

2.3 Hazardous substances in the marine environment in 1998-2008

2.3.1 Overview

Hazardous substances are widespread in the marine environment. The effects they have on the environment and their potential risk to human health and social-economics are considered serious and therefore considerable efforts have been channelled to combat their emissions as well as to the political, management and scientific segments of society. The reason for concern has been the proven and potential hazard that some chemicals have on humans and the environment due to their toxic, bioaccumulative and persistent characteristics.

The pathway of contamination is not always obvious. Although hot spots tend to be directly linked to particular human activities, the substances are also found in organisms that are collected far away from point-sources. Some substances are transported by ocean currents, the atmosphere or by migrating species.

Considerable efforts have been made to establish and maintain monitoring programmes to assess the level, trends and effects of HS in biota and sediment, and to select the preferred indicator matrices. However, there is a lack of reliable and consistent data for many HS and for several regions. Although basic legislation is in place to combat excessive exposure, specific assessment criteria with respect to levels, trends and effects need to be further developed for the indicator matrices.

While the number of potentially hazardous substances is high, to date, only few data are available with sufficient geographical and temporal cover to warrant a pan-European assessment. The EEA pan-European assessment of the state of hazardous substances is based on the assessment of seven substances (cadmium, lead, mercury (total), the pesticides DDT (using pp'DDE as a representative of DDT) and lindane (α -HCH), hexachlorobenzene (HCB), and PCBs that form the core set of indicators for the EEA (CSI040). All seven contaminants are included in the Water Framework Directive lists of the 'Environmental Quality Standards' or EQS-directive (2008/105/EC) concerning hazardous substances.

The EEA CSI040 indicators of hazardous substances cover the North-East Atlantic, the Baltic Sea and the Mediterranean Sea. Data from the Black Sea were insufficient for this assessment. The results reveal that concentrations are generally low or moderate for all seven hazardous substances.

Cadmium, lead and mercury are found at low concentrations in the earth's crust and occur naturally in seawater. Lindane, PCB and DDT are synthetic substances that are not found naturally in the environment. Human activities have caused a general mobilisation of these hazardous substances in aquatic and terrestrial environments. In the marine environment, they accumulate in fish and shell fish, and because these in return are a food source for marine wildlife and humans the substances are moved to higher levels in the food chain. The contaminants are not needed for any organism (they are not essential) and are toxic. In humans long-term exposure or consumption of contaminated seafoods can be detrimental. The main sources are from general waste/disposal burning of fossil fuels and industrial activities (NSC, 2002), including mining and production.

2.3.2 Occurrence and concentrations of hazardous substances

Map symbol description: Indicating Low, Moderate and High classes of concentrations for the mean of 1999-2008 annual median based on limits provided in Table 2.3.2.1 and results from statistical trend analyses in four categories (too few data, trend not significant or that a significant increase/decrease in concentrations was found) with at least 5 years data that at least included 2000.

	Low (green)	Moderate (yellow)	High (red)
Too few data (circle)	●	●	●
Not significant (square)	■	■	■
Decrease (arrow down)	↓	↓	↓
Increase (arrow up)	↑	↑	↑

Table 2.3.2.1 Limit concentration used for classification in figures and maps: Low/High concentration limits for spatial assessment which delimits the classes Low, Moderate and High. EU foodstuff limits are highlighted in a grey shade. Except for EU legislation, the limits have no legal application. All values are expressed units of µg/kg and on a dry weight (D), wet weight (W) or a fat weight (L) basis. Many values are derived from OSPAR Background Assessment Concentration (BAC) or Ecotoxicological Assessment Criteria (EAC). NB: these concentrations are under development.

Note: * indicates where limits have been revised (cf. EEA 2003). Limits for lindane in fish have also been added.

Name and tissue	Latin name	Low/High	µg/kg	basis	Reference	Comment
CADMIUM						
Mussels	<i>Mytilus</i> sp. ¹	Low	960	D	OSPAR 2008	BAC limit
Mussels	<i>Mytilus</i> sp.	High	5000	D	EU 2006	Foodstuffs limit for "bivalve molluscs", Regulation (EC) No. 1881/2006, conversion assuming 20% wet weight (cf. OSPAR CEMP assessment manual 2008, Table 2.1)
Atlantic cod, liver	<i>Gadus morhua</i>	Low	26	W	OSPAR 2008	BAC limit
Atlantic cod, liver	<i>Gadus morhua</i>	High	1000	W	EU 2006	Foodstuffs limit for "bivalve molluscs", Regulation (EC) No. 1881/2006
Herring, muscle	<i>Clupea harengus</i>	Low	26	W	OSPAR 2008	BAC limit
Herring, muscle	<i>Clupea harengus</i>	High	1000	W	EU 2006	Foodstuffs limit for "bivalve molluscs", Regulation (EC) No. 1881/2006
MERCURY						
Mussels	<i>Mytilus</i> sp. ¹	Low	90	D	OSPAR 2008	BAC limit
Mussels	<i>Mytilus</i> sp.	High	2500	D	EU 2006	Foodstuffs limit for "fisheries products", Regulation (EC) No. 1881/2006, conversion assuming 20% wet weight (cf. OSPAR CEMP assessment manual 2008, Table 2.1)
Atlantic cod, muscle	<i>Gadus morhua</i>	Low	35	W	OSPAR 2008	BAC limit
Atlantic cod,	<i>Gadus</i>	High	500	W	EU 2006	Foodstuffs limit for "meat of fish"

