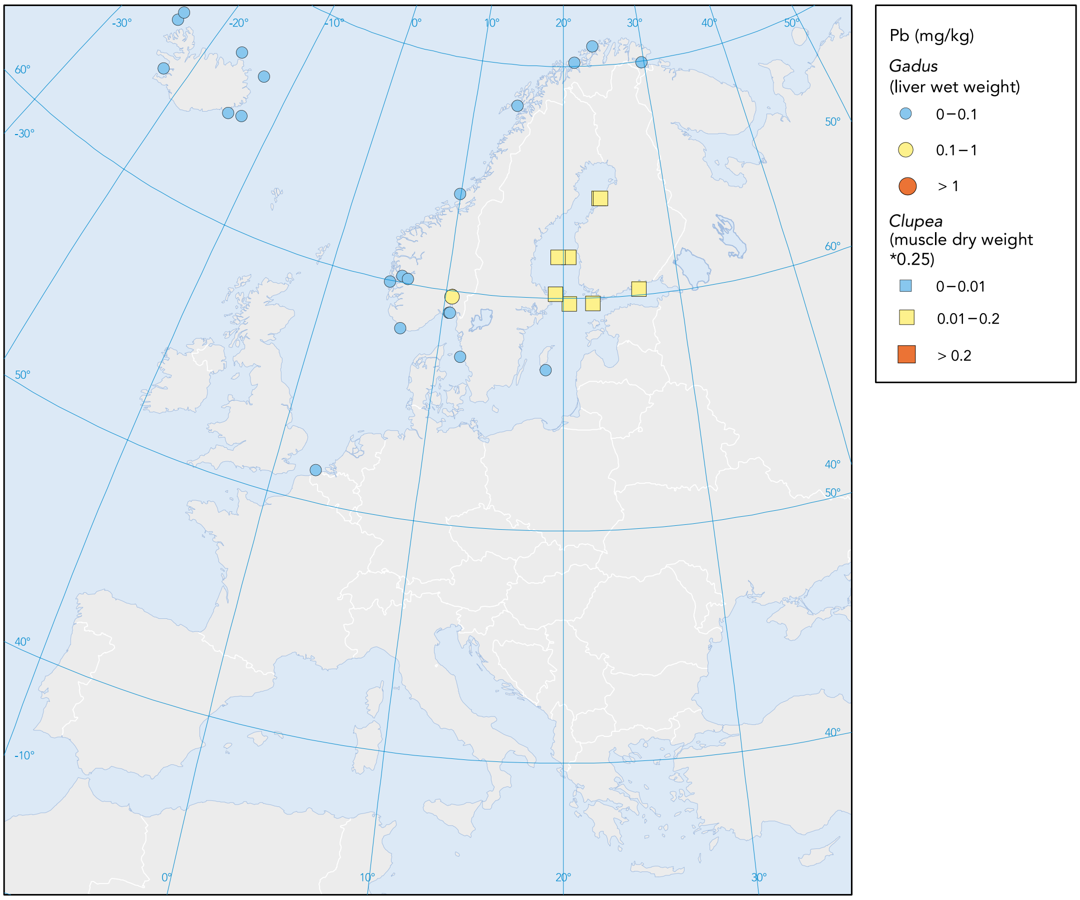
Figure 6.12

Lead (Pb) in liver of cod *(Gadus morhua)* and muscle of herring *(Clupea harrengus)*, median mg/kg wet weight for 1995–1999



Notes: See Table 6.1 for basis of classification. EU legislation limit for lead in foodstuff muscle of fish is 0.2 mg/kg wet weight (EU, 2002). Based on data from ICES, see also Table A.3. NB: larger symbols may obscure other symbols.

and fjords, which were closer to the sources of land-based diffuse pollution.

In contrast to cadmium, lead is extensively recycled because it is associated with many products that are recycled. Its use as an additive to petrol has decreased drastically over the past decade. However, there is a wide range of diffuse sources for lead in addition to point sources. Lead is used, for example, in batteries, ammunition, boat keels, weights (nets, etc), paints, electronic equipment and solder. Although many of the above products lend themselves to recycling, there is an obvious potential for emissions, e.g. through waste incineration and leaching from landfills. Mining and smelting of lead ore is a substantial local source of lead inputs to marine ecosystems.

Figure 6.13 **Lead (Pb) time trend in blue mussel *(Mytilus edulis)* in the North-East Atlantic and the Mediterranean mussel *(M. galloprovincialis)* 1985–1999 (see Table 6.4)**

