of hazardous substances to the environment. CEMP monitoring is suitable to track contaminants which accumulate through the food chain in marine organisms but cannot easily be detected in seawater. Therefore, CEMP assessment results may lead to different conclusions about the chemical quality status than water based monitoring under the Water Framework Directive, despite that the scientific basis for deriving CEMP environmental assessment criteria and WFD environmental quality standards is the same.

The assessment evaluates the status and trend of concentrations of hazardous substances in the marine environment for selected hazardous substances which have been prioritised for action by OSPAR due to their risk for the marine environment and which are being monitored under the Coordinated Environmental Monitoring Programme (CEMP). It builds on experience gained in the first comprehensive trend assessment of CEMP data in 2005 (OSPAR, 2005), and the annual CEMP assessments undertaken in the period 2006 – 2009 (OSPAR, 2006; OSPAR, 2007; OSPAR, 2008a; OSPAR, 2009a), which contributed to the OSPAR Quality Status Report 2010 (OSPAR, 2010) accessible at http://qsr2010.ospar.org.

The purpose of annual assessments is to provide updated information on the quality of the marine environment in relation to the hazardous substances monitoring under the CEMP for selected groups of substances or biological effects. These assessments also provide a framework for continuing improvements to methods and procedures. In the web-assessment tool, other substances than the ones described in this report are included, and can be used to get an overview of the current status. Assessment criteria used for each parameter available are indicated in appendix 1.

1.1 Web-based presentation of CEMP assessment results

In 2010-11, MIME developed a web-based application for presentation of CEMP assessment results which relates to the ICES database and allows rapid update and near-automated assessment outputs following the inclusion of CEMP data submissions in the ICES database. While the web-based tool continues to be expanded, as assessment criteria are developed for contaminants, and its functionalities improved, the main features, required by the OSPAR Commission for going live, are now in place and have been validated.

For the first time, all CEMP assessment results, together with supporting tables, plots, help files, methodological information are available at http://dome.ices.dk/osparmime/main.html.

The purpose of this summary report is a reference to the web-based CEMP assessment products and to provide interpretation of, and context for, the assessment products. The report is intended to be updated each year.

1.2 Contaminants and matrices covered

The contaminants covered by the CEMP are metals (cadmium (Cd), mercury (Hg), lead (Pb), nickel, copper, zinc, chromium, arsenic), and the organic contaminants PCBs (congeners 28, 52, 101, 118, 138, 153, 180) and PAHs (fluoranthene, benzo[a]pyrene, benzo[ghi]perylene, anthracene and phenanthrene). This summary report highlights the findings for cadmium, mercury and lead, which are the metals selected by the

OSPAR Commission for priority action, and for PCBs and PAHs as a group. The other metals covered are either micronutrients (zinc and copper) or have other biological functions (arsenosugars, chromium, nickel).

The assessment covers the concentrations of a selection of hazardous substances from the CEMP in marine sediment, fish tissue (muscle and liver) and shellfish tissues.

1.3 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 which have been used in previous CEMP assessments and are described in the CEMP Assessment Manual (OSPAR, 2008b).

The assessment criteria used to assess environmental concentrations of hazardous substances are set out in OSPAR agreement on CEMP Assessment Criteria for the QSR 2010 (OSPAR agreement 2009-2). The derivation of these assessment criteria for hazardous substances is discussed in a Background Document on CEMP Assessment Criteria for the QSR 2010 (OSPAR, 2009b). The assessment criteria reflect a two stage process in which data are compared to concentrations that are unlikely to give rise to unacceptable biological effects (c.f. Environmental Assessment Criteria, EACs) and then against Background Concentrations (BCs) or zero, expressed as Background Assessment Concentrations (BACs). The latter reflects the objective of the OSPAR Hazardous Substances Strategy that concentrations should be at or close to background levels for naturally occurring substances or to zero for man-made substances.

An overview of the assessment criteria is at Appendix 1.

Further information is available at http://dome.ices.dk/osparmime/main.html.

1.4 Overview of submission data

The data submissions by Contracting Parties are assessed from the ICES website (http://www.ices.dk/datacentre/accessions/CommissionSummary.aspx?commission=OSPAR). The status of each submission is xC for x submissions, C for Complete, PO for Pending response from originator, PI for Pending work by ICES. The parameters reported within the 2005-2010 period are listed (only parameter groups assessed in MIME during the last years, others may occur). Data for each parameter are not necessarily reported every year for each station.

Imposex and other Biological Effects in Biota Data

Country	2005	2006	2007	2008	2009	2010	Parameters #
Denmark	1PO	1C	1PO		1PO		IMP
France	1C	1C	1C	1C	1C	1C	IMP (Erod)
Germany	1PO 1C	1C	1C		1C		GRS, PAH
Netherlands	2C	2C	2C	2C	3C	2C	IMP, GRS
Norway	1PO	1PO	1PO	1C	1PO	1C	IMP, ALAD, EROD, PAH
Spain	1C	1C	1C	1C		2C	IMP, Erod, TOX
Sweden	1C	1C	1C	1C	1C	1C	IMP
United Kingdom	1C	1C	1C	1C	1C	1C	IMP, GRS, Erod, PAH, TOX
Portugal				x	x		IMP

IMP: Imposex/intersex; GRS: Fish diseases; PAH: PAH metabolites.

Contaminants in Biota Data

Country	2005	2006	2007	2008	2009	2010	Parameters
Belgium	1C	1C	1C	1C	1C	1C	Metal, TBT, PAH, PCB, PBDE
Denmark	1C	1C	1C	1C	1C	1C	Metal, TBT, PAH, PCB, PBDE, Dioxin
Faroe Islands	1C						Metal, TBT, PAH, PCB, PBDE
France	1C	1C	1C				Metal, PAH, PCB
Germany	2PO 1C	1C	1C	1C	2C	2C	Metal, TBT, PAH, PCB, PBDE
Iceland	1C	1C	1C	1C	1C	1C	Metal, PCB
Ireland	1C	1C	1C	1C	1C		Metal, PAH, PCB, PBDE, Dioxin, PFOS
Netherlands	1C	1C	1C	1C	1C	1C	Metal, PTB, PAH, PCB, PBDE
Norway	1PO	1PO	1PO	1C	1PO	1C	Metal, PAH, TBT, PCB, PBDE, Dioxin, PFOS
Portugal				1C	1C	1C	Metal, PAH, PCB, Dioxin
Spain	1C	1C	1C	1C	1C	1C	Metal, TBT, PAH, PCB, PBDE
Sweden	1C	1C	1C	1C	1C	1C	Metal, TBT, PAH, PCB, PBDE
United Kingdom	1C	1C	1C	1C	1C	1C	Metal, TBT, PAH, PCB, PBDE

Contaminants in Sediment Data

Country	2005	2006	2007	2008	2009	2010	Parameters
Belgium	1C	1C	1C	1C		1C	Metals, TBT, PAH, PCB, PBDE
Denmark			1C	1C	1C	1C	Metals, TBT, PAH, PCB, PBDE, dioxin
Germany	1C	2C	1C	2C	2C	2PO	Metals, TBT, PAH, PCB, PBDE
Ireland	1C	1C	1C				Metal, PCB, TBT, PAH
Netherlands	1C	1C	1C	1C	1C	1C	Metal, PCB, TBT, PAH, PBDE
Norway		1C		1C			Metal, PCB, TBT, PAH, BDE, PFOS
Spain	1C	1C	1C	1C	1C	1C	Metal, TBT, PCB, PBDE, PAH
United Kingdom	1C	1C	1C	1C	1C	1C	Metal, PCB, TBT, PAH, PBDE

France has submitted Metals, PAH and PCB in 2003 sediments as the latest.

For information the submission of seawater data is illustrated below (no mandatory monitoring and not included in the CEMP assessment). The seawater parameters submitted are nutrients and related measurements, such as Chlorophyll a. Not all parameters are monitored and reported every year.

Contaminants in Seawater Data

Country	2005	2006	2007	2008	2009	2010	Parameters
Belgium	1C	1C	1C	1PI	1C	1C	Metals, TBT, PBDE, PAH
France	1PO	1C					
Germany	2PO 2C	1C	1PI 1C	1PI 1C	2C	1PO 1C	PCB, PAH, Triazines
Ireland	1C	1C	1C				
Netherlands	1C	1C	1C	1C	1C	1C	Metal
Spain		1C				1C	
United Kingdom	1C	1C	1C	1PI	1PI	1C	Metal, TBT, PCB, Triazines

2. Status and trends of heavy metals

The results of the assessment of status and trends of concentrations of heavy metals cadmium, mercury and lead in sediments and biota are summarised in this section. In addition to the illustrations given in this report, the full range of assessment maps (including the possibility to zoom in on smaller areas) and supporting data and information is available at:

http://dome.ices.dk/osparmime/main.html.

The results of the assessment for the heavy metals cadmium, mercury and lead in sediments and biota are presented in Sections 2.2 – 2.4. In each section a map illustrates temporal trends (and geographic distribution) in the concentrations of heavy metals in sediment and biota. Significant trends[1] detected within the period 2001-2010 are shown as upward or downward pointing triangles. The colouring indicates in the last year of monitoring according to the classification set out in the appended table on Assessment criteria. Circles indicated locations where the data available was for too few years to allow trend assessment. The summary statistics of the samples analysed for time trends are given in table 2.1, indicating both the total number of stations and the number of stations with more than 3 years of data (i.e. where time trends can be analysed). In general, around 20% of the stations exhibit a detectable time trend, with approximately half of the stations monitored for more than 10 years. For sediments, the number of time series is much smaller and the % of stations exhibiting time trends is around 10%, as would be expected from the fact that sediments are indicating typically the last 2-5 years of deposition in the upper sediment layer, depending on the accumulation rate at each station.

Table 2.1 Summary of time-trend stations for metals in biota and sediment (time-trend is calculated for >3 years samples, non-linear after >6 years of sampling)

	Biota	**Biota**	**Biota**	**Sediment**	**Sediment**	**Sediment**
Metal	**Hg**	**Cd**	**Pb**	**Hg**	**Cd**	**Pb**
Stations assessed	439	432	428	341	344	347
Stations >3 years samples	300	303	277	182	184	216
# Time trends >6 years	197	212	183	50	34	64
Downward trends	10%	10%	11%	11.5%	6.5%	5.5%
Upward trends	5%	8%	4%	0.5%	2%	2%
% with time trends	*15%*	*18%*	*15%*	*12%*	*8.5%*	*7.5%*

2.1 Metals general trends

2.1.1 Biota

Time trends for Pb is downward in most cases, probably due to the end of leaded fuels, the single main source for lead in the atmosphere until the late 1990ies. For Hg, the smallest number of timetrends are observed, and a larger number of these (around 1/3) is upward trends. Finally for Cd, only a bit more than 50% are downward, and upward trends are mainly observed in the Channel and southern North Sea, together with mixed signals from the Irish Sea.

2.1.2 Sediments

The general trend for metals in sediments is downward, but for the Channel, trends for Pb are upward in both east and west, and also upward for Cd in the east and Hg in the western Channel.

[1] Trends are counted as significant if the linear trend of the last 5 years (or longer) is significant at the 5% level.