Name and tissue	Latin name	Low/High	µg/kg	basis	Reference	Comment
muscle	<i>morhua</i>					molluscs", Regulation (EC) No. 1881/2006
Herring, muscle	<i>Clupea harengus</i>	Low	35	W	OSPAR 2008	BAC limit
Herring, muscle	<i>Clupea harengus</i>	High	500	W	EU 2006	Foodstuffs limit for "meat of fish molluscs", Regulation (EC) No. 1881/2006
LEAD						
Mussels	<i>Mytilus sp.</i> ¹	Low	1300	D	OSPAR 2008	BAC limit
Mussels	<i>Mytilus sp.</i>	High	7500	D	EU 2006	Foodstuffs limit for "bivalve molluscs", Regulation (EC) No. 1881/2006, conversion assuming 20% wet weight (cf. OSPAR CEMP assessment manual 2008, Table 2.1)
Atlantic cod, liver	<i>Gadus morhua</i>	Low	26	W	OSPAR 2008	BAC limit
Atlantic cod, liver	<i>Gadus morhua</i>	High	1500	W	EU 2006	Foodstuffs limit for "bivalve molluscs", Regulation (EC) No. 1881/2006
Herring, muscle	<i>Clupea harengus</i>	Low	26	W	OSPAR 2008	BAC limit
Herring, muscle	<i>Clupea harengus</i>	High	1500	W	EU 2006	Foodstuffs limit for "bivalve molluscs", Regulation (EC) No. 1881/2006
HCB						
Mussels	<i>Mytilus sp.</i> ¹	Low	0.63	D	OSPAR 2008	BAC limit
Mussels	<i>Mytilus sp.</i>	High	6.3	D		Taken as 10 times "Low" (or approximately the median of High:Low ratio for CBs in mussel, which is 8.6)
Atlantic cod, liver	<i>Gadus morhua</i>	Low	0.18	L	OSPAR 2008	BAC limit times 2 (OSPAR ²)
Atlantic cod, liver	<i>Gadus morhua</i>	High	135	L		Taken as 750 times "Low" (median of High:Low ratio for CBs in cod)
Herring, muscle	<i>Clupea harengus</i>	Low	1.8	L	OSPAR 2008	BAC ² limit times 20 (OSPAR ²)
Herring, muscle	<i>Clupea harengus</i>	High	135	L		Taken as the same for cod, in pattern with CBs EAC's
LINDANE						
Mussels	<i>Mytilus sp.</i> ¹	Low	0.97	D	OSPAR 2008	BAC limit
Mussels	<i>Mytilus sp.</i>	High	1.45	D	OSPAR 2008	EAC limit
Atlantic cod, liver	<i>Gadus morhua</i>	Low	0.29	L		Taken as 1/750 times "High" (median of Low:High ratio for CBs in cod)
Atlantic cod, liver	<i>Gadus morhua</i>	High	220	L		Taken as the same for herring
Herring, muscle	<i>Clupea harengus</i>	Low	2.9	L		Taken as 10 times value for cod, as
Herring, muscle	<i>Clupea harengus</i>	High	220	L	OSPAR 2008	Taken as OSPAR EAC (2008) = 11 * 20 (to convert wet weight to lipid weight – (OSPAR ²) = 220 ppb l.w.
PCB (CB 28)						

Name and tissue	Latin name	Low/High	µg/kg	basis	Reference	Comment
Mussels	<i>Mytilus</i> sp. ¹	Low	0.75	D	OSPAR 2008	BAC limit
Mussels	<i>Mytilus</i> sp.	High	3.2	D	OSPAR 2008	EAC limit
Atlantic cod, liver	<i>Gadus morhua</i>	Low	0.2	W	OSPAR 2008	BAC limit times 2 (OSPAR ²)
Atlantic cod, liver	<i>Gadus morhua</i>	High	64	L	OSPAR 2008	EAC limit
Herring, muscle	<i>Clupea harengus</i>	Low	2	W	OSPAR 2008	BAC limit times 20 (OSPAR ²)
Herring, muscle	<i>Clupea harengus</i>	High	64	L	OSPAR 2008	EAC limit
PCB (CB 52)						
Mussels	<i>Mytilus</i> sp. ¹	Low	0.75	D	OSPAR 2008	BAC limit
Mussels	<i>Mytilus</i> sp.	High	5.4	D	OSPAR 2008	EAC limit
Atlantic cod, liver	<i>Gadus morhua</i>	Low	0.16	W	OSPAR 2008	BAC limit times 2 (OSPAR ²)
Atlantic cod, liver	<i>Gadus morhua</i>	High	108	L	OSPAR 2008	EAC limit
Herring, muscle	<i>Clupea harengus</i>	Low	1.6	W	OSPAR 2008	BAC limit times 20 (OSPAR ²)
Herring, muscle	<i>Clupea harengus</i>	High	108	L	OSPAR 2008	EAC limit
PCB (CB 101)						
Mussels	<i>Mytilus</i> sp. ¹	Low	0.7	D	OSPAR 2008	BAC limit
Mussels	<i>Mytilus</i> sp.	High	6	D	OSPAR 2008	EAC limit
Atlantic cod, liver	<i>Gadus morhua</i>	Low	0.16	W	OSPAR 2008	BAC limit times 2 (OSPAR ²)
Atlantic cod, liver	<i>Gadus morhua</i>	High	120	L	OSPAR 2008	EAC limit
Herring, muscle	<i>Clupea harengus</i>	Low	1.6	W	OSPAR 2008	BAC limit times 20 (OSPAR ²)
Herring, muscle	<i>Clupea harengus</i>	High	120	L	OSPAR 2008	EAC limit
PCB (CB 118)						
Mussels	<i>Mytilus</i> sp. ¹	Low	0.6	D	OSPAR 2008	BAC limit
Mussels	<i>Mytilus</i> sp.	High	1.2	D	OSPAR 2008	EAC limit
Atlantic cod, liver	<i>Gadus morhua</i>	Low	0.2	W	OSPAR 2008	BAC limit times 2 (OSPAR ²)
Atlantic cod, liver	<i>Gadus morhua</i>	High	24	L	OSPAR 2008	EAC limit
Herring, muscle	<i>Clupea harengus</i>	Low	2	W	OSPAR 2008	BAC limit times 20 (OSPAR ²)
Herring, muscle	<i>Clupea harengus</i>	High	24	L	OSPAR 2008	EAC limit
PCB (CB 138)						
Mussels	<i>Mytilus</i> sp. ¹	Low	0.6	D	OSPAR 2008	BAC limit
Mussels	<i>Mytilus</i> sp.	High	15.8	D	OSPAR 2008	EAC limit
Atlantic cod, liver	<i>Gadus morhua</i>	Low	0.18	W	OSPAR 2008	BAC limit times 2 (OSPAR ²)
Atlantic cod, liver	<i>Gadus morhua</i>	High	316	L	OSPAR 2008	EAC limit
Herring, muscle	<i>Clupea harengus</i>	Low	1.8	W	OSPAR 2008	BAC limit times 20 (OSPAR ²)
Herring, muscle	<i>Clupea</i>	High	316	L	OSPAR 2008	EAC limit