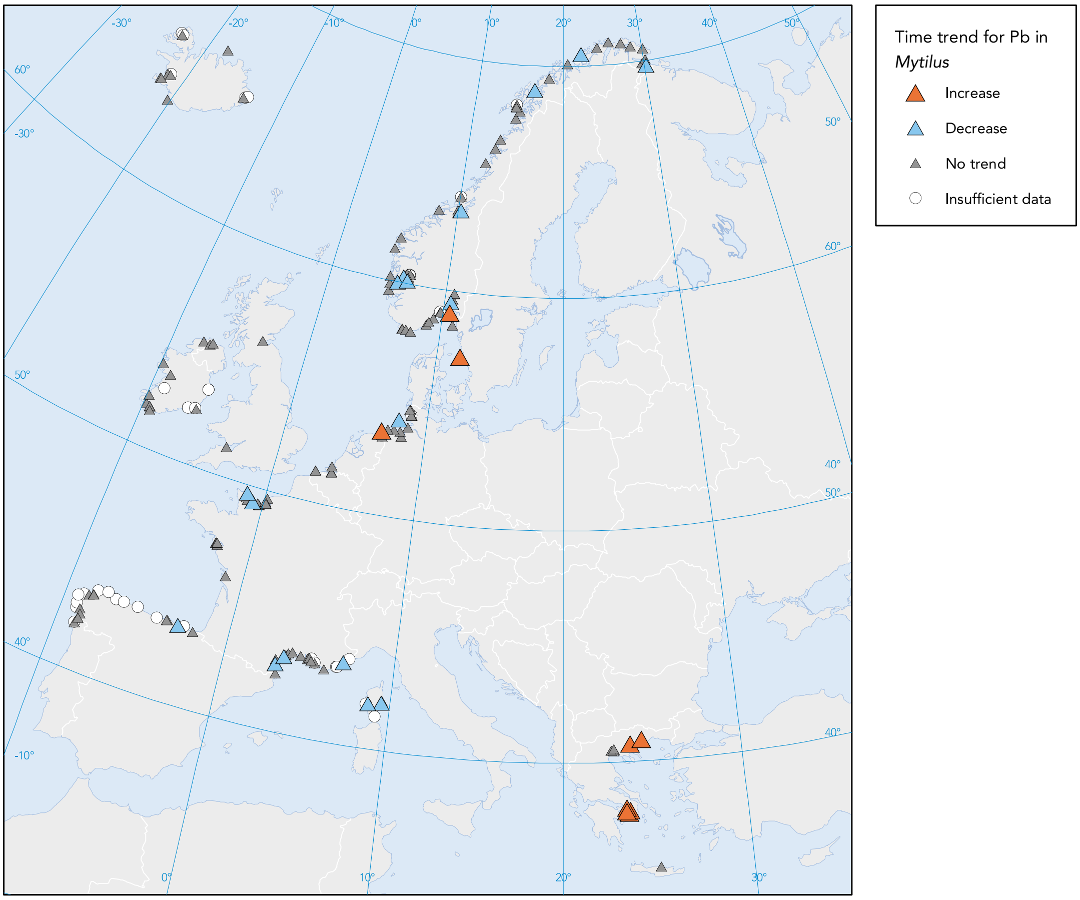
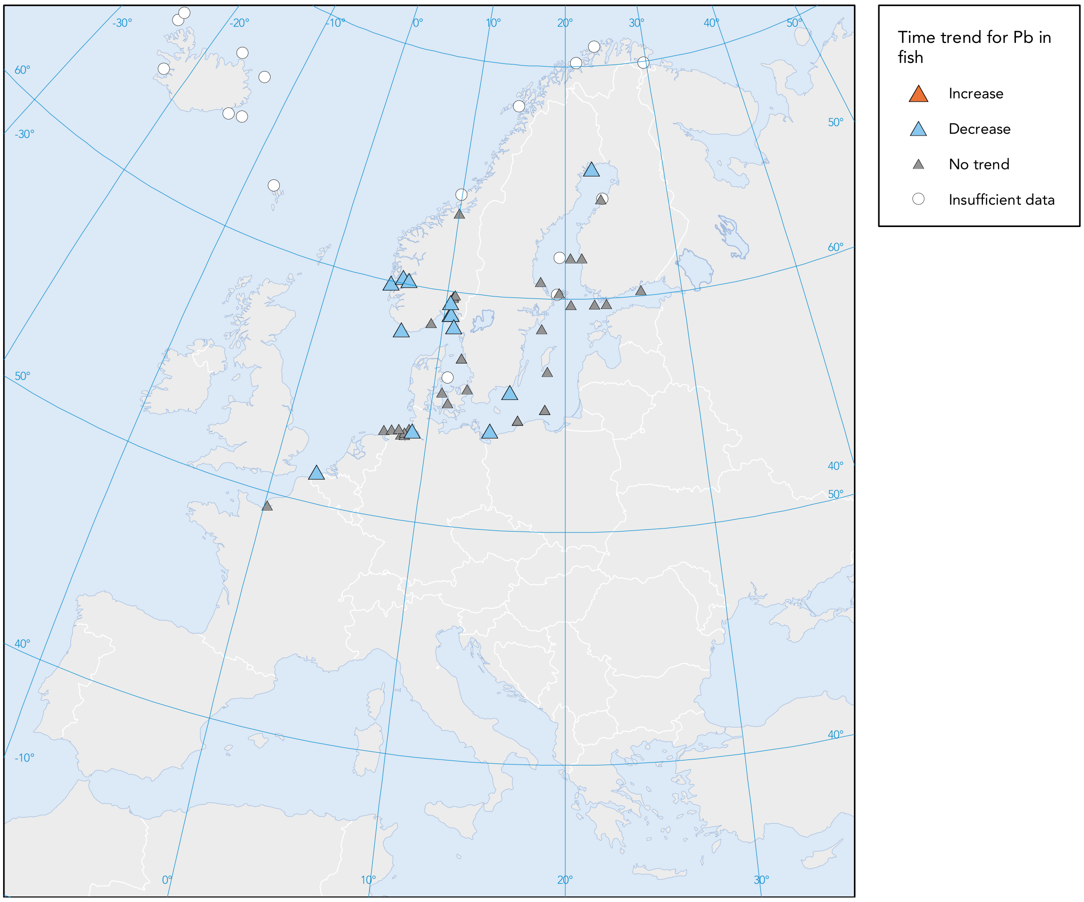


Figure 6.14 **Lead (Pb) time trend in cod liver, herring liver/muscle, flounder liver, 1986–1999 (see Table 6.4)**

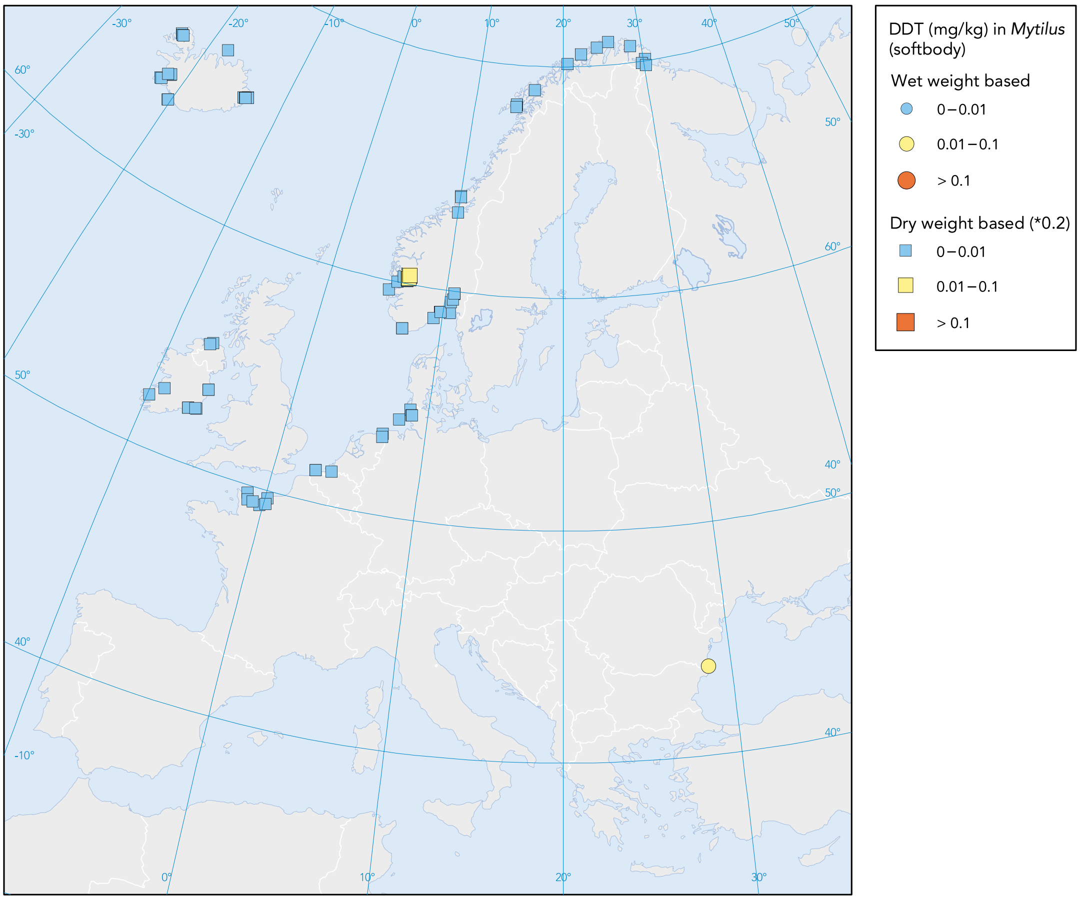


Subindicator summary assessment for DDT in mussels and fish from the North-East Atlantic, Baltic Sea, Mediterranean Sea and Black Sea — Table 6.5

		Spatial variation			Time trends		
Sea region	**Sub-indicator**	**Total no. of stations**	**Number over low**	**Number over high**	**Total no. of stations**	**Number down**	**Number up**
North-East Atlantic	Mussels	78	3	0	98	3	1
	Fish	26	4	0	55	3	1
Baltic Sea	Mussels	0			1	0	0
	Fish	14	0	0	24	7	0
Mediterranean Sea	Mussels	0			0		
	Fish	0			0		
Black Sea	Mussels	1	1	0	0		
	Fish	0			0		

Notes: See Table 6.1 for selection of indicator species and low/high concentrations limits. See also results in maps in Figures 6.15–6.18.