2.2 Cadmium

General information see Appendix 2.

Concentrations of cadmium in the marine sediments are generally near background on the Norwegian Coast, parts of the northern UK and central offshore areas of the North Sea and northern coast of Spain. Concentrations above the upper assessment criterion (ERL) are mainly confined to areas in the coast of the Netherlands and Belgium, and some larger rivers of the UK. These and other scattered locations indicate that the elevated concentrations are mainly located around the estuaries of large rivers. Concentrations in sediment elsewhere, such as the UK coast, the coasts of the Netherlands and Germany, and the coast of Spain, are above background. Where significant temporal trends were found, they tend to be downwards, except two UK sites on the channel coast and two Belgian hotspots.

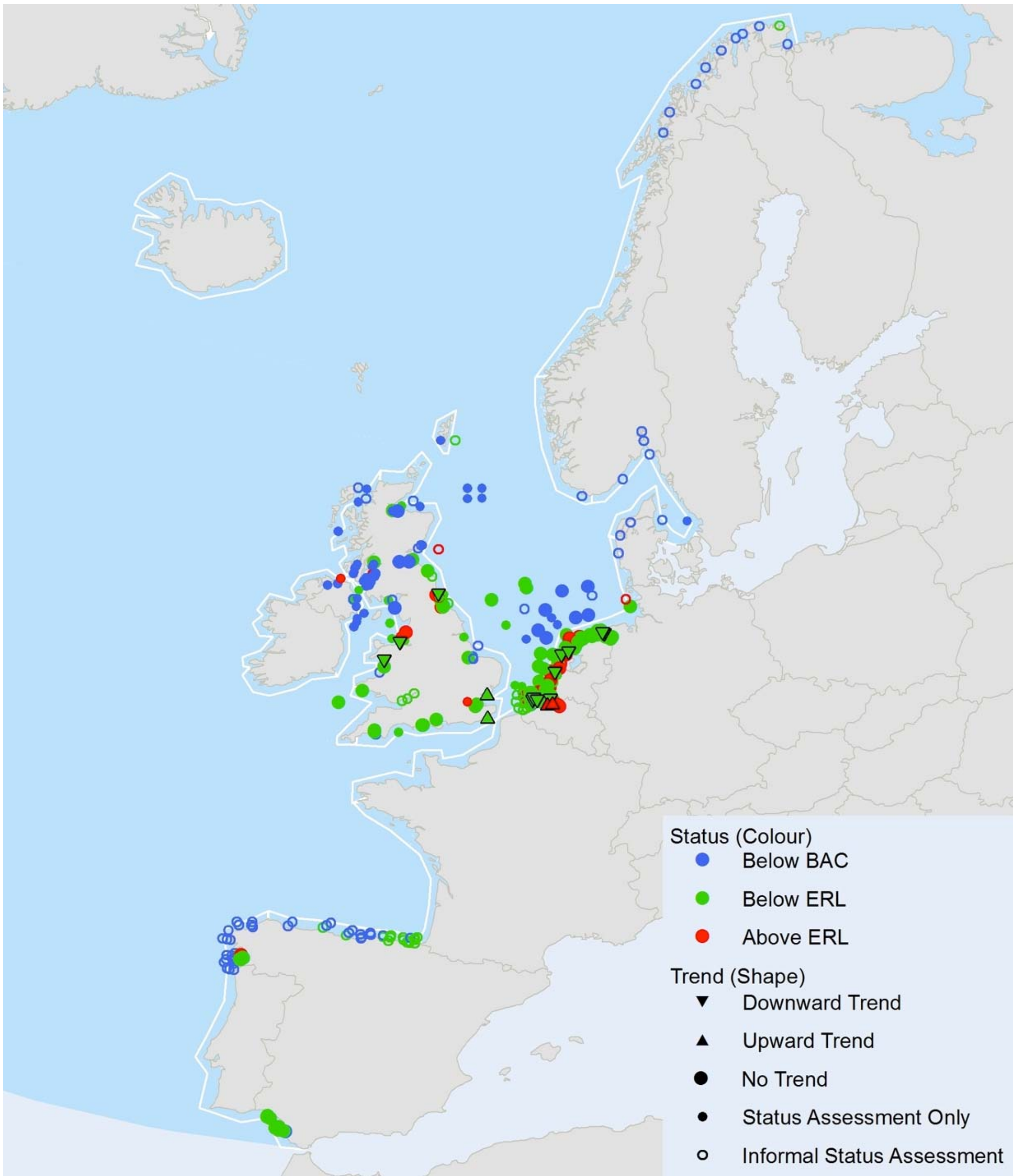

Figure 2.1: Trends of cadmium in sediments. Significant trends detected within the period 2001 – 2010 are shown. Shading indicates status in last year of monitoring. Open circles indicate where insufficient data are available to assess trends.

Cadmium concentrations in fish and shellfish are only occasionally above the upper assessment criterion (EU food standards). Relative few high concentrations can be found at occasional locations in the UK, France and Norway. Concentrations in biota and sediment in north-west Spain may be influenced by the transport of cadmium to surface coastal waters through localized upwelling of deep oceanic waters. Concentrations in fish and shellfish are at or below background at a good proportion of sites in northern Spain, the Bay of Biscay, the Channel coast of France and parts of Ireland and Scotland. Elsewhere, concentrations are above background. Temporal trends in concentrations are found and it seems like upward trends are mainly in the Channel and up to the central North Sea, whereas the Irish Sea has a mixture of up- and downward trend stations. Monitoring data from OSPAR region V are scarce.

The four hotspots identified on the French Atlantic coast are situated in the Gironde estuary, which has been recognised for a long time as polluted by cadmium (Boisson 2003; Bouvier *et al*., 2000, Michel *et al*., 2000, Stradya 2011). The pollution point source has been tracked and identified as a zinc sulphide ore treatment plant 450 km upstream. Remedial measures have been taken, and the outfall dramatically decreased.
Upward trends are found in the Irish Sea at Sutton (Dublin Bay) and on the Atlantic coast at Tralee Bay. The mean last year are close to background concentrations in both cases, and as such not cause for immediate alarm. The development should however be followed and possible causes investigated further.

Around the UK hotspots are found mainly in the north, and 10 upward trends were found in biota on both sides of Scotland, at Morey Firth (Inverness), the North sea coast Tyne (Newcastle on Tyne) and open sea and in the Eastern Irish Sea. Also one station on Shetland Islands showed increasing Cd concentrations. One hotspot is also observed in the central North Sea together with 3 upward time-trends at Dogger Bank.

In Norway, 3 upward trends were found at Skogerøy (Northern Norway), Akershuskaia in Oslo (mussels) and Oslo City (fish), but none of these are above the current assessment criteria. The only hotspots, with downward trend, at Kvalness (Hardangerfjord) are due to previous pollution by smelters. The general trend in Hardangerfjord is downward at 5 stations.

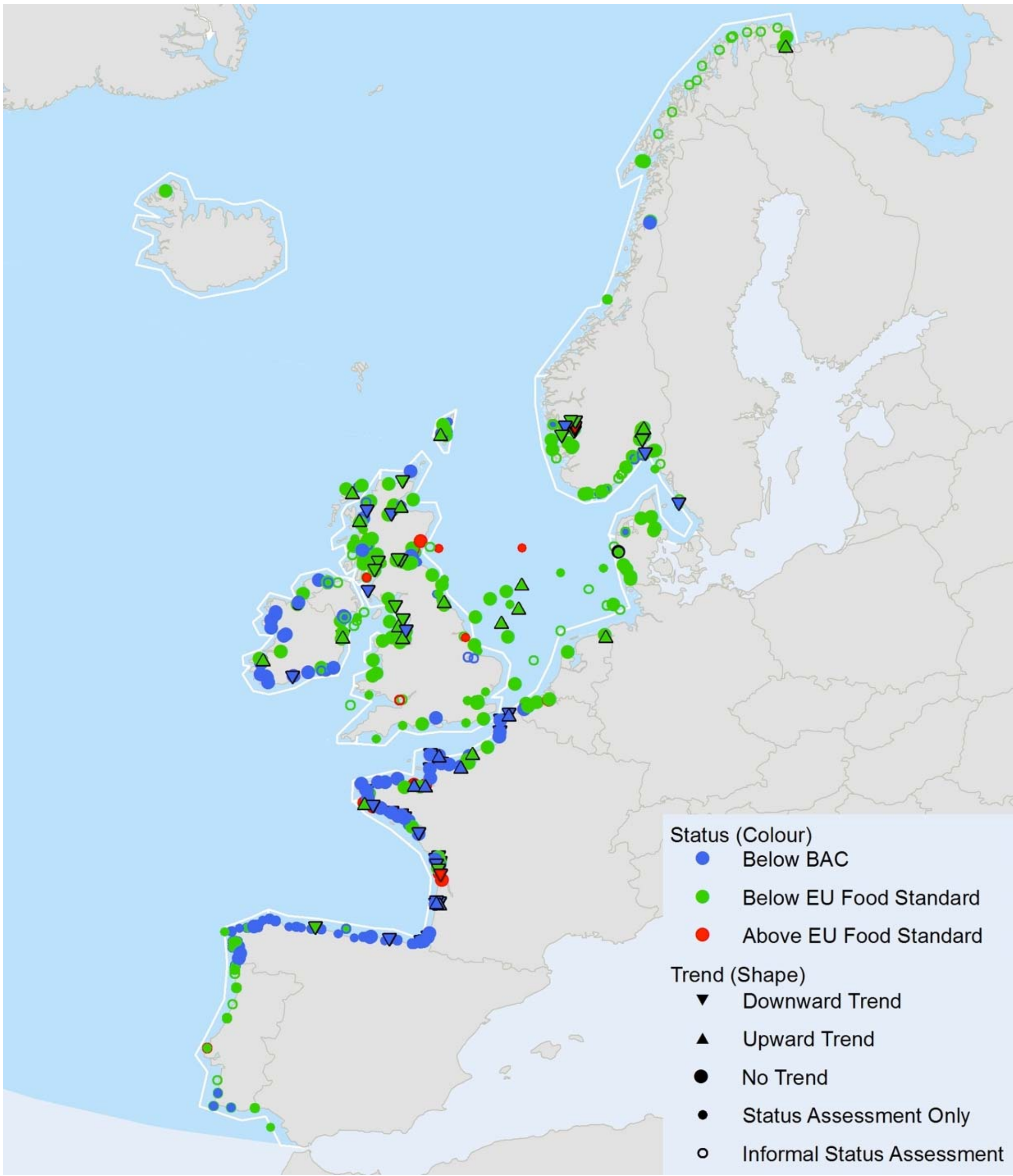

Figure 2.2: Trends of cadmium in biota. Significant trends detected within the period 2001-2010 are shown. Shading indicates status in last year of monitoring. Circles indicate where insufficient data are available to assess trends.

2.3 Mercury

General information see Appendix 3.