Name and tissue	Latin name	Low/High	µg/kg	basis	Reference	Comment
muscle	<i>harengus</i>					
PCB (CB 153)						
Mussels	<i>Mytilus</i> sp. ¹	Low	0.6	D	OSPAR 2008	BAC limit
Mussels	<i>Mytilus</i> sp.	High	80	D	OSPAR 2008	EAC limit
Atlantic cod, liver	<i>Gadus morhua</i>	Low	0.2	W	OSPAR 2008	BAC limit times 2 (OSPAR ²)
Atlantic cod, liver	<i>Gadus morhua</i>	High	1600	L	OSPAR 2008	EAC limit
Herring, muscle	<i>Clupea harengus</i>	Low	2	W	OSPAR 2008	BAC limit times 20 (OSPAR ²)
Herring, muscle	<i>Clupea harengus</i>	High	1600	L	OSPAR 2008	EAC limit
PCB (CB 180)						
Mussels	<i>Mytilus</i> sp. ¹	Low	0.6	D	OSPAR 2008	BAC limit
Mussels	<i>Mytilus</i> sp.	High	24	D	OSPAR 2008	EAC limit
Atlantic cod, liver	<i>Gadus morhua</i>	Low	0.22	W	OSPAR 2008	BAC limit times 2 (OSPAR ²)
Atlantic cod, liver	<i>Gadus morhua</i>	High	480	L	OSPAR 2008	EAC limit
Herring, muscle	<i>Clupea harengus</i>	Low	2.2	W	OSPAR 2008	BAC limit times 20 (OSPAR ²)
Herring, muscle	<i>Clupea harengus</i>	High	480	L	OSPAR 2008	EAC limit
DDE (as DDT representative)						
Mussels	<i>Mytilus</i> sp. ¹	Low	0.63	D	OSPAR 2008	BAC limit
Mussels	<i>Mytilus</i> sp.	High	6.3	D		Taken as 10 times "Low"
Atlantic cod, liver	<i>Gadus morhua</i>	Low	0.2	L	OSPAR 2008	BAC limit times 2 (OSPAR ²)
Atlantic cod, liver	<i>Gadus morhua</i>	High	150	L		Taken as 750 times "Low" (median of High:Low ratio for CBs)
Herring, muscle	<i>Clupea harengus</i>	Low	2	L	OSPAR 2008	BAC limit times 20 (OSPAR ²)
Herring, muscle	<i>Clupea harengus</i>	High	150	L		Taken as the same for cod, in pattern with CB's EACs

Cadmium

Generally low or moderate concentrations of cadmium for 1998-2008 were found in mussels and fish of the North-East Atlantic, fish in the Baltic Sea, and mussels in the Mediterranean. Generally no trends were found for cadmium in mussels and fish of the North-East Atlantic, fish in the Baltic Sea, and mussels in the Mediterranean, which is a positive indication considering that concentrations are generally low or moderate.