DDT (expressed as DDE+DDD) in mussels *(Mytilus edulis* — North-East Atlantic; *M. galloprovincialis* — Mediterranean and Black Sea), median mg/kg wet weight for 1995–1999 (2001 for Black Sea) — Figure 6.15



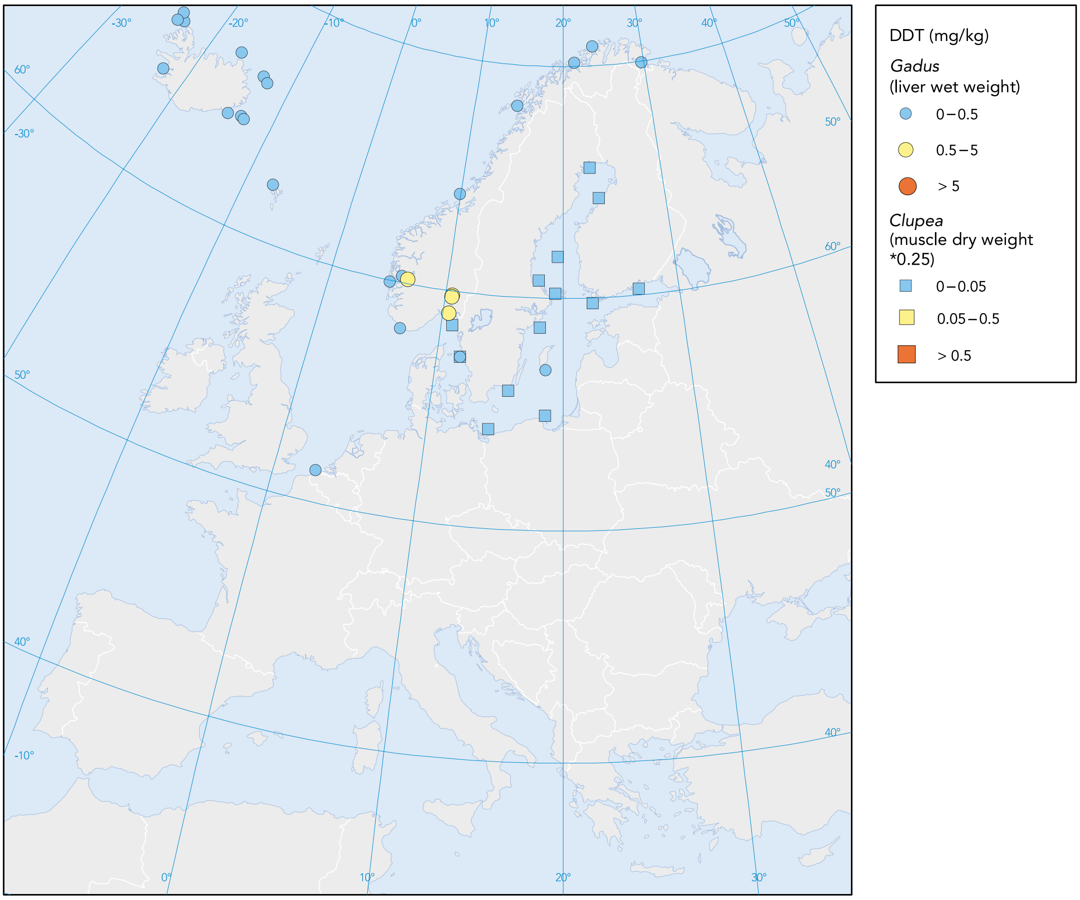
Notes: See Table 6.1 for basis of classification. Based on data from OSPAR and EEA member countries (Mediterranean), and data reported by Romania, see also Table A.4. NB: larger symbols may obscure other symbols.

6.3.4. DDT

The regional assessment of time trend indicated a decreasing trend for DDT in mussels from the North-East Atlantic (Figure 6.1). The DDT level in herring muscle in the Baltic decreased. The levels in Atlantic cod have varied considerably.

With respect to the station-by-station overview of 1995–1999, levels of DDT in blue mussels were low all over Europe (Table 6.5, Figure 6.15). Concentrations above background levels have only been observed in mussels collected from a site in the Sørfjord, western Norway. The lack of change

Figure 6.16 **DDT (expressed as DDE+DDD) in liver of cod *(Gadus morhua)* and muscle of herring *(Clupea harrengus)*, median mg/kg wet weight for 1995–1999**



Notes: See Table 6.1 for basis of classification. NB: larger symbols may obscure other symbols.

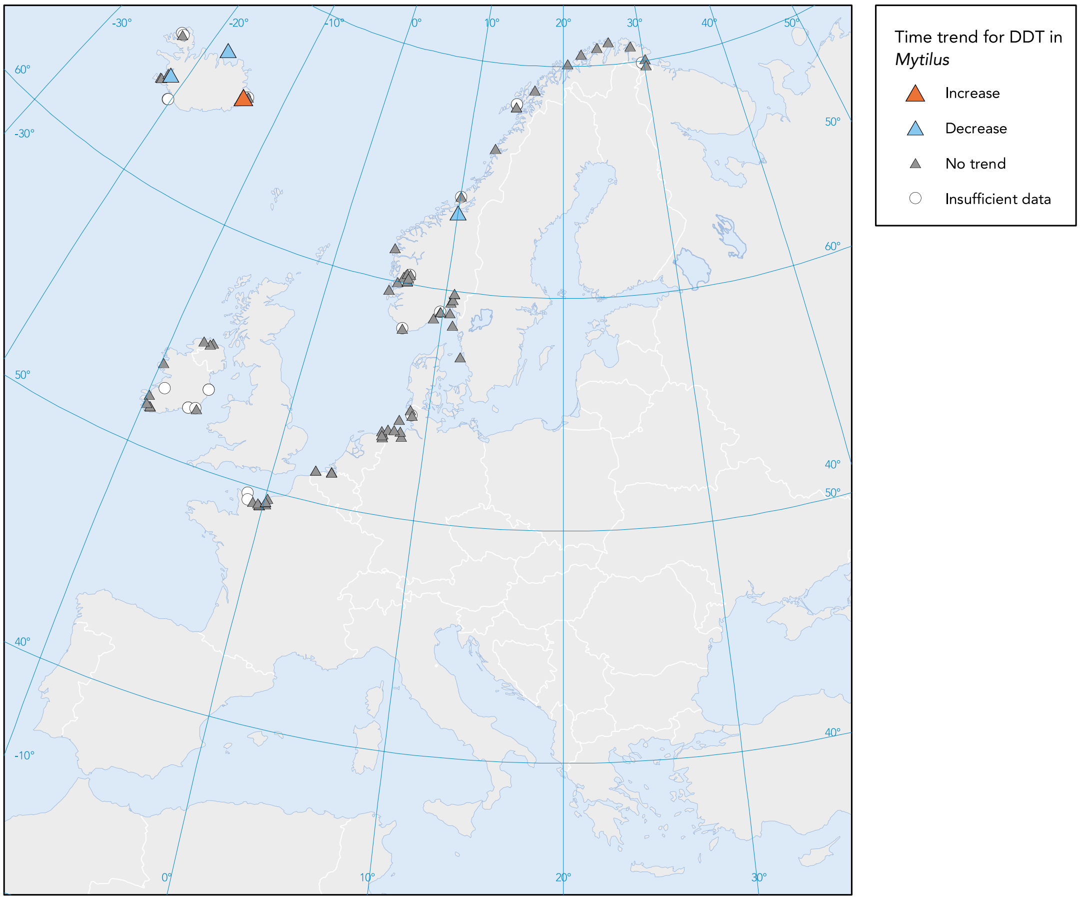
in DDT concentration in mussels at most sites presumably indicates that the current background level was maintained through ecosystem recycling or inputs through slow leaching or long-range transport.