Concentrations of mercury in the marine sediments in the southern Bight of the North Sea, and in most of the UK are generally above the upper assessment criterion (ERL) for mercury in sediment, implying some potential for adverse biological effects. High concentrations are also found in parts of the south coast of Norway (Oslofjord), at the coast of Belgium and the Netherlands, and in Spain. Concentrations around the open North Sea are at background or below ERL and decreasing. Background concentrations also occur in parts of northern Scotland and in northern Norway. Almost all temporal trends in mercury concentrations in sediments are downwards, only exception is an upward trend at one station at the river Tamar (Plymouth).

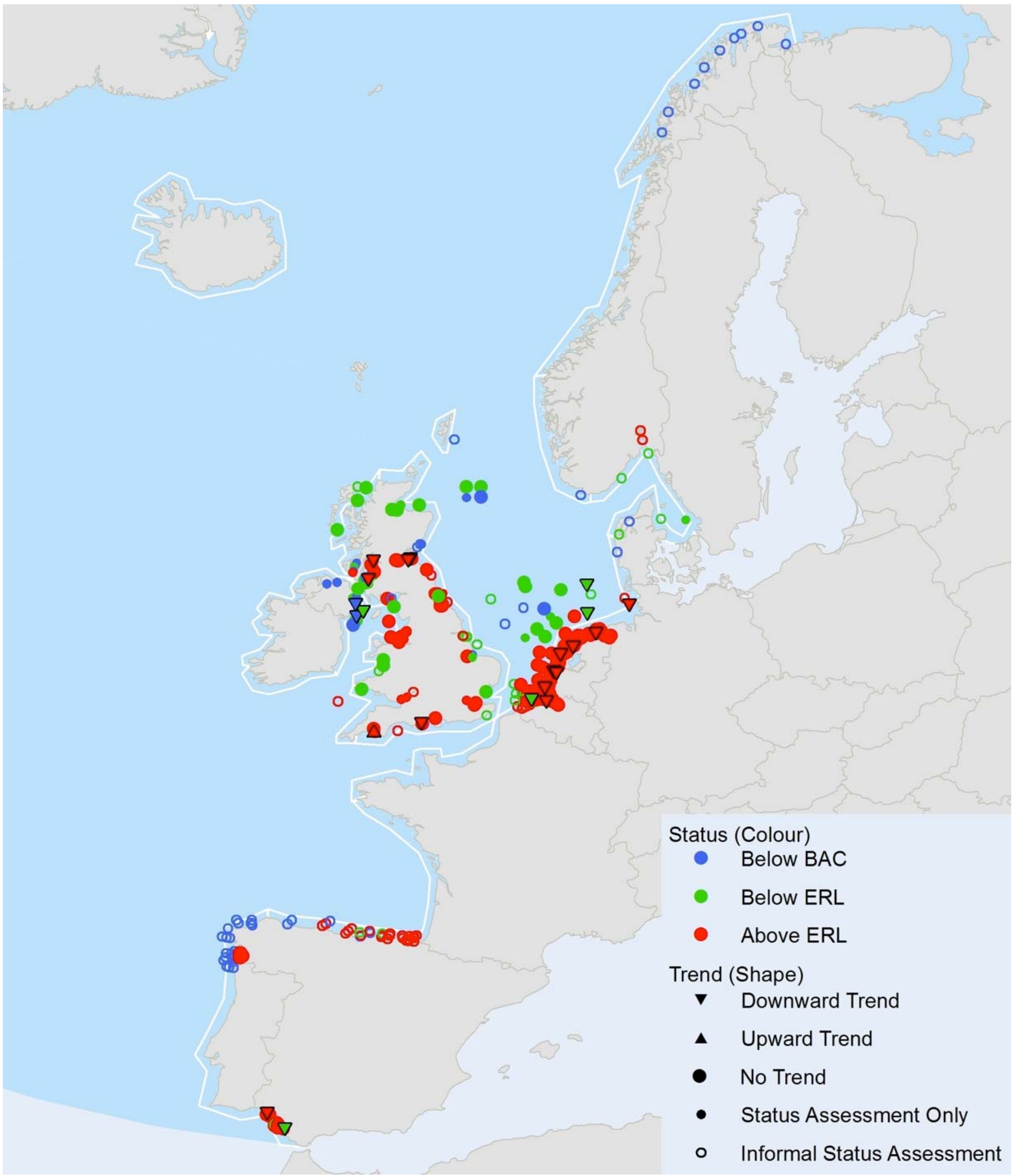

Figure 2.3: Trends of mercury in sediments. Significant trends detected within the period 2001-2010 are shown. Shading indicates status in last year of monitoring. Circles indicate where insufficient data are available to assess trends.

Mercury concentrations in fish and shellfish are at background at a large proportion of stations on the Channel coast of France, and at some of the French and Spanish coasts of the Bay of Biscay. Background concentrations are also found at some stations in Ireland, Scotland, and northern Norway. Concentrations above the upper assessment criterion (EU food standards) occur at a few stations at the outlet of the Thames in southern UK and Moray Firth (Inverness) in North West Scotland. In some of these cases (*e.g.* around Iceland), the high concentrations may be a consequence of geological conditions. Both upward and downward temporal trends occur, with a grouping of generally upward trends in southern Norway.

Background concentrations of mercury in sediment, fish and shellfish are measured at coastal locations in Regions I, III and IV, but rarely in Region II.

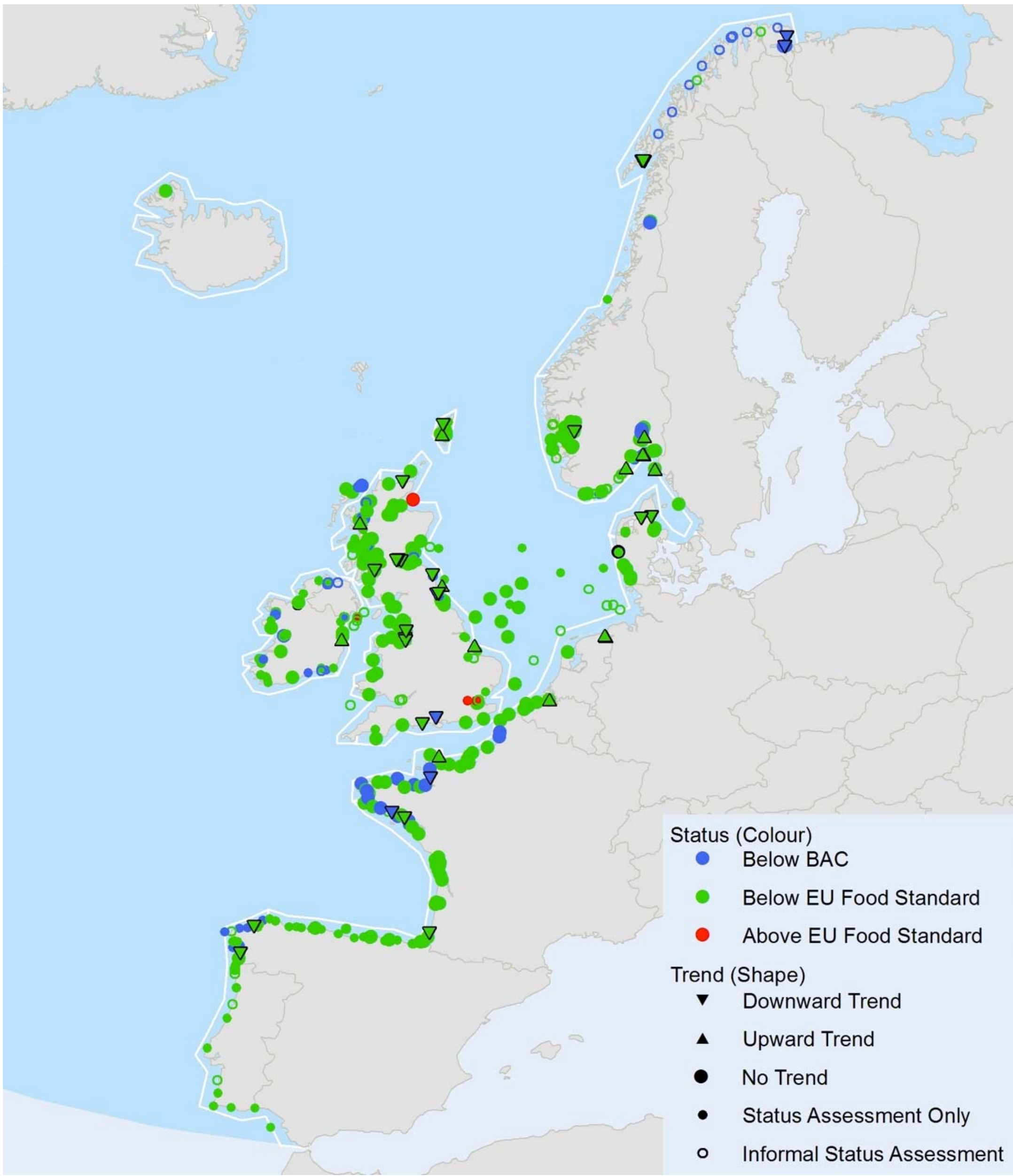

Figure 2.4: Trends of mercury in biota. Significant trends detected within the period 2001 – 2010 are shown. Shading indicates status in last year of monitoring. Circles indicate where insufficient data are available to assess trends.

Irish biota were generally low in Hg concentrations (blue/green), but with one upward trend in Dublin Bay at Seapoint (for *Mytilus*), At this point, concentration is lower than the average Hg concentration around Ireland, and as such not a cause for alarm, considering it also is a long way from the upper assessment criteria.

In southern Norway Hg upward time trends were detected at Trollfjorden (Oslo), and out in the northern Skagerrak (Færder, Solbergstrand and Risøy). The high Hg concentrations in upper Oslo Fjorden could be a source of Hg for the biota in the area.

Only one station in Sweden was increasing at Väderöarna, but this increase in mussel is not seen for fish and is most likely an artefact from a high concentration measured in 2005.

Stations at the coast outside the Netherlands and Belgium showed some increasing trends at BOCHTVWTM (for both Hg and Cd), MIDDGPWPMLPT, PAAPGTGRDPT and BCP.

Some UK stations close to the stations with increasing Cd were also showing upward time-trends for Hg, Amble (Newcastle on Tyne), outer Humber (Grimsby) and one of four stations on Shetland Islands.

2.4 Lead

General information see Appendix 4.

Concentrations of lead in the marine sediments in the southern bight of the North Sea, and in the southern parts of the UK are generally above the upper assessment criterion (ERL) for lead in sediment, implying some potential for adverse biological effects in these areas. Scattered high concentrations are also found along the coast of Norway, and Spain. However, concentrations in the northern UK, northern Norway and northern Spain are generally below the upper assessment criterion, and in some cases are at background. Temporal trends in lead concentrations are not common but where they occur, are generally downward, indicating a tendency for environmental status to improve.