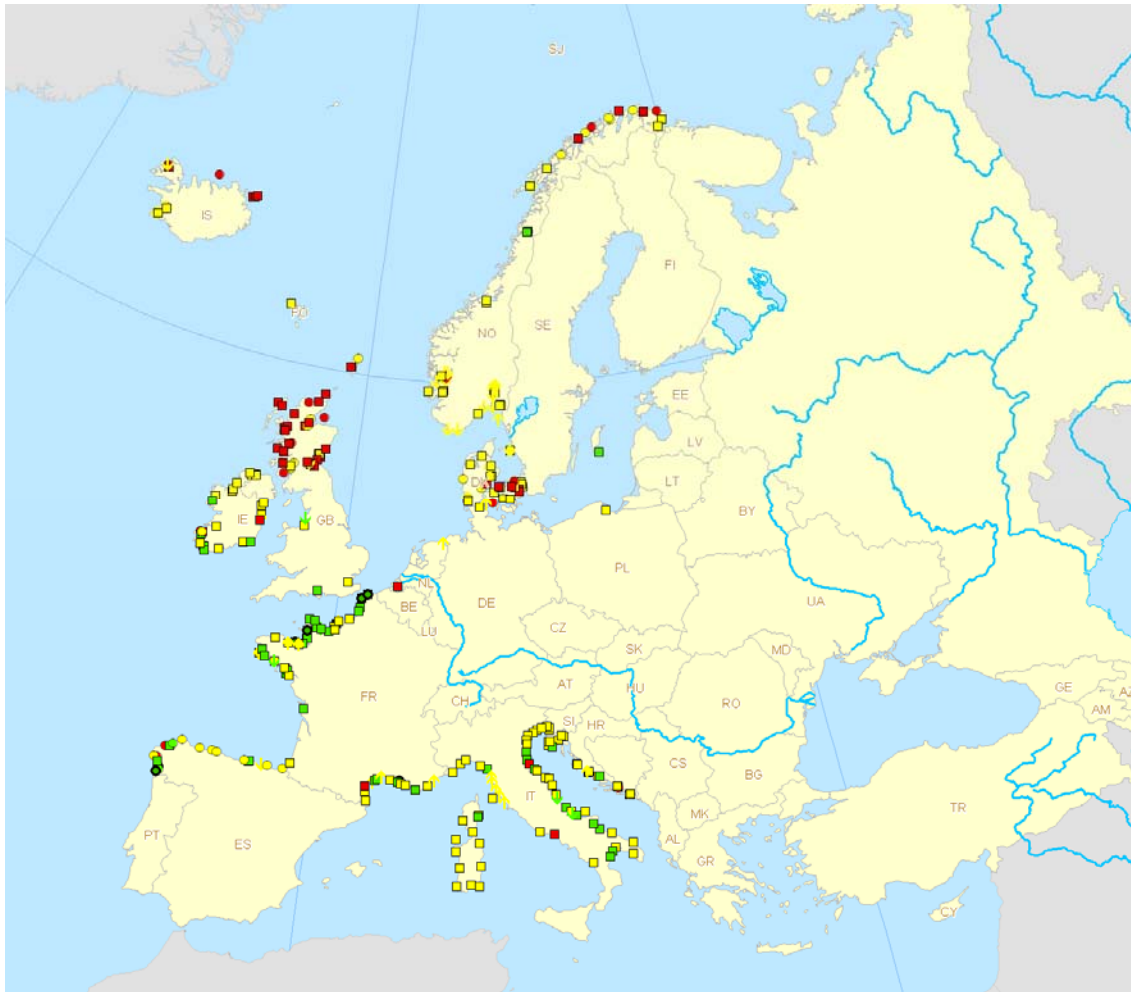


Figure 2.3.2.1 Trends and Low, Moderate and High concentrations of cadmium in biota in European Seas

Notes: The arrows indicate direction of trend (if any) and the colour indicates the concentration category for Low (green), Moderate (yellow) and High (red) for the latest period. (See Table 3 for description of symbols).

Sources: Data from HELCOM, OSPAR and EEA member countries.

Mercury

Generally low or moderate concentrations of mercury for 1998-2008 were found in mussels and fish of the North-East Atlantic, fish in the Baltic Sea, and mussels in the Mediterranean. Generally no trends were found for mercury in mussels and fish of the North-East Atlantic, fish in the Baltic Sea, and mussels in the Mediterranean, which is a positive indication considering that concentrations are generally low or moderate. However, the relatively large number of upward trends compared to downward trends should be a warning sign.

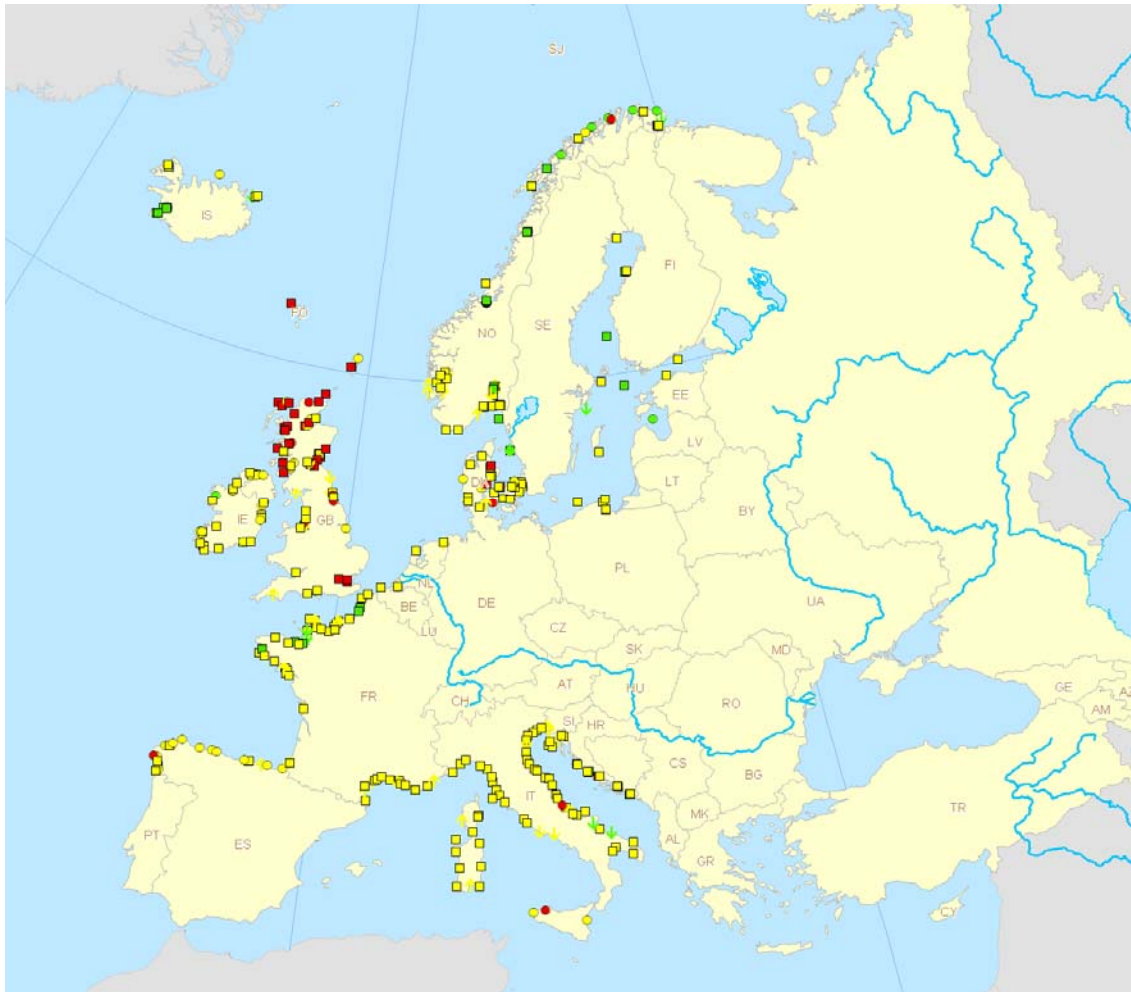


Figure 2.3.2.2 Trends and Low, Moderate and High concentrations of mercury in biota in European Seas