Similarly to the levels in blue mussels, concentrations of DDT in Atlantic cod liver were at background levels in most areas, even in the Baltic (Figure 6.16). Somewhat elevated concentrations, but below 10 times the background levels, were found at three locations in Norway. The sites reflected both fresh discharges of DDT (by leaching from containers or waste) and leaching from old deposits.

For the Black Sea, too little data were available to make assessments. The concentration of DDT in mussels for the single location with data on the Romanian coast were all in the intermediate range (map in Figure 6.15), but this may not be representative for the region.

Of the 178 temporal trends analysed (99 for mussels, 79 for fish) only 15 were significant, and 13 were down (Table 6.5, Figures 6.17 and 6.18). As expected, DDT concentrations in fish have decreased in most areas, including the Baltic and the Scheldt (Rhine estuary). An exception was cod from the Oslofjord and the southeast coast of Iceland. There was no known reason for the increase found at the one site in eastern Iceland. As was the case for the metals, substantial long-term trends might be undetected due to insufficient data. Statistically significant trends were found mainly at locations in estuaries and fjords, which were closer to sources of land-based diffuse pollution.

DDT (expressed as DDE+DDD) time trend in blue mussel *(Mytilus edulis)* in the North-East Atlantic 1985–1999 (see Table 6.5) Figure 6.17



DDT (expressed as DDE+DDD) time trend in cod liver, herring liver/muscle, 1986–1999 (see Table 6.5) Figure 6.18

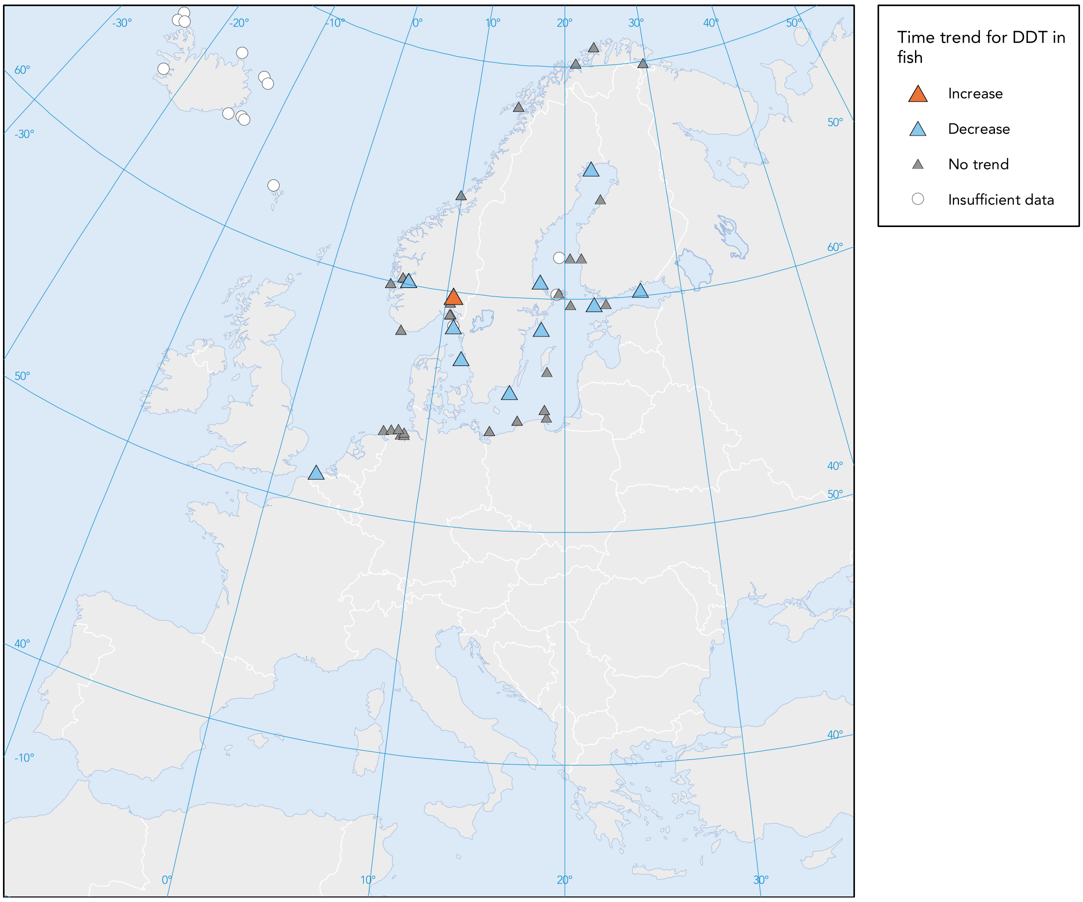
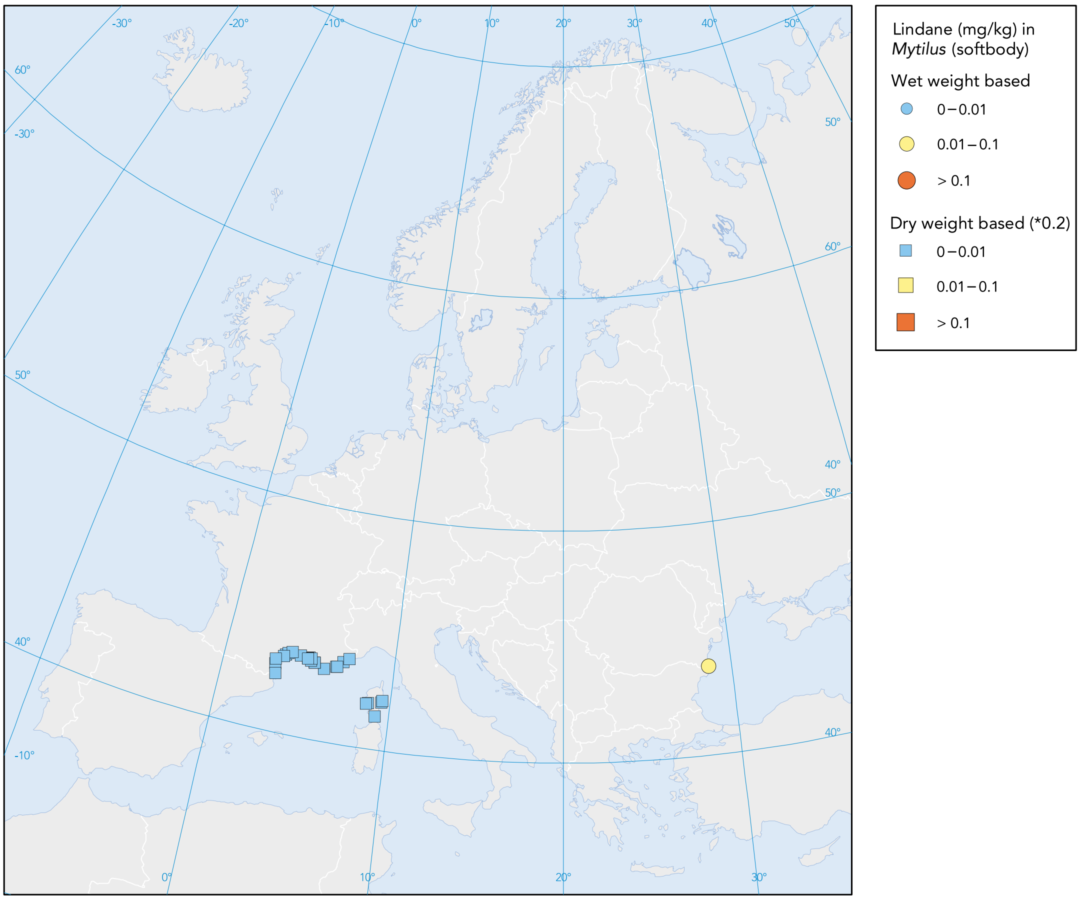