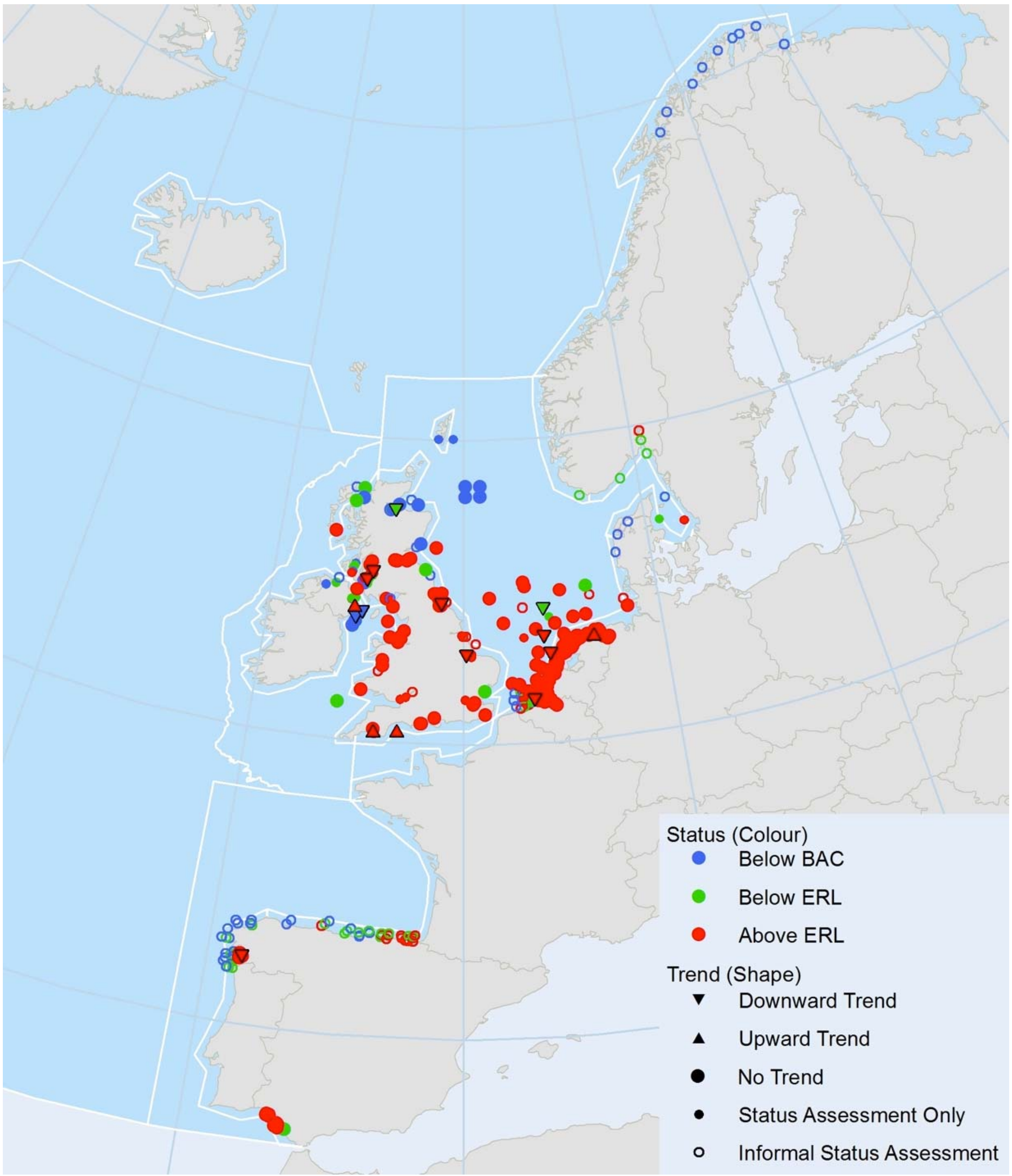

Figure 2.5: Trends of lead in sediments. Significant trends detected within the period 2001 – 2010 are shown. Shading indicates status in last year of monitoring. Circles indicate where insufficient data are available to assess trends.

Lead concentrations in fish and shellfish are at background at a significant proportion of stations on the north-west coast of Norway, the west of Ireland, and some stations in Iceland, northern Spain and the Channel coast of France. Elsewhere concentrations are higher and exceed the upper assessment criterion

(EU food standard) at a small number of stations in Denmark, the UK, Ireland and in northern Spain. Surprisingly, concentrations are similarly elevated at two stations in an offshore area around the Dogger Bank. Where they are found, temporal trends in lead concentrations in fish and shellfish are almost invariably downwards, particularly along the coasts of the Channel and in the Bay of Biscay.

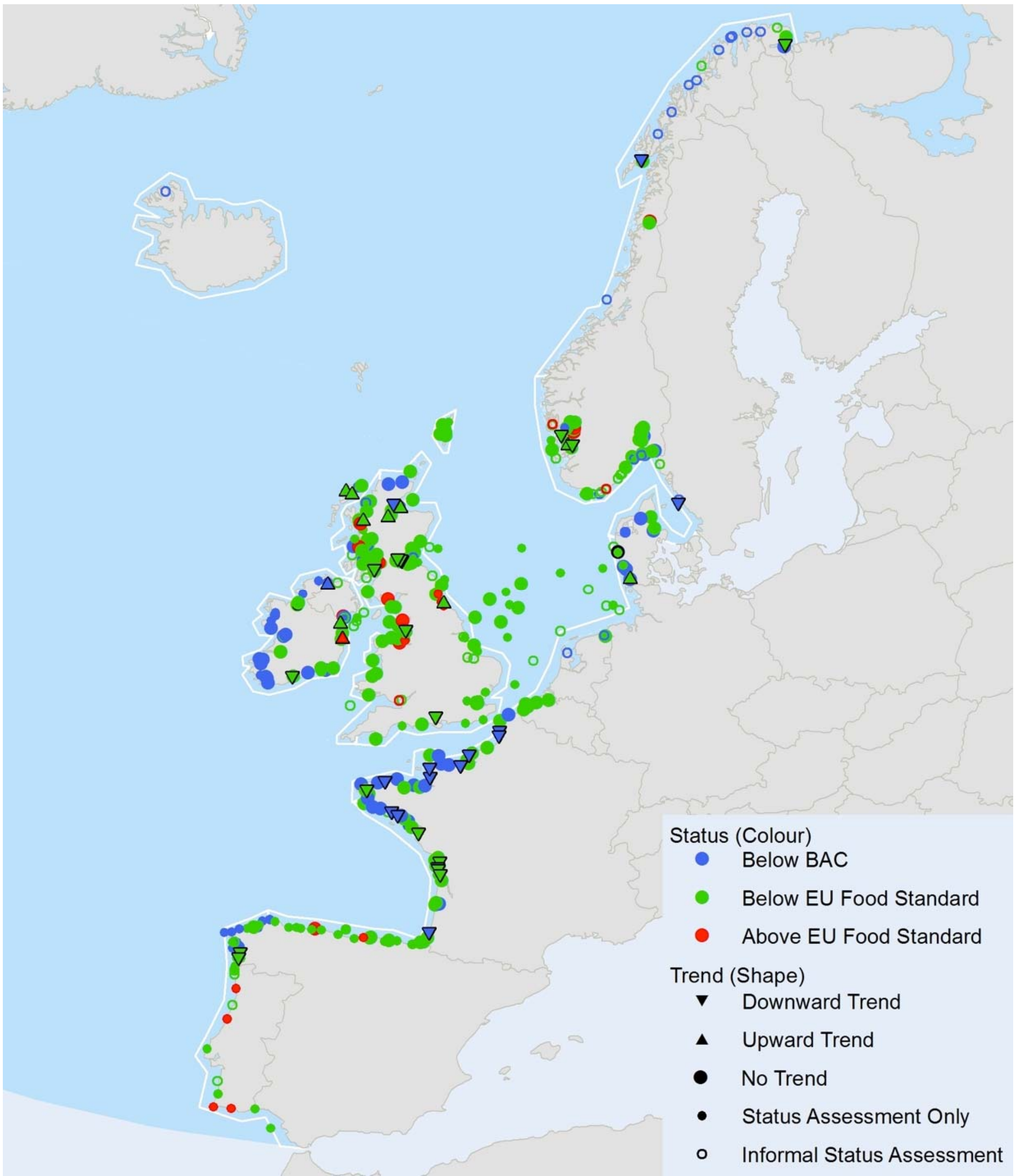

Figure 2.6: Trends of lead in biota. Significant trends detected within the period 2001 – 2010 are shown. Shading indicates status in last year of monitoring. Circles indicate where insufficient data are available to assess trends.

In the Danish station Juvre Dyb, the trend is increasing, but the rate of change has decreased and is flattening out. (But also Cd, Hg and Cu indicating a maximum level might be reached, with almost no development in concentrations from 2005 onward.) Main source of contaminants are considered to be German rivers Elbe and Weser, and some local sources from the Danish city of Ribe.

Upward trends for Pb is found in *Mytilus* at Annagasan, Quigley's point and Sutton, in the last case just above the upper assessment criteria. One significant downward trend in lead is evident at Ringaskiddy station, in Cork Harbour, Ireland. This is a site of known historic contamination from Haulbowline Island steel plant.

Upward trends are found at some of the same sites as for Cd in the UK. Morey Firth and Tyne Tees and at three places for sediment Lyme Bay, Strangford Lough, Tamar (Hamoaze, also seen for Pb).

Norway only 21F Åkrafjord showed increasing trends.

3.Organic substances

The results of the assessment of status and trends of concentrations of selected organic contaminants from the group of PCBs (CB 118 and CB 153) and PAHs (pyrene and benzo[*a*]pyrene) and organochlorine pesticides (lindane, p,p-DDE) in sediments and biota together with organochlorine pesticides (lindane, p,p-DDE) in biota are summarised in this section. In addition to the illustrations given in this report, the full range of assessment maps (including the possibility to zoom in on smaller areas) and supporting data and information is available at:

http://dome.ices.dk/osparmime/main.html.

The results of the assessment for the PCBs, PAHs and pesticides in sediments and biota are presented in Sections 3.2 – 3.4. In each section a map illustrates temporal trends (and geographic distribution) in the concentrations of heavy metals in sediment and biota. Significant trends detected within the period 2001-2010 are shown as upward or downward pointing triangles. The colouring indicates in the last year of monitoring according to the classification set out in the appended table on Assessment criteria. Circles indicated locations where the data available was for too few years to allow trend assessment. The summary statistics of the samples analysed for time trends are given in table 3.1, indicating both the total number of stations and the number of stations with more than 3 years of data (i.e. where time trends can be analysed). Detectable time-trends are found in 10-37% of the biota stations, with approximately half of the stations monitored for 7 years or more (smoother and non-linear trend used). For sediments, the number of time series is about 1/3 and the % of stations exhibiting time trends is around 13%, even though very few (<10%) of the stations was monitored for 7 years or more.

Table 3.1 Summary of time-trend stations for organic pollutants in shellfish and fish

	Shellfish	**Fish**	**Fish**
Organic pollutant	**Pyrene**	**p,p-DDE**	*gamma*-HCH
Stations assessed	242	35	35
Stations >3 years samples	174	29	29
# Time trends >6 years	92	24	24
Downward trends	10.5%	22%	0%
Upward trends	0.5%	0%	0%
% with time trends	*11%*	*22%*	*0%*

Table 3.2 Summary of time-trend stations for organic pollutants in biota and sediment

	Biota	**Biota**	**Sediment**	**Sediment**	**Sediment**
Organic pollutant	**p,p-DDE**	*gamma*-HCH	**Benz(a)-pyrene**	**CB118**	**CB153**
Stations assessed	286	255	351	331	319
Stations >3 years samples	162	169	182	117	130
# Time trends >6 years	133	137	32	16	18
Downward trends	13.5%	37%	11.5%	11%	11.5%
Upward trends	0.5%	0%	2%	2%	1%
% with time trends	*14%*	*37%*	*13.5%*	*13%*	*12.5%*

3.1 Polychlorinated biphenyls (PCBs)

General information see Appendix 5.