Notes: Arrows indicate direction of trend (if any) and colour indicates concentration category for Low (green), Moderate (yellow) and High (red) for latest period. (See Table 3 for description of symbols).

Sources: Data from HELCOM, OSPAR and EEA member countries.

Lead

Generally moderate concentrations of lead for 1999-2008 were found in mussels and fish of the North-East Atlantic but high concentrations were found in the Baltic and Mediterranean Seas. Generally no trends were found for lead, which should be a warning signal considering the predominance of elevated levels.

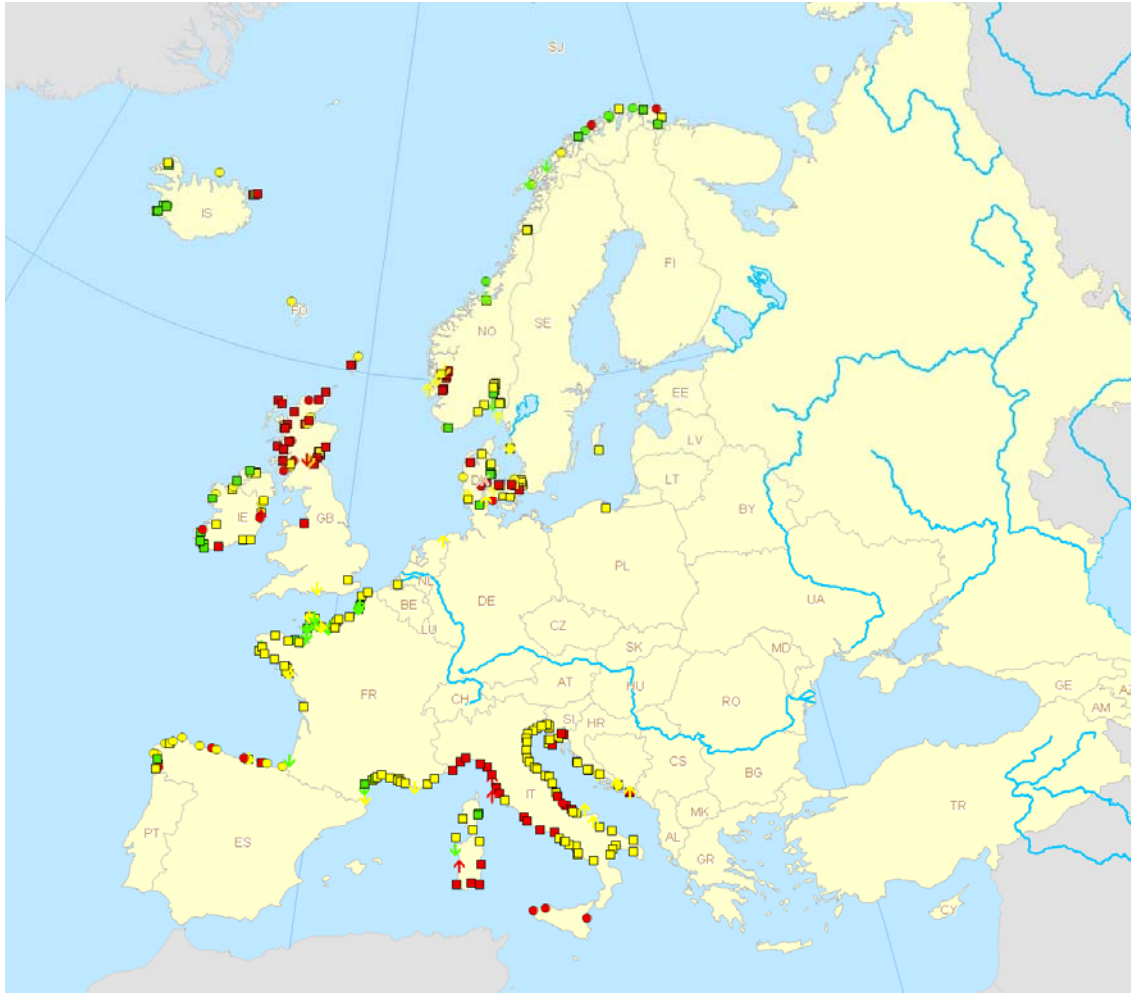


Figure 2.3.2.3 Trends and Low, Moderate and High concentrations of lead in biota in European Seas

Note: The arrows indicate direction of trend (if any) and the colour indicates the concentration category for Low (green), Moderate (yellow) and High (red) for the latest period. (See Table 3 for description of symbols).

Sources: Data from HELCOM, OSPAR and EEA member countries.

Hexachlorobenzene (HCB)

Generally, moderate concentrations of HCB for 1999-2009 were found in the north-east Atlantic, the Baltic Sea and the Mediterranean Sea. Generally no trends or a predominance of downward trends were found for HCB, which is a positive, however that so many moderate concentrations are registered should be a warning sign.