Table 6.6 **Subindicator summary assessment for lindane in mussels and fish from the North-East Atlantic, Baltic Sea, Mediterranean Sea and Black Sea**

		Spatial variation			Time trends		
Sea region	**Sub-indicator**	**Total no. of stations**	**Number over low**	**Number over high**	**Total no. of stations**	**Number down**	**Number up**
North-East Atlantic	Mussels	0			0		
	Fish	0			0		
Baltic Sea	Mussels	0			0		
	Fish	0			0		
Mediterranean Sea	Mussels	25	0	0	25	7	0
	Fish	0			0		
Black Sea	Mussels	1	1	0	0		
	Fish	0			0		

Notes: See Table 6.1 for selection of indicator species and low/high concentrations limits. See also results in maps in Figures 6.19–6.20.

Figure 6.19 **Lindane in mussels *(Mytilus galloprovincialis* — Mediterranean and Black Sea), median mg/kg wet weight for 1995–1999 (2001 for Black Sea). See Table 6.1 for basis of classification.**



6.3.5. Lindane

The regional assessment of time trend for lindane in Mediterranean mussels indicated a decreasing trend (Figure 6.1). For the Black Sea, too little data were available to make a regional assessment for this sea. The available data for the Black Sea were from a single location on the Romanian coast. This could not be considered representative for the region.

The station-by-station overview of 1995–1999 levels of lindane covered sites along the French Mediterranean coast and a single station on the Romanian coast of the Black Sea (Figure 6.19). An elevated level was

Lindane time trend in Mediterranean mussel *(Mytilus galloprovincialis)* 1985–1999 (see Table 6.6) Figure 6.20

found only at the Romanian station (Figure 6.19).

Of the 25 temporal trends (all mussel stations from the French Mediterranean coast) analysed, seven were significant, all down (Table 6.6 and map in Figure 6.20). Substantial long-term trends might be undetected due to insufficient data. The French data indicated decreased concentrations in mussels which tallies with the known decrease in use of this pesticide.

6.3.6. PCB

The regional assessment of time trend indicated a decreasing trend for PCB_7 in mussels from the North-East Atlantic and for herring muscle in the Baltic (Figure 6.1). Since 1990, the levels in Atlantic cod have increased slightly. For this species, the abrupt reduction from a high level in 1989 to more constant levels afterwards was probably an artefact, e.g. due to changes in geographical coverage that the general linear model (GLM) analysis had not been able to correct for.

The station-by-station overview of 1995–1999 levels of PCB_7 in blue mussel reflects the general exposure pattern for this group of substances. It also indicates that long-distance atmospheric transport was less important in temperate parts of Europe than regional or local sources. Aggregated levels (regional assessments) in cod have fluctuated since 1990 with no clear trend one way or the other (Figure 6.1). Concentrations of PCB_7 were generally found at natural high background levels in areas remote from industrial or urban inputs (Figures 6.21 and 6.22). High levels were found in estuaries draining large rivers, e.g. the Seine, Rhine and Ems. In addition, somewhat elevated concentrations were found along the entire northern coast of Spain with local hot spots in the industrialised river valleys. PCB_7 concentrations were also elevated in the area around the inner Oslofjord. Higher concentrations might be found in comparable estuaries around Europe, but limited data coverage (e.g. no UK data) precludes general assessment.

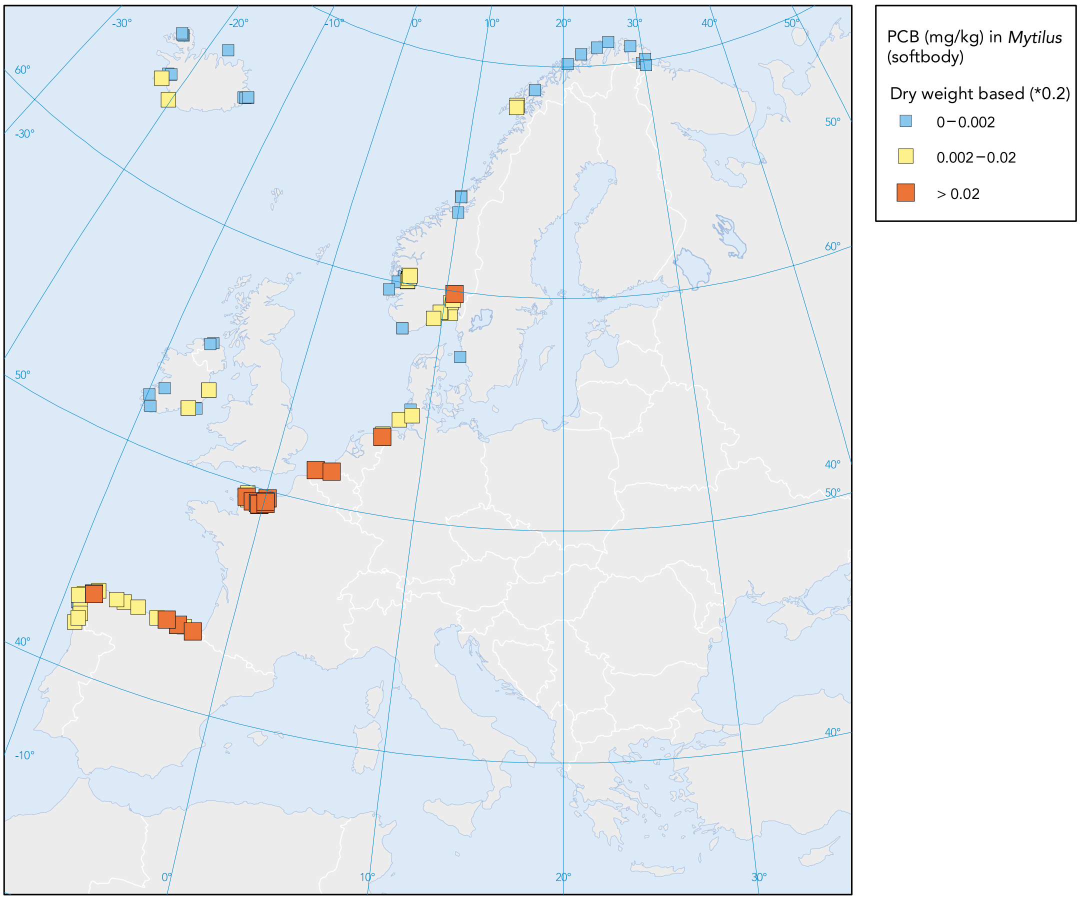
Data for PCB_7 concentrations in fish have a more limited geographical coverage than for blue mussel (Figure 6.22). The data basically show that a species high in the food chain, such as cod, bio-accumulate PCB to