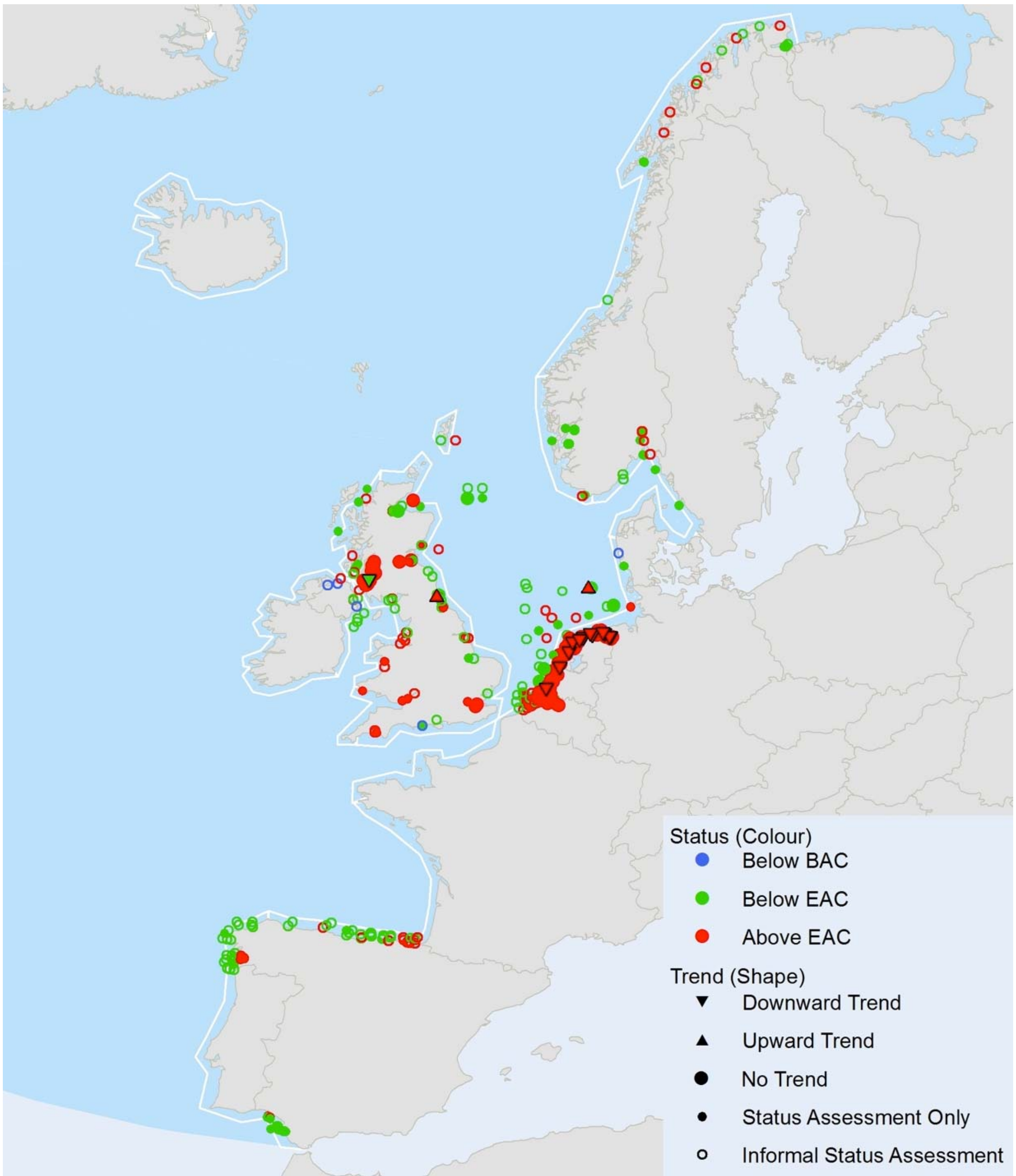

Figure 3.1: CB118 in sediments

The majority of sites show as red (above EAC) as CB118 is the most toxic congener, capable of exhibiting dioxin-like toxicity as it is a mono-*ortho* chlorobiphenyl congener.

In general, trends were downward in 15 samples and upwards in 2 samples of the 103 stations sampled for 4 years or more and above detection limit. Coastal stations are generally above EAC, with some stations below EAC in the open waters of the North Sea and from Northern UK and Spanish stations. Most downward trends were above EAC (red) along the Netherlands coastline, and the two stations with upward trends were also above ERL in UK and German waters (see below).

The individual Contracting Party assessment of values above EAC is as follows:

For the southern North Sea, Belgian and the Netherlands coastal stations have many downward trends, which are still above the EAC value in 2010. The concentration levels ranges from just above the EAC limit to 10 times above, so in most places background level will not be achieved by 2020.

For the UK, one station near Newcastle on Tyne is showing an upward trend, and inspection shows that concentrations in 2010 is above the EAC for CB153, CB 101, CB 118 and CB138, and all increasing.

In the central North Sea, Germany found upward trends at WB5, above EAC, and generally all CBs were very high in latest sampling at this station. Examination of the newest monitoring data indicated that this was an outlier, as results from 2010 and 2011 are below EAC level again, in the same range as pre-2009 data.

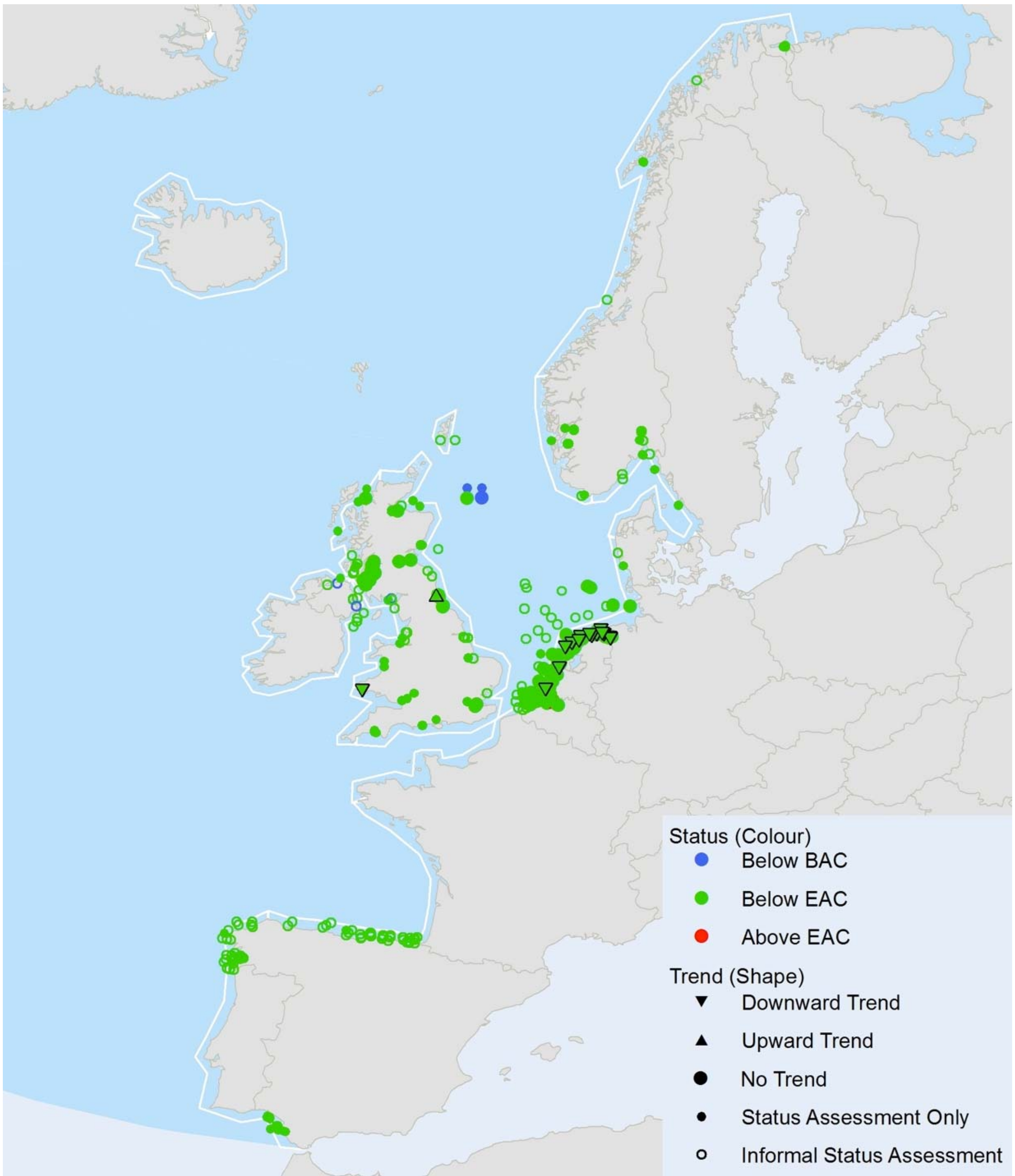

Figure 3.2: CB153 in sediments

Although difficult to see in the graphic as many stations overlap, only one station was above the EAC. There were 15 downward trends, mainly along the Netherlands coastline and coinciding with CB118, and only one upward trend, also coinciding with the UK Newcastle on Tyne station.

The only station above EAC was found in Belgium, in S09 at the Scheldt River downstream of the industrial area around Antwerp harbour.

For biota, the same pattern of predominantly downward trends for CB 118 and CB153 can be observed in the web tool (1 upward vs. 42 downward out of 195 timeseries for CB118 and 5 upward vs. 43 downward out of 213 time series for CB153).

3.2 Polycyclic aromatic hydrocarbons (PAHs)

General information see Appendix 6.