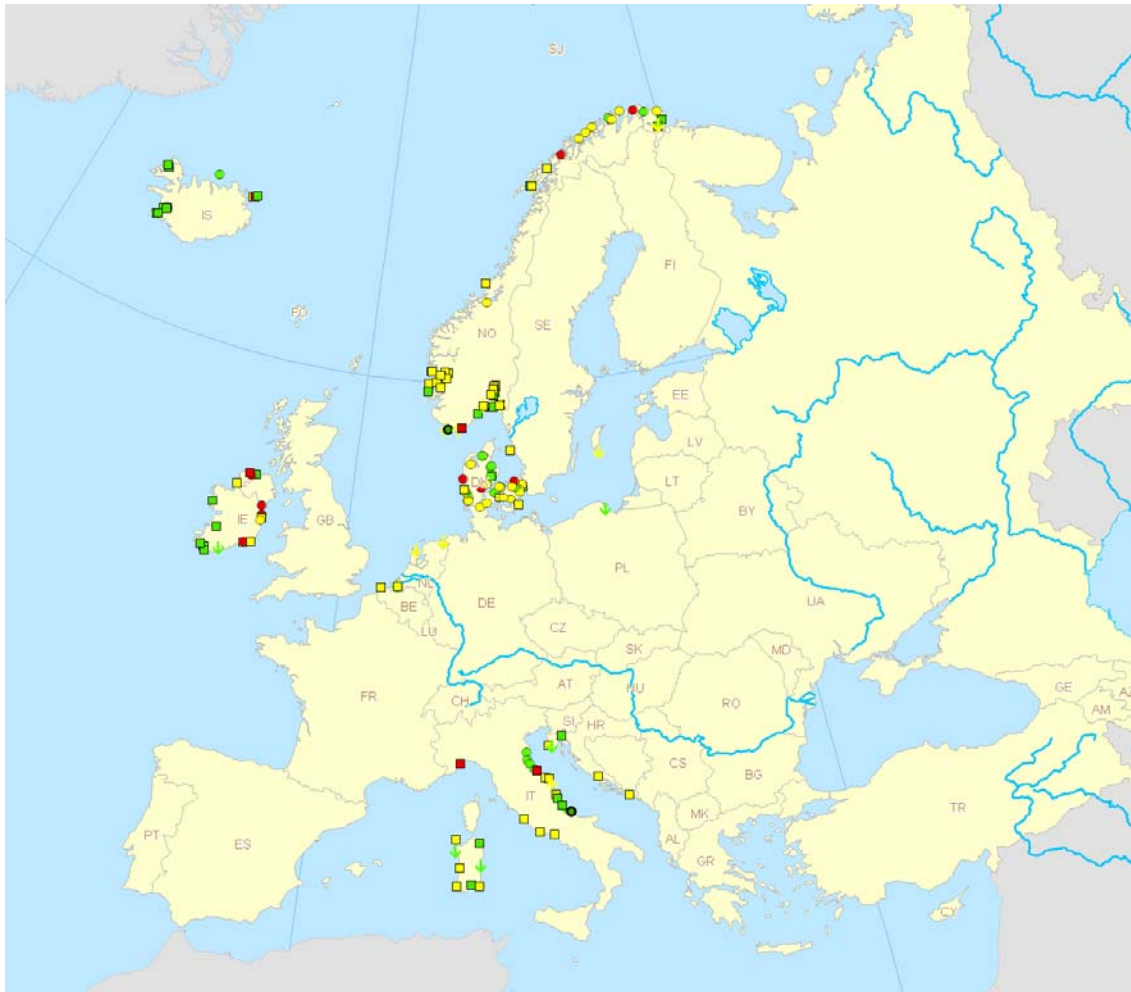


Figure 2.3.2.4 Trends and Low, Moderate and High concentrations of HCB in biota in European Seas

Notes: HCB = hexachlorobenzene. The arrows indicate direction of trend (if any) and colour indicates the concentration category for Low (green), Moderate (yellow) and High (red) for the latest period. (See Table 3 for description of symbols).

Sources: Data from HELCOM, OSPAR and EEA member countries.

Gamma-HCH (Lindane)

Generally low concentrations of lindane for 1999-2008 were found in the North-East Atlantic, but a predominance of high concentrations were found the Baltic and Mediterranean Seas. No trends or only downward trends were found for lindane, which is positive, however the high concentrations found should be a warning sign.