Table 6.7 **Subindicator summary assessment for PCB_7 in mussels and fish from the North-East Atlantic and Baltic Sea**

		Spatial variation			Time trends		
Sea region	**Sub-indicator**	**Total no. of stations**	**Number over low**	**Number over high**	**Total no. of stations**	**Number down**	**Number up**
North-East Atlantic	Mussels	103	32	17	121	10	0
	Fish	24	15	2	70	4	0
Baltic Sea	Mussels	1	0	0	1	0	0
	Fish	12	0	0	16	4	0

Notes: See Table 6.1 for selection of indicator species and low/high concentrations limits. See also results in maps in Figures 6.21-6.24.

Figure 6.21 **PCB_7 in mussels (*Mytilus edulis* — North-East Atlantic, median mg/kg wet weight for 1995–1999**

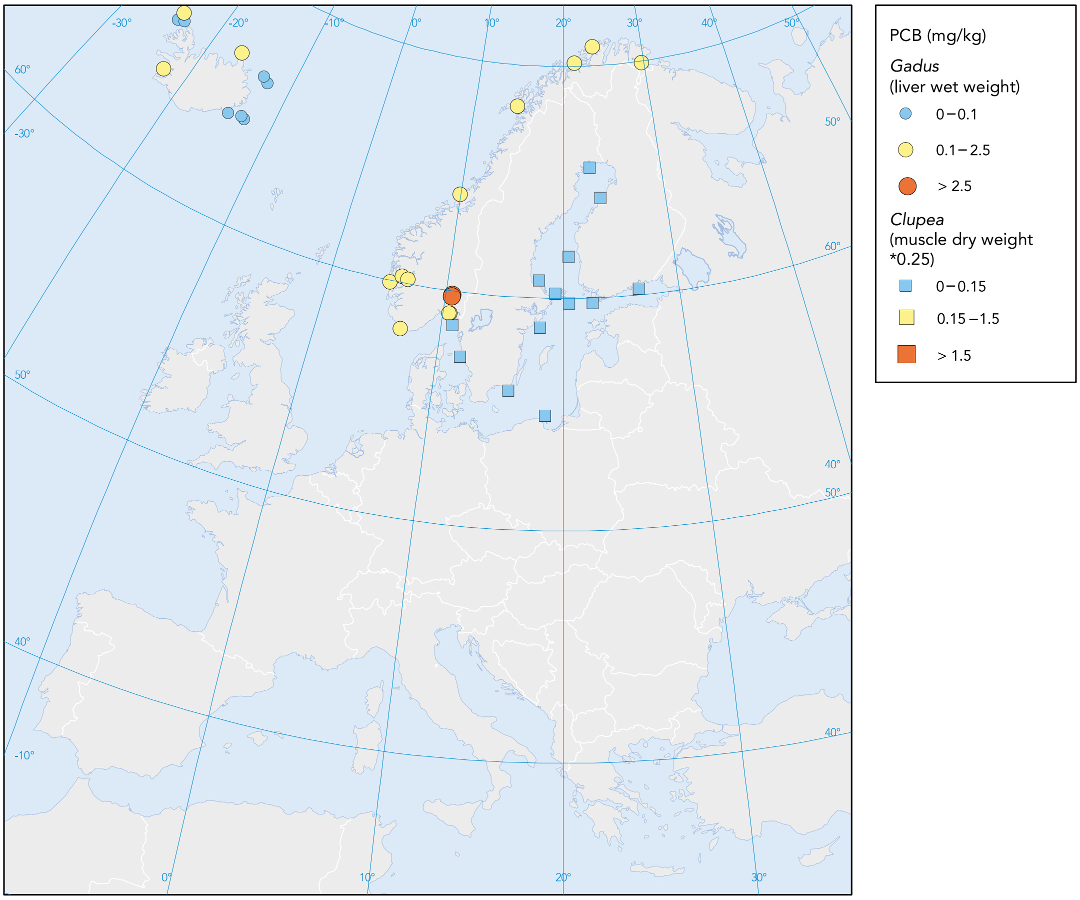


Notes: See Table 6.1 for basis of classification. NB: larger symbols may obscure other symbols.

somewhat higher concentrations than blue mussel, for example. Otherwise, the geographical pattern of PCB accumulation in cod fits well with that observed for blue mussel, with high concentrations in the inner Oslofjord. As for blue mussel, time trend data indicates generally decreased PCB_7 exposure of fish in some areas of northern Europe, especially the Baltic. The substantial number of stations with no change, however, suggests that decreasing PCB_7 input into the marine environment is a slow process. There were no available data for the Mediterranean Sea.

A station-by-station statistical analysis included 208 temporal trends (122 for mussels, 86 for fish). Only 18 were significant, all down (Table 6.7, maps in Figures 6.23 and 6.24). PCB_7 inputs in the North-East Atlantic decreased (OSPAR, 2000) and the results for mussels and fish (including the Baltic) also confirm this trend. Again, the substantial number of stations where no trend was detected suggest that decreasing PCB_7 input into the marine environment is a slow process.

PCB_7 in liver of cod *(Gadus morhua)* and muscle of herring *(Clupea harrengus)*, median mg/kg wet weight for 1995–1999 Figure 6.22



Notes: See Table 6.1 for basis of classification. NB: larger symbols may obscure other symbols.