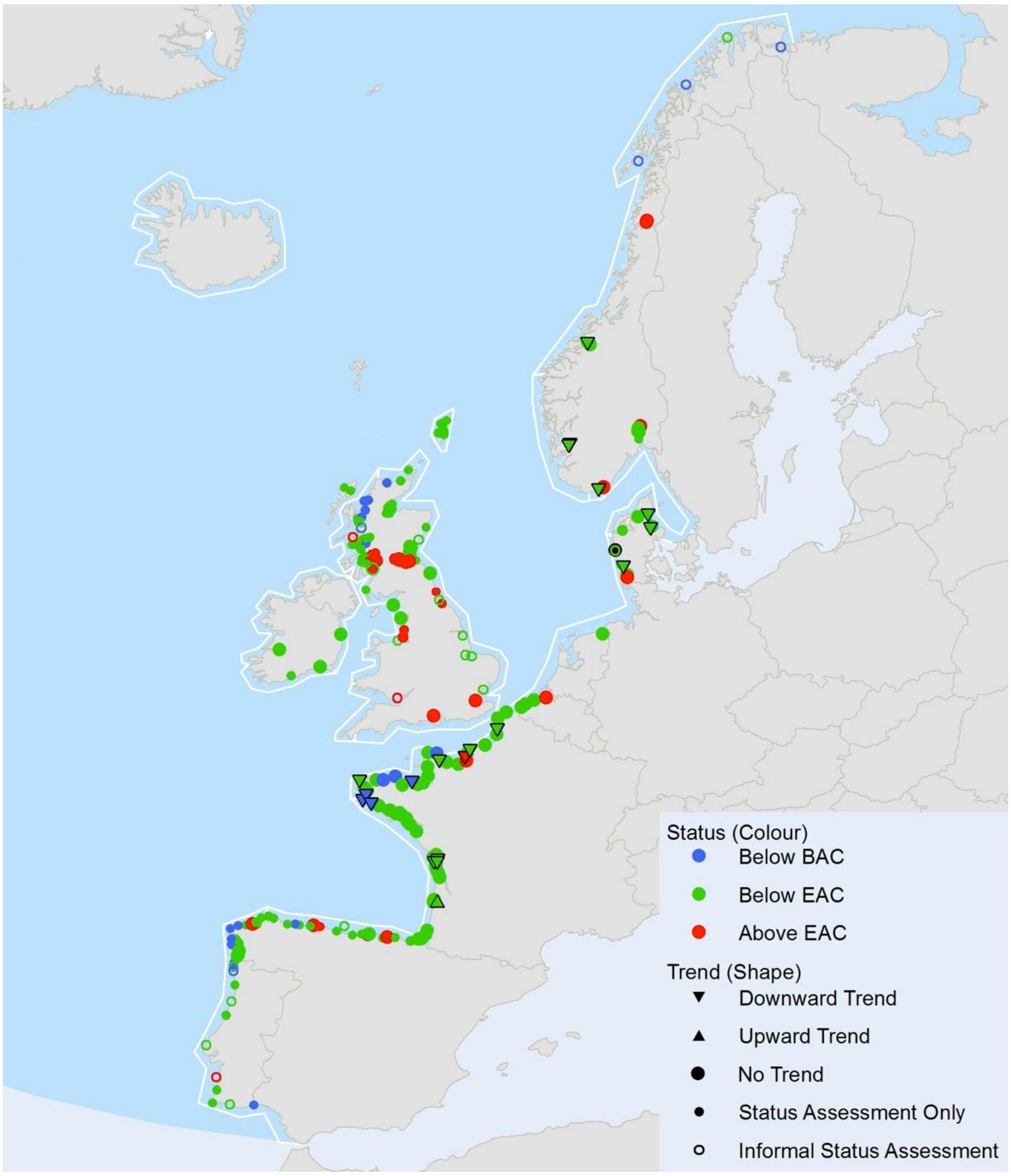

Figure 3.3: pyrene in mussels

Stations showing in red (above the EAC) represent data submitted by Denmark, France, Norway, Portugal, Spain and the UK. Portugal was not represented at the MIME meeting and so this could not be taken further.

The individual Contracting Party assessment of values above EAC is as follows:

Time trends in Danish waters are mainly going down. The high concentrations in Lister Dyb, Wadden Sea may result from contamination from major German rivers, in this case the uncertainty bounds indicates high variability resulting in the upper confidence limit breaching the EAC, with actual modelled mean 3 times below the EAC.

Two French stations in the lower Seine estuary were above EAC. These are affected by historic and current industrial discharges. Comprian in the Bay of Biscay was the only upward trend for PAHs.

Norwegian high concentration stations at Oslo harbour are probably due to the heavily populated area. Another six sites shown as red are in fjords affected by historical discharges from smelters.

For Spain, sites with red points are all close to harbours or industrialised areas.

In the UK, all red points are in industrial/urban or historically contaminated areas affected by earlier industrial discharges. Tobermory is rather a puzzle as it is an area of low population and little industry, with only small boats and a small ferry.

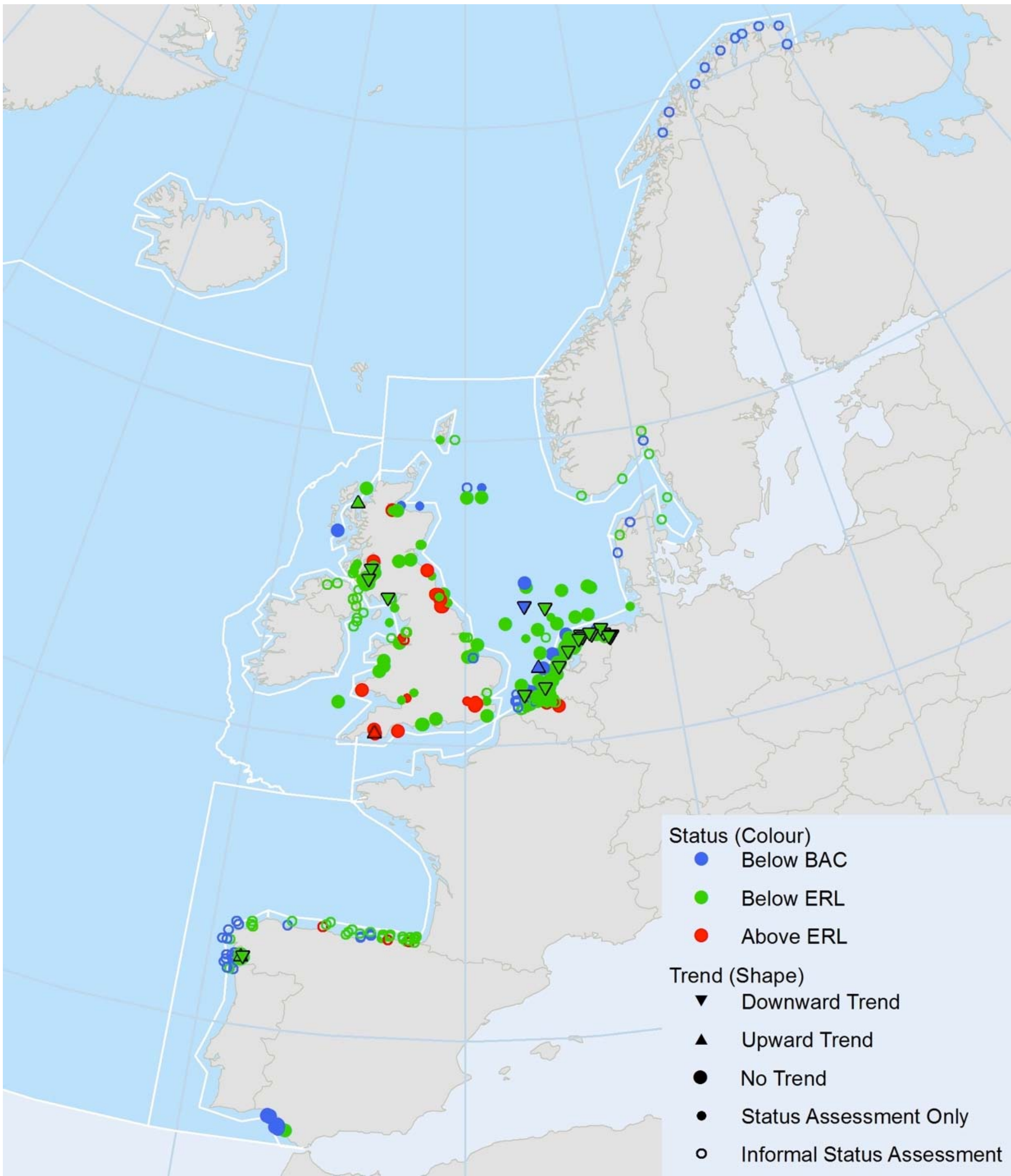

Figure 3.4: Benzo[*a*]pyrene in sediment

Stations shown as red (above the ERL – Effects Range Low value) were in data submitted by Belgium, Denmark, Netherlands, Spain and the UK.

In general, trends were downward in 21 samples and upwards in 4 samples of the 183 stations sampled for 4 years or more. All downward trends were below ERL (green), and only one UK station with upward trend was also above ERL (see below).

The individual Contracting Party assessment of values above ERL is as follows:

In the Belgian North Sea, the higher levels of Benz(a)pyrene are related to heavily industrialised estuarine areas, and likewise in Spain, where red areas are found fine sediment accumulation areas close to industrial activity.

For the UK, benz(a)pyrene is mainly above ERL in estuaries historically contaminated by industry; some with current sources also. Tamar (Hamoze) is increasing and red, all PAH are going upward (except NAP and CHRTP).

At South Minch all PAH are going upward (except ICDP and NAP), but concentrations are well below the ERL.

For Denmark and the Netherlands, no station was above ERL.