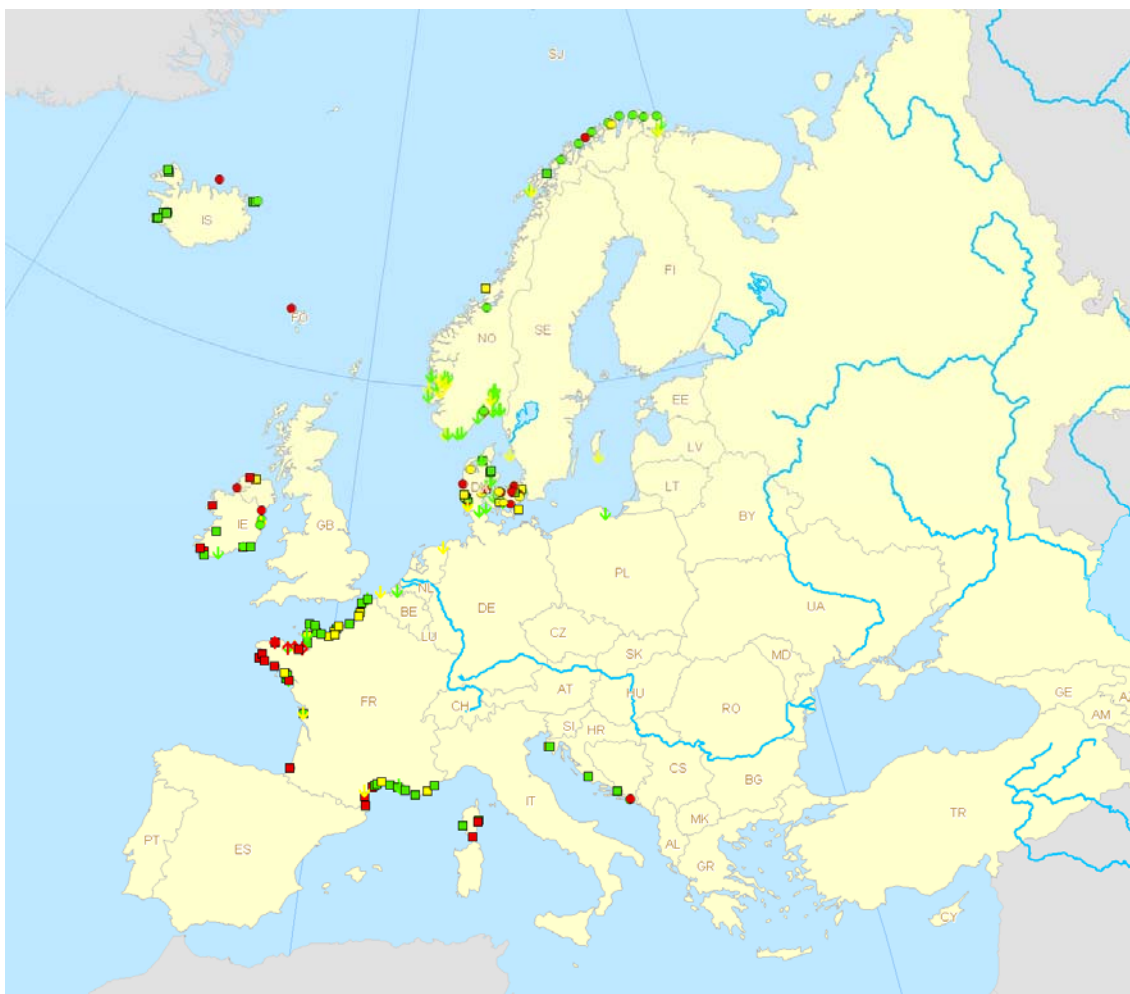


Figure 2.3.2.5 Trends and Low, Moderate and High concentrations of lindane in biota in European Seas

Notes: Lindane = gamma hexachlorocyclohexane (γ HCH). The arrows indicate direction of trend (if any) and the colour indicates the concentration category for Low (green), Moderate (yellow) and High (red) for the latest period. (See Table 3 for description of symbols).

Sources: Data from HELCOM, OSPAR and EEA member countries.

PCB

Generally High concentrations of PCB for 1999-2008 were found in all three seas, more evident in the north-east Atlantic. Generally there was a predominance of downward trends over upward trends, which is a positive, however, the large number high concentrations and no trends should be a warning sign.