Figure 6.23 **PCB_7 time trend in blue mussel *(Mytilus edulis)* in the North-East Atlantic 1985–1999 (see Table 6.7)**

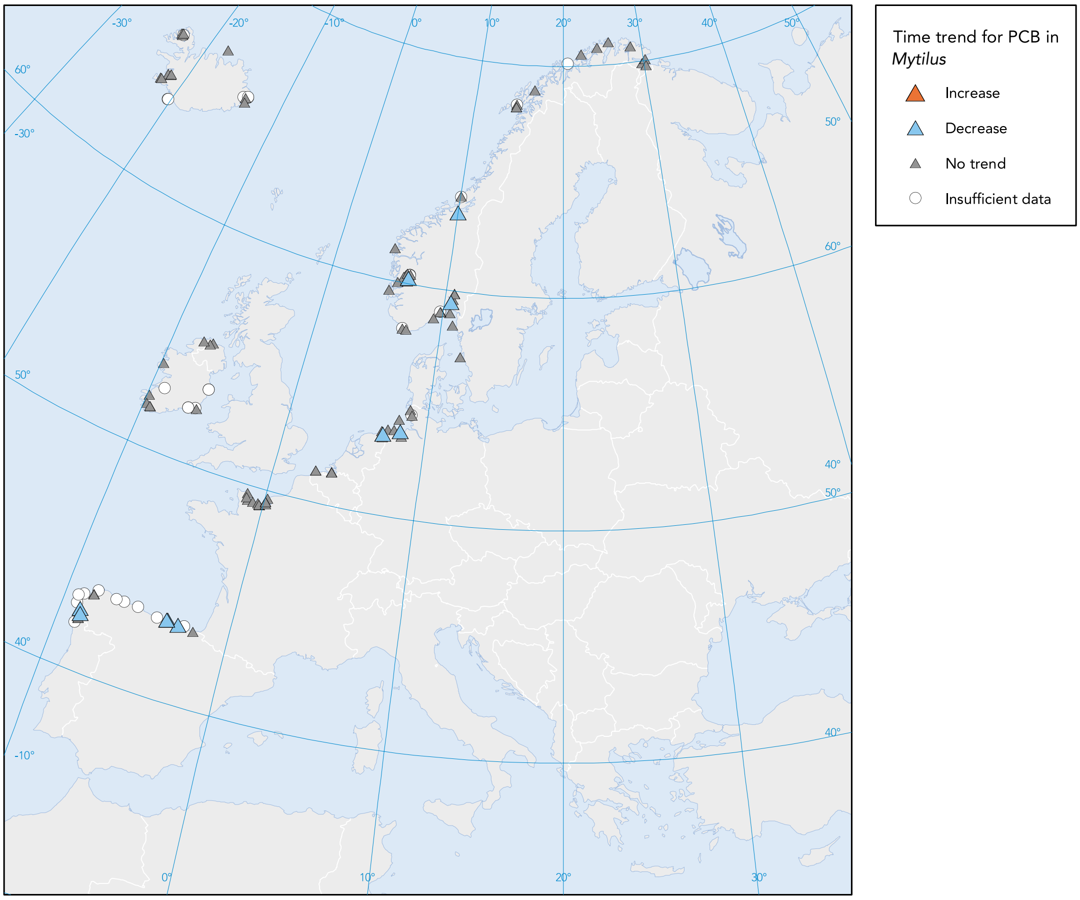
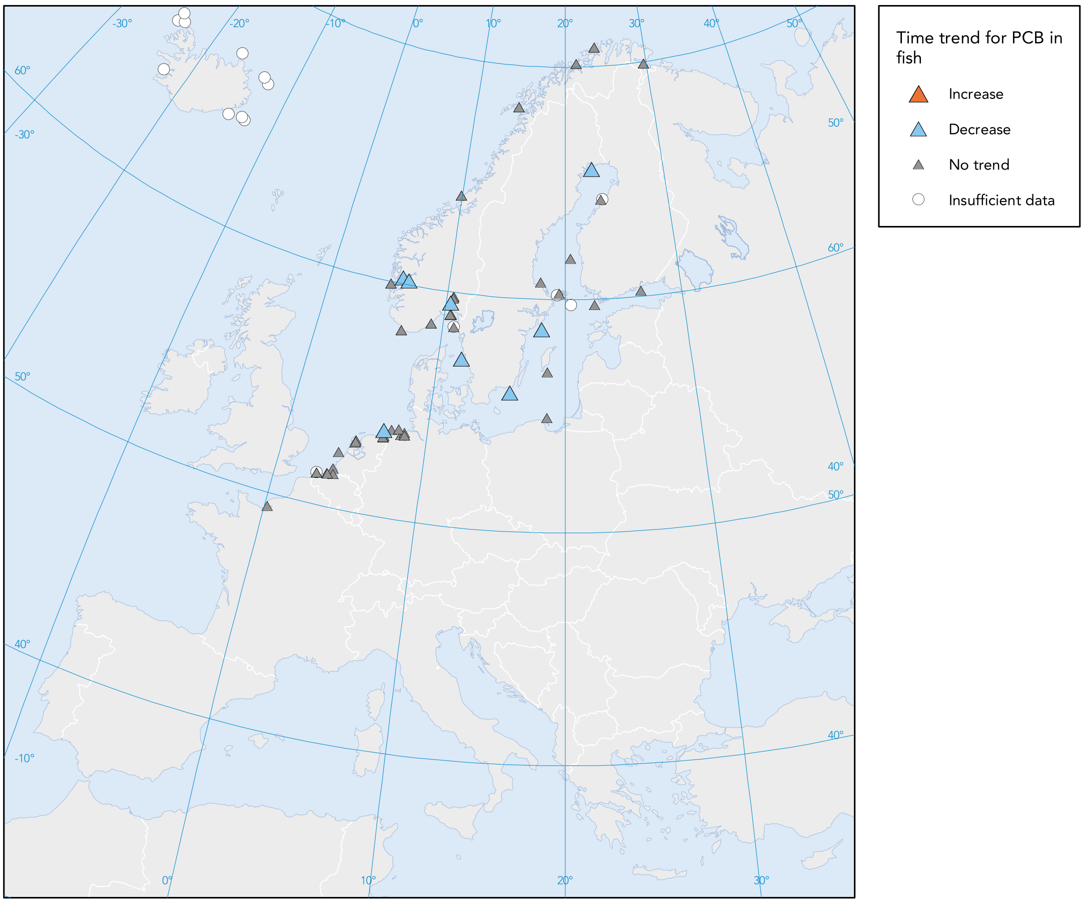


Figure 6.24 **PCB_7 time trend in cod liver, herring liver/muscle, flounder liver 1986–1999 (see Table 6.7)**



7. Response measures

7.1. Overall EU chemicals policy

A strategy for a future chemicals policy has been presented by the Commission (COM(2001) 88). It aims to prevent future environmental hazardous substances problems such as those experienced with POPs. Its overriding goal is sustainable development. The strategy mainly refers to the following four legal instruments on chemicals currently in force in the European Union:

- Council Directive 67/548/EEC relating to the classification, packaging and labelling of dangerous substances, as amended;
- Council Directive 88/379/EEC relating to the classification, packaging and labelling of dangerous preparations, recently replaced by Directive 1999/45/EC;
- Council Regulation (EEC) No 793/93 on the evaluation and control of the risks of existing substances;
- Council Directive 76/769/EEC relating to restrictions on the marketing and use of certain dangerous substances and preparations.

The White Paper (COM(2001) 88) states that the EU chemicals policy must ensure a 'high level of protection of human health and the environment' as enshrined in the Treaty, both for the present generation and future generations; while also ensuring the efficient functioning of the internal market and the competitiveness of the chemical industry.