3.3 Pesticides

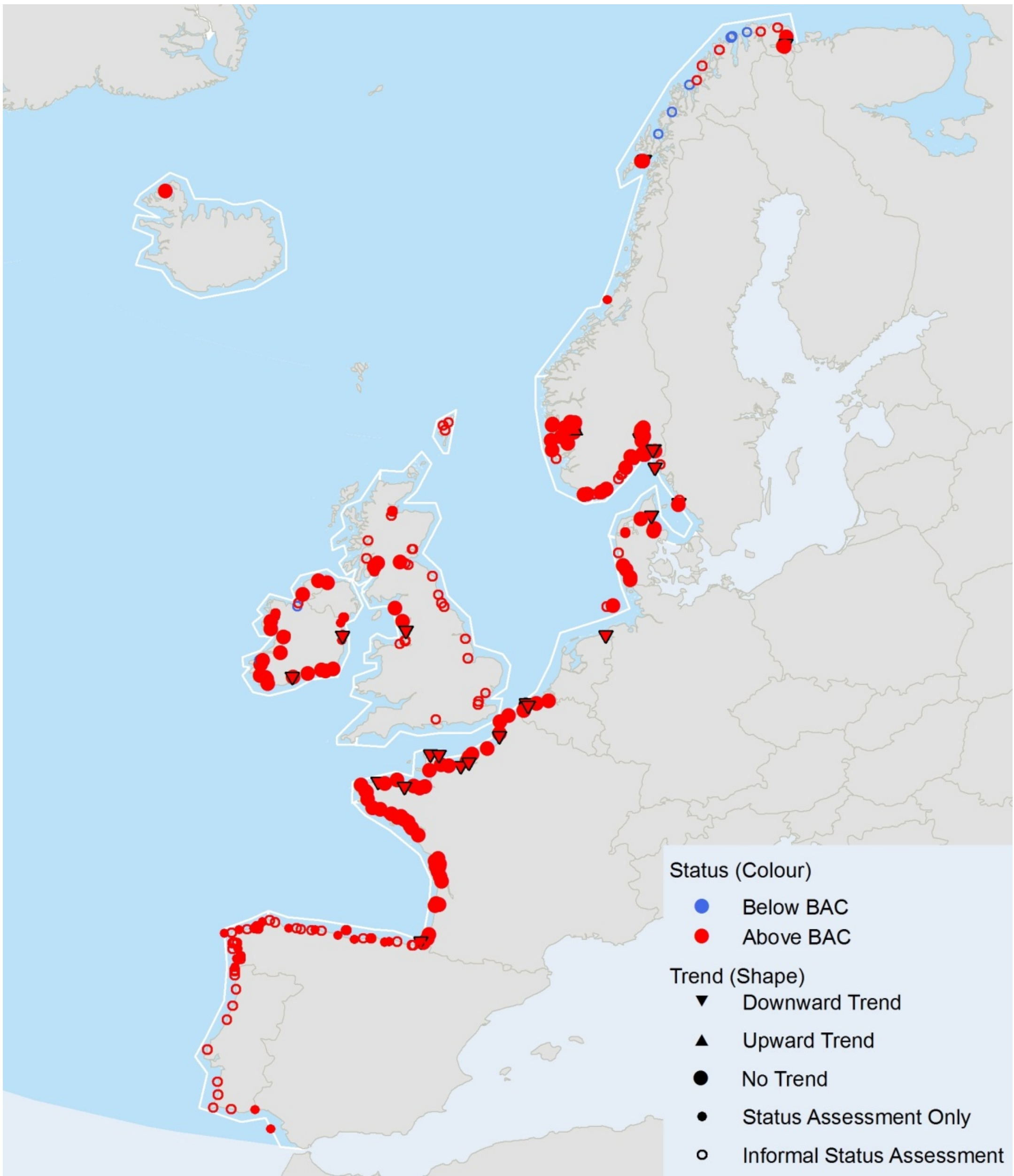

Figure 3.5: *p,p'*-DDE in biota

All of the data from northern Europe are shown as red, but this is because the BAC is used as the assessment criterion, there being no EAC value set. Also, it is apparent that data are sparse and that Contracting Parties other than Denmark, Norway, Spain and Sweden are not reporting monitoring data in fish.

Taking both mussels and fish into account, except for the Norwegian mussel station 51K Kvalnes, all trends are downwards in the whole Convention Area (22 stations equal to 7.7% of all 286 stations and 13% of timetrend stations (162 stations with >3 years of monitoring)). Concentrations in fish are generally higher than mussel, with 10 µg/kg as the lower limit of fish concentrations, whereas >200 mussel concentrations are <10 µg/kg. The span of mean last year concentration is from 0.3 to 1750 µg/kg, with the highest mussel value at 137 µg/kg (Kvalnes).

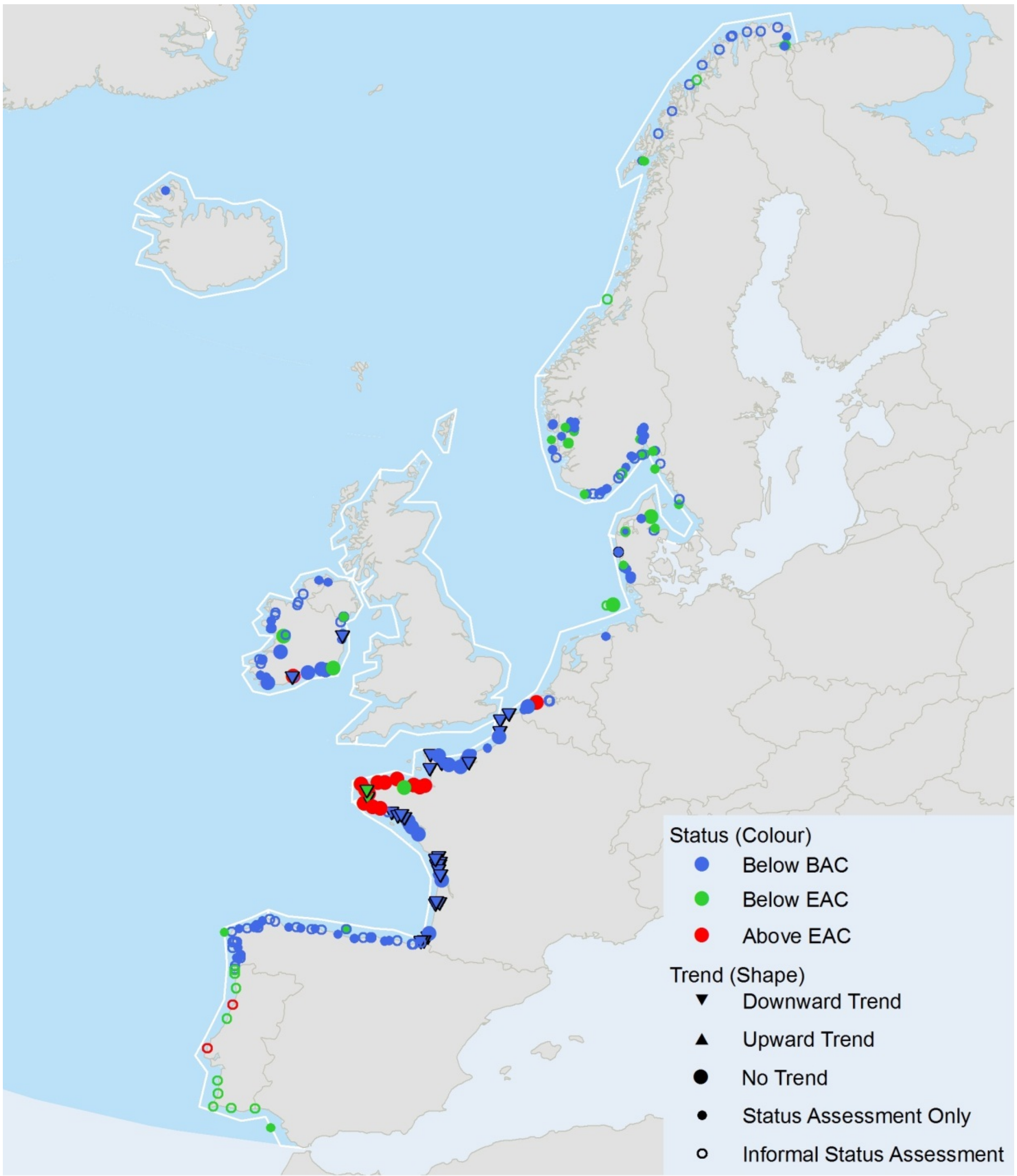

Figure 3.6: *gamma*-HCH in biota

All 35 fish was below the EAC value, whereas 75% of the mussels are at background concentration. Most downward trends are French stations, and two Irish stations, one in the Celtic Sea and one in the Irish Sea.

Taking both mussels and fish into account, all trends are downwards in the whole Convention Area (30 stations equal to 11.8% of all 255 stations reported and 37% of timetrend stations (82 stations with >3 years of monitoring). In many cases, results are close to or below detection limits and therefore no time trends can be established.

The ban on the use of *gamma*-HCH in Europe is still resulting in declining concentrations in the environment, but concentration factors to fish are higher than to shellfish, on average a factor of 7 higher in fish liver compared to shellfish.

One major exception is the Portuguese Praia da Barra, where concentrations are around 25 times higher than ordinary mussel concentrations (13 compared to 0.5 µg/kg).

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Appendices

Appendix 1: Assessment criteria used in the CEMP data assessment

Appendix 2: Cadmium

Appendix 3: Mercury

Appendix 4: Lead

Appendix 5: Polychlorinated biphenyls (PCBs)

Appendix 6: Polycyclic aromatic hydrocarbons (PAHs)

Appendix 1

Assessment criteria used in the CEMP data assessment

Group	Substance	SEDIMENT (µg/kg dry weight) Background/low concentrations BC	LC Spain	Blue (T_0) < BAC	< BAC Spain	Green (T_1) < EAC	< ERL	MUSSELS (M) AND OYSTERS (O) (µg/kg dry weight except EC for metals: wet weight (ww)) BC/LC	Blue (T_0) < BAC	Green (T_1) < EAC	< EC	FISH (µg/kg wet weight, except: $EAC^{passive}$ for CB: lipid weight (lw)) BC/LC	Blue (T_0) < BAC	Green (T_1) < EAC passive	Amber (T_1) < EC max. food limit
Metals	Cd	200	86	310	129		1200	M-600 O-1800	M-960 O-3000		M-1000 O-1000	a	26		1000 (bivalve. tissue)
	Hg	50	53	70	91		150	M-50 O-100	M-90 O-180		M-500 O-500	a	35		500
	Pb	25000	15500	38000	22400		47000	M-800 O-800	M-1300 O-1300		M-1500 O-1500	a	26		1500 (bivalve. tissue)
	As	15000		25000			---								
	Cr	60000		81000			81000								
	Cu	20000		27000			34000		6000						
	Ni	30000		36000			---								
	Zn	90000		122000			150000		63000						
	TBT	---		---		---		1.0	5.0	12.0					
PAHs	Naphthalene	5	---	8	---		160	---	---	340					
	C1-naphthalene						155[2]								
	C2-naphthalene						150								
	Phenanthrene	17	4.0	32	7.3		240	4.0	11.0	1700					
	C1-phenanthrene						170								
	C2-phenanthrene						200								
	Anthracene	3	1.0	5	1.8		85	---	---	290					
	Dibenzothiophene (DBT)	0.6	---	---	---		190	---	---	---					
	C1-dibenzothiophene						85								
	Fluoranthene	20	7.5	39	14.4		600	5.5	12.2	110					
	Pyrene	13	6.0	24	11.3		665	4.0	9.0	100					
	Benz[a]anthracene	9	3.5	16	7.1		261	1.0	2.5	80					
	Chrysene (Triphenylene)	11	4.0	20	8.0		384	4.0	8.1	---					
	Benzo[a]pyrene	15	4.0	30	8.2		430	0.5	1.4	600					
	Benzo[ghi]perylene	45	3.5	80	6.9		85	1.5	2.5	110					
	Indeno[1,2,3-cd]pyrene	50	4.0	103	8.3		240	1.0	2.4	---					
PCBs	CB28	0.0/0.05		0.22		1.7		0.0/0.25	0.75	3.2		0.0/0.05	0.10	64 lw	
	CB52	0.0/0.05		0.12		2.7		0.0/0.25	0.75	5.4		0.0/0.05	0.08	108 lw	
	CB101	0.0/0.05		0.14		3.0		0.0/0.25	0.70	6.0		0.0/0.05	0.08	120 lw	