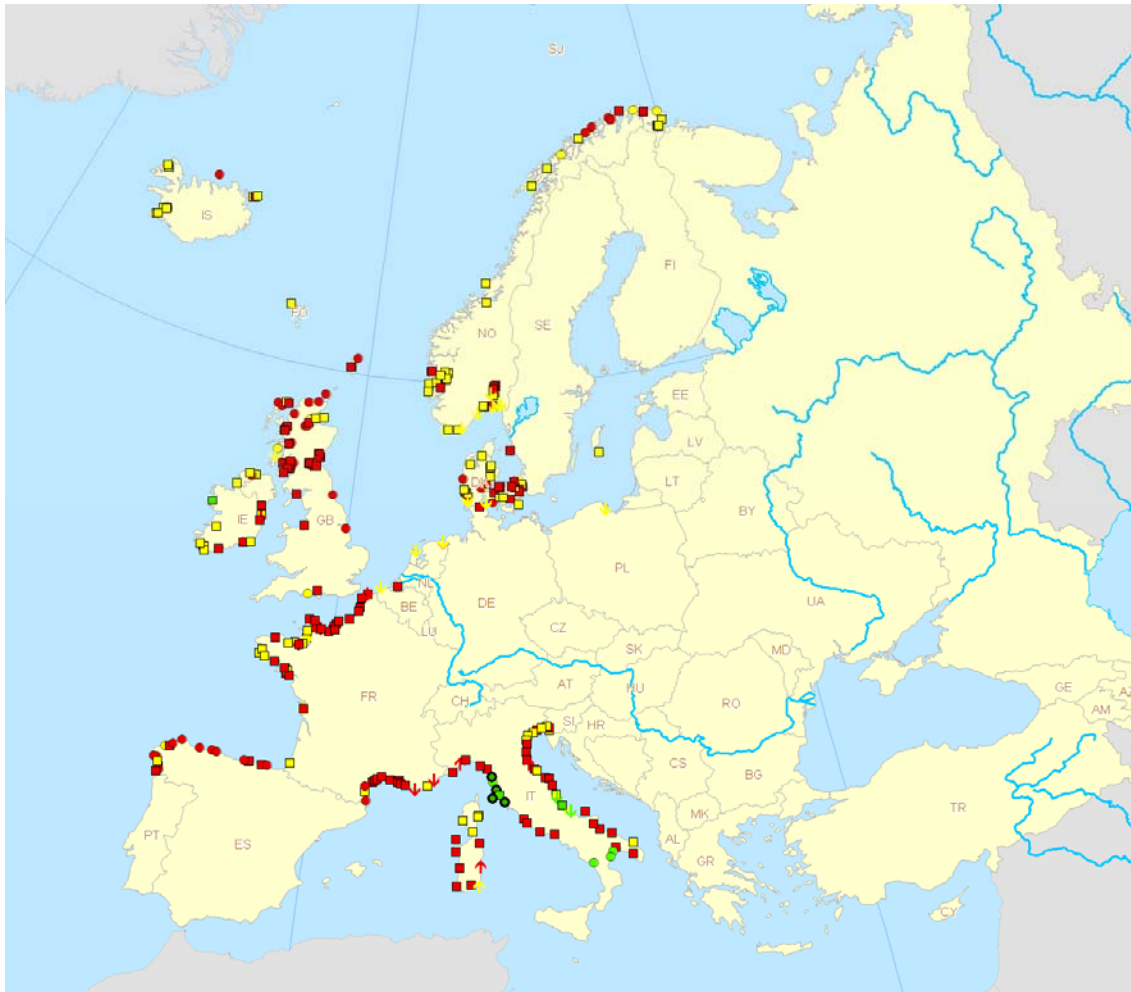


Figure 2.3.2.6 Trends and Low, Moderate and High concentrations of PCB in biota in European Seas

Notes: PCB = assessment based on the classification of the second highest congener of polychlorinated biphenyl (PCB) congeners 28, 52, 101, 118, 138, 153 and 180. The arrows indicate direction of trend (if any) and colour indicates the concentration category for Low (green), Moderate (yellow) and High (red) for the latest period. (See Table 3 for description of symbols).

Sources: Data from HELCOM, OSPAR and EEA member countries.

DDT

A predominance of high concentrations of DDT for 1999-2008 were found more so in the Atlantic and Mediterranean than in the Baltic. Generally downward trends if significant trends were found, which is a positive, however, the large number of no trends and abundance of high concentrations should be a warning sign.

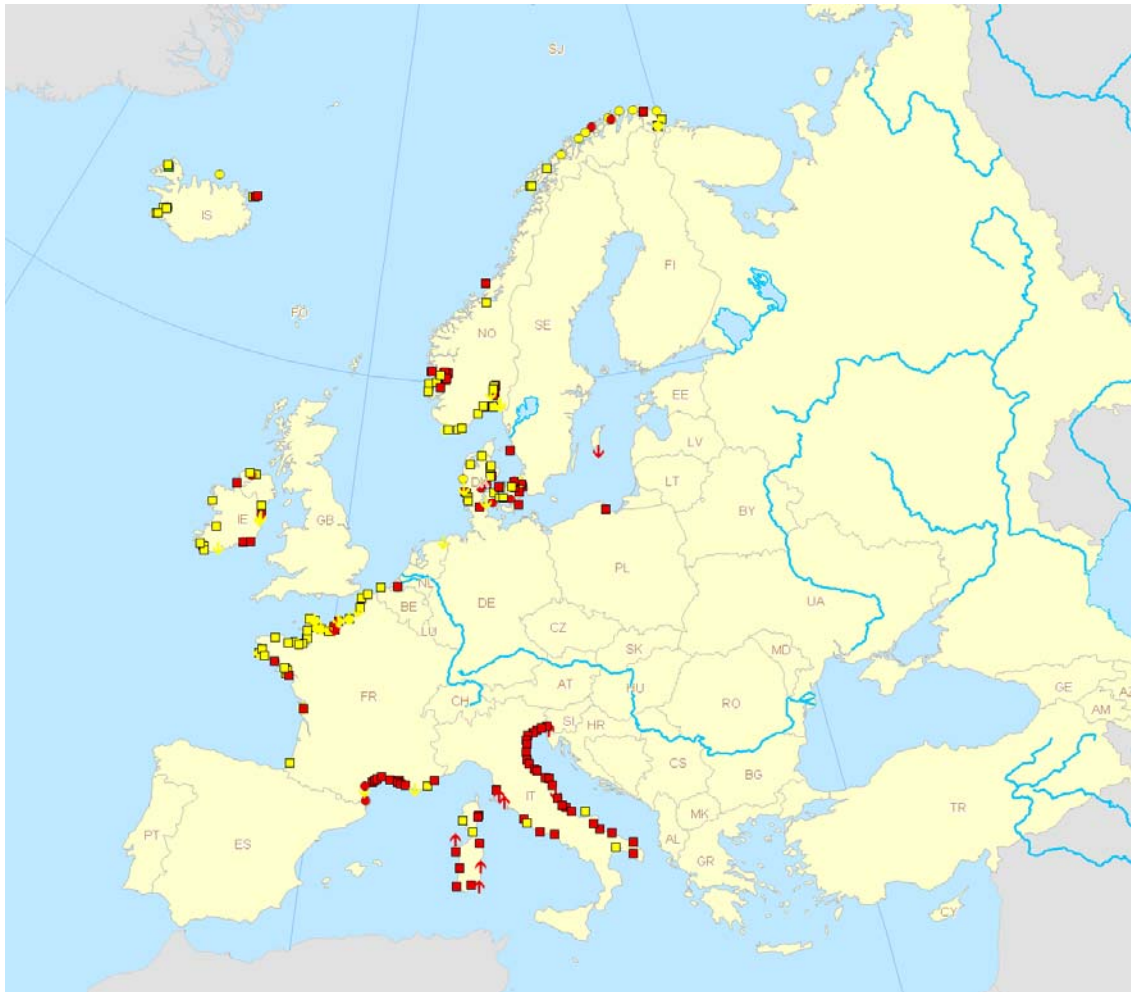


Figure 2.3.2.7 Trends and Low, Moderate and High concentrations of DDT in biota in European Seas

Notes: DDT using DDE as a surrogate. The arrows indicate direction of trend (if any) and colour indicates the concentration category for Low (green), Moderate (yellow) and High (red) for the latest period. (See Table 3 for description of symbols).

Sources: Data from HELCOM, OSPAR and EEA member countries.