[2] Sum of 1-methyl naphthalene and 2-methyl naphthalene

Group	Substance	SEDIMENT (µg/kg dry weight) Background/low concentrations		Blue (T_0)		Green (T_1)		MUSSELS (M) AND OYSTERS (O) (µg/kg dry weight except EC for metals: wet weight (ww))	Blue (T_0)	Green (T_1)		FISH (µg/kg wet weight, except: EAC[passive] for CB: lipid weight (lw))	Blue (T_0)	Green (T_1)	Amber (T_1)
		BC	LC Spain	< BAC	< BAC Spain	< EAC	< ERL	BC/LC	< BAC	< EAC	< EC	BC/LC	< BAC	< EAC passive	< EC max. food limit
	CB105	---		---		---		0.0/0.25	0.75	---		0.0/0.05	0.08	---	
	CB118	0.0/0.05		0.17		0.6		0.0/0.25	0.60	1.2		0.0/0.05	0.10	24 lw	
	CB138	0.0/0.05		0.15		7.9		0.0/0.25	0.60	15.8		0.0/0.05	0.09	316 lw	
	CB153	0.0/0.05		0.19		40		0.0/0.25	0.60	80		0.0/0.05	0.10	1600 lw	
	CB156	---		---		---		0.0/0.25	0.60	---		0.0/0.05	0.08	---	
	CB180	0.0/0.05		0.10		12		0.0/0.25	0.60	24		0.0/0.05	0.11	480 lw	
Pesticide	γ-HCH	0.0/0.05	0.13				3.0	0.0/0.25	0.97	1.45	---	---	---	11[b]	
	α-HCH	---	---				---	0.0/0.25	0.64	---	---	---	---	---	
	DDE (p,p’)	0.0/0.05	0.09				2.2	0.0/0.25	0.63	---	---	0.0/0.05	0.10	---	
	Hexachlorobenzene	0.0/0.05	0.16				20.0	0.0/0.25	0.63	---	---	0.0/0.05	0.09	---	
	Dieldrin	0.0/0.05	0.19				2.0	---	---	---	---	---	---	---	

[a] datasets too limited to allow recommendation for BCs for metals in fish; [b] EAC for fish liver derived by applying a conversion factor of 10 on EAC for whole fish

Notes

- No assessment criteria for PBDE.
- Assessment criteria are used to assess contaminant concentrations
  - **B**ackground **A**ssessment **C**oncentration (BAC)
  - **E**nvironmental **A**ssessment **C**riteria (EAC)
  - **E**ffects **R**ange **L**ow (ERL)
  - **E**uropean **C**ommission food standard (EC)
- BACs were developed by the OSPAR Commission (OSPAR) for testing whether concentrations are near background levels. Mean concentrations significantly below the BAC are said to be near background.
- BACs and EAC[passive]s are available for seven CBs.
- EACs were developed by OSPAR and the International Council for the Exploration of the Sea for assessing the ecological significance of sediment concentrations. Concentrations below the EAC should not cause any chronic effects in marine species.
- BACs and / or EACs are available for ten PAHs.
- EAC[passive]s were developed by OSPAR for assessing the ecological significance of sediment concentrations. Concentrations below the EAC[passive] should cause no chronic effects in marine species.
- ERLs were developed by the United States Environmental Protection Agency for assessing the ecological significance of sediment concentrations. Concentrations below the ERL rarely cause adverse effects in marine organisms. Concentrations *above* the ERM will often cause adverse effects in some marine organisms.
- ECs have been used in the absence of any satisfactory criteria for assessing the ecological significance of biota concentrations. ECs are the maximum acceptable concentrations in food for the protection of public health.

Appendix 2

Cadmium

Cadmium occurs naturally in geological ores and is found at background levels in the marine environment. Cadmium is toxic and liable to bioaccumulate and thus is a contaminant of concern both for the marine environment and for human health in terms of consumption of fish and other seafood. Because of its properties, the OSPAR Commission has selected cadmium as chemical for priority action.

Cadmium enters the environment via the atmosphere and water. The main sources are emissions from combustion processes primarily in power plants and industry, but also other commercial and domestic sources. Other relevant sources are from the metallurgical industry, road transport and wastes (e.g. dump sites).

As much of the reduction in inputs of cadmium occurred before 2000, changes in environmental concentrations have been relatively small since then as concentrations approach, but do not reach, background levels in large parts of the OSPAR area.

Many of the OSPAR data series are currently too short to determine trends as – owing to the large amount of natural variation in the marine environment – trends in concentrations can only be determined using data collected systematically over relatively long periods.

Concentrations of cadmium in sediments generally present no environmental risk in large open sea areas in all OSPAR Regions. Levels are mostly approaching or are at background. However, in some coastal areas, such as the inner German Bight and around the industrial estuaries of the Rhine, Seine, Tyne, Tees and Thames, cadmium is at levels which give rise to risk of pollution effects. Concentrations of cadmium in fish and shellfish are above EU food limits around the coasts of Scotland and some locations in southern Norway, the southern North Sea, the Channel and the Bay of Biscay.

Mercury

Mercury is an extremely rare element in the earth's crust but occurs in concentrated ores in young geologically active areas e.g. often in hot springs or volcanic regions. Industrial and commercial use of mercury has led to the dispersion of mercury in the environment. Mercury is extremely toxic to both man and marine life and can be transformed within the aquatic environment into more toxic organic compounds (e.g. methyl mercury). Because of its properties, the OSPAR Commission has selected mercury as chemical for priority action.

A main pathway of mercury to the sea is atmospheric and it can be carried long distances from its source. The main sources of mercury to the environment are natural atmospheric emissions from volcanoes and anthropogenic emissions from coal-fired power stations and metal and cement production. Mercury also enters into the environment through the disposal of products containing mercury, including car parts, batteries, fluorescent bulbs, medical products, thermometers, and thermostats.

As much of the reduction in inputs of mercury occurred before 2000, changes in environmental concentrations have been relatively small since then as concentrations approach, but do not reach, background levels in large parts of the OSPAR area. Detected time trends are mostly downward, with few locations in Regions III where mercury concentrations have risen (e.g. western Irish Sea). Many of the OSPAR data series are currently too short to determine trends as – owing to the large amount of natural variation in the marine environment – trends in concentrations can only be determined using data collected systematically over relatively long periods.

Concentrations of mercury in sediment are at levels giving rise to risk of pollution effects in the southern North Sea, North-East coast of the UK, both on the coast and offshore on the Dogger Bank, in the Channel and the Irish Sea and at some locations near urban industrialised areas in northern and southern Spain.

Concentrations of mercury in fish and shellfish are generally below EU food limits other than in the northern Wadden Sea of Denmark and in certain industrialised estuaries around the UK.

Background concentrations of mercury in sediment, fish and shellfish are measured at coastal locations in Regions I, III and IV, but rarely in Regions II.

Lead

Lead occurs naturally in the environment and it is a vital element in everyday life. Mining, smelting and industrial use of lead has led to widespread elevation of environmental lead concentrations. Lead is persistent and an acute toxic compound for mammals and aquatic organisms and thus is a contaminant of concern both for the marine environment and for human consumption of fish and other seafood. Because of its properties, the OSPAR Commission has selected lead as chemical for priority action.

The main sources of lead to the environment are primary production processes such as ferrous and non-ferrous metal production and mining. Other relevant sources are transport, glass production and recycling processes, ceramics production, offshore industry, and waste incineration and disposal. The main pathway of lead to the sea is via air and it can be carried long distances from its source.

Much of the reduction in inputs of mercury occurred up to 2000, when lead in petrol was prohibited in the European Union. The changes in environmental concentrations have been relatively small since then as concentrations approach, but do not reach, background levels in large parts of the OSPAR area. Detected time trends are mostly downward, with few locations in Regions II and III where lead concentrations in biota have risen (e.g. western Irish Sea). Many of the OSPAR data series are currently too short to determine trends as – owing to the large amount of natural variation in the marine environment – trends in concentrations can only be determined using data collected systematically over relatively long periods. Overall, concentrations of lead in biota show a consistent downward trend across OSPAR Regions.

Concentrations of lead in sediments give rise to risk of pollution effects over large parts of the southern North Sea, both inshore and offshore, the Channel and the Irish Sea. Scattered high concentrations are also found along the East coast of the UK and in some locations near urban industrialised areas in northern Spain. However, concentrations in northern Norway, northern Spain and a few areas in the northern UK, are generally approaching or at background.

Concentrations in biota exceeding EU food limits are less widespread, and the locations can generally be linked to urban and industrial activity, e.g. several UK estuaries and certain sites in Ireland, southern Norway and northern Spain. Concentrations in the offshore area around the Dogger Bank are at near coastal levels. This has been attributed to enhanced fine sediment fraction and riverine humic acids in that area which are carriers for lead.

Lead concentrations in fish and shellfish are at background levels in western Ireland, the north west coast of Norway, and some stations in northern Spain and along the coast of northern France. Concentrations above background at sites around Iceland may be the result of volcanic activity

Appendix 5

Polychlorinated biphenyls (PCBs)

Polychlorinated biphenyls (PCBs) are a group of substances with 209 forms (congeners) which are very persistent, concentrate in fatty tissues and have varied harmful effects on marine organisms. Because of their properties, the OSPAR Commission has selected the group of PCBs as chemicals for priority action.

OSPAR environmental monitoring has concentrated on a set of 7 PCB congeners, which cover the range of toxicological properties of the group (CB congeners 28, 52, 101, 118, 138, 153, 180). CB153 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.

Production of PCBs was banned in the mid-1980s but European-wide action has not been enough to eliminate all inputs to the marine environment. Remaining sources are PCB-containing equipment, waste disposal, remobilisation from marine sediments contaminated with PCBs as a result of historic releases, and, to an unknown extent, formation as by-products in thermal and chemical processes.

Contamination from PCBs is widespread and there are few areas where concentrations are close to zero. Concentrations are lowest along the northern coast of Norway (Region I). PCBs are however among the most prevalent pollutants in the Arctic and are widely distributed by long-range atmospheric transport. At most locations in Regions II, III and IV, concentrations of at least one PCB congener in fish and shellfish pose a risk of causing pollution effects. PCB 118 is the congener most often above EAC,

Concentrations are decreasing at a high proportion of the fish/shellfish stations, particularly along the continental coast of the North Sea, the west of the UK, and Ireland. A small number of stations showed increasing trends.

Appendix 6

Polycyclic aromatic hydrocarbons (PAHs)

Polycyclic aromatic hydrocarbons (PAHs) are natural components of coal and oil and are also formed during the combustion of fossil fuels and organic material. They are one of the most widespread organic pollutants in the marine environment of the OSPAR area, entering the sea from offshore activities, operational and accidental oil spills from shipping, river discharges and the air. Long-range atmospheric transport is an important pathway for PAHs within and to the OSPAR area and is of regional and global concern.

PAHs are toxic and, since they are hydrophobic, bioconcentrate particularly in fatty tissues. They can adversely affect reproduction, and may affect immune systems so as to make disease epidemics worse. The higher levels of the food web, especially fish-eating birds and marine mammals can be particularly affected. Because of their properties, the OSPAR Commission has selected the group of PAHs as chemicals for priority action.

OSPAR environmental monitoring has concentrated on a set of 6 PAH compounds: 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. 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.

Trends in PAH concentrations in fish and shellfish are predominantly downward, especially in Region III, but concentrations are still at levels which pose a risk of pollution effects in many estuaries and urbanised and industrialised locations.

In contrast, there are relatively fewer temporal trends in sediment concentrations, suggesting that concentrations in sediments respond less rapidly to changes in inputs to the sea than concentrations in biota. This is reflected in widespread concentrations of PAHs in sediments at levels which give rise to risk of pollution effects. The failure to achieve background concentrations of PAHs in mussels is evidence of continuing widespread contamination, possibly mediated through atmospheric transport. The scattered occurrence of concentrations which give rise to risk of pollution effects are often in harbours, estuaries and close to industrial installations.

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