Fundamental to achieving these objectives is the precautionary principle ([3]). Whenever reliable scientific evidence is available that a substance may have an adverse impact on human health and the environment, but there is still scientific uncertainty about the precise nature or the magnitude of the potential damage, decision-making must be based on precaution in order to prevent damage to human health and the environment. Another important objective is to encourage the substitution of dangerous by less dangerous substances where suitable alternatives are available.

To protect human health and promote a non-toxic environment, the Commission (COM(2001) 88) proposes that existing ([4]) and new ([5]) substances should, in the future, following the phasing in of existing substances until 2012, be subject to the same procedure under a single system. The proposed system is called REACH (registration, evaluation and authorisation of chemicals). The requirements, including testing requirements, of the REACH system depend on the proven or suspected hazardous properties, uses, exposure and volumes of chemicals produced or imported. All chemicals above one tonne should be registered in a central database. At higher tonnage, special attention should be given to long-term and chronic effects.

The Commission (COM(2001) 88) further proposes to implement a step-by-step process to address the 'burden of the past' and to develop adequate knowledge for existing

(3) The precautionary principle is contained in Article 174 of the Treaty and the subject of a Commission Communication of 2 February 2000. It applies when there is a preliminary objective scientific evaluation indicating reasonable grounds for concern that the potentially dangerous effects on the environment, human, animal or plant health may be inconsistent with the high level of protection chosen for the Community.

(4) Existing substances are substances in use within the EU before September 1981 and listed in the European inventory of existing commercial chemical substances (EINECS). EINECS contains 100 106 entries including chemicals; substances produced from natural products by chemical modifications or purification, such as metals, minerals, cement, refined oil and gas; substances produced from animals and plants; active substances of pesticides, medicaments, fertilisers and cosmetic products; food additives; a few natural polymers; some waste and by-products. They can be mixtures of different chemicals occurring naturally or as an unintentional result of the production process. 'Existing' substances do not include: synthetic polymers (which are registered in EINECS under their building block monomers), intentional mixtures, medical preparations, cosmetic preparations and pesticide preparations as intentional mixtures; food; feedstuffs; alloys, such as stainless steel (but individual components of alloys are included); most naturally occurring raw materials, including coal and most ores.

(5) New substances: substances not in use in the EU before September 1981 and so not in EINECS. They must be notified before being placed on the market, after which they are registered in the existing list of notified chemical substances (ELINCS). New substances are governed by Directive 67/548, as amended by Directive 92/32.

substances that industry wants to continue to market. Given the vast number of existing substances on the market, the Commission proposes that first priority is given to substances that lead to a high exposure or cause concern by their known or suspected dangerous properties, be they physical, chemical, toxicological or ecotoxicological. All such substances should be tested within five years and subsequently be properly assessed for their impact on human health and the environment.

7.2. EU policy on hazardous substances in water

7.2.1. Dangerous substances directive

Community policy concerning hazardous substances in European waters was introduced more than 25 years ago (in 1976) by a council directive on water pollution caused by discharges of certain dangerous substances: the Dangerous Substances Directive (76/464/EEC). This has been the basis for the water framework directive (see section 7.2.2), which has now largely replaced the earlier regulation.

The objective of the dangerous substances directive is to regulate potential aquatic pollution by the vast number of chemicals already produced in Europe. The directive covers discharges to inland surface waters, territorial waters, inland coastal waters and groundwater.

The directive introduced the concept of List I and List II substances, with the purpose of eliminating pollution from List I substances and reducing pollution from List II substances. Specific hazardous substances were placed on List I on the basis of their persistence, toxicity and bio-accumulation. Organochlorines, such as DDT (and metabolites) and hexachlorocyclohexane (lindane and other isomers), and metals, such as cadmium (and its components) and mercury (and its components), are found on List I.

List II includes groups and families of substances that have deleterious effects in the aquatic environment. It also contains all individual List I substances that have not yet been regulated at Community level. For the relevant pollutants of List II, Member States must establish pollution reduction programmes, including quality objectives, according to Article 7 of the dangerous substances directive.

In 1982, the Commission communicated a list to the Council that included 129 'candidate List I substances' to which three more substances were subsequently added. Eighteen individual substances of the 'candidate List I' have been regulated in five specific directives (daughter directives to the dangerous substances directive), setting emission limit values and quality objectives at Community level. The specific directives relevant to the contaminants assessed in this report are:

- Council directive of 22 March 1982 on limit values and quality objectives for **mercury** discharges by the chlor-alkali electrolysis industry (Council Directive 82/176/EEC);
- Council directive of 26 September 1983 on limit values and quality objectives for **cadmium** discharges (Council Directive 83/15/EEC);
- Council directive of 8 March 1984 on limit values and quality objectives for **mercury** discharges by sectors other than the chlor-alkali electrolysis industry (Council Directive 84/156/EEC);
- Council directive of 9 October 1984 on limit values and quality objectives for the discharges of **hexachlorocyclohexane** of which lindane is included (Council Directive 84/491/EEC);
- Council directive of 12 June 1986 on limit values and quality objectives for discharges of **certain dangerous substances** in List I of the Annex to Council Directive 76/464/EEC, (Council Directive 86/280/EEC) as amended by Council Directives 88/347/EEC and 90/415/EEC.

7.2.2. Water framework directive

The Dangerous Substances Directive (76/464/EEC) is now integrated in the 'Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy' (commonly known as the EU water framework directive — WFD), adopted on 23 October 2000.

Article 16(3) of the directive has the objective of ceasing or phasing out discharges, emissions and losses of priority hazardous substances, with the ultimate aim of achieving concentrations in the marine environment near background values for naturally occurring substances and close to zero for man-made synthetic substances. This is to be achieved by 2020.

Environmental quality standards for the 33 priority substances have been proposed for the water column by the Commission consultant Fraunhofer Institute (EC, 2003). Similar progress has not been made for concentrations of hazardous substances in mussels and fish, for which there is considerable international monitoring activity. These standards have to be established before the success of the directive can be measured.

The main part on Community pollution control policy related to hazardous substances is set out in Article 16 of the WFD ('Strategies against pollution of water'). The Commission has proposed a list of substances of major concern (the so-called 'priority substances'). The list identifies 33 substances, which are shown to be of major concern for European Waters (2455/2001/EC). The 33 priority substances have been grouped according to their 'level of concern', taking particular account of their 'level of hazard'.

The procedure proposed by the Commission for the identification of priority hazardous substances is outlined in Working Document ENV/191000/01, and is based on the best available knowledge. The main emphasis is put on available 'hazard assessments', in particular work carried out under the OSPAR 'Strategy with regard to hazardous substances'; the classification and labelling of dangerous substances under Council Directive 67/548/EEC; and the 'Protocol on POPs' under the UN-ECE Convention on long-range transboundary air pollution (signed in 1984, in force since 1988).

The procedure also considers the finalised risk assessments made under Council Regulation (EEC) 793/93 and Council Directive 91/414/EEC, in addition to the information under the dangerous substances directive and its five 'daughter' directives concerning the regulations of pollution by certain dangerous substances discharged into the aquatic environment. The sum of this information was used to group the priority substances into clusters with increasing 'levels of concern'.

For the final assignment of a priority substance, 'additional considerations' were taken into account to confirm or reject the status of the substance. The 'additional considerations' included other relevant Community legislation or relevant international agreements, the production and use of the substance, the socio-economic impacts of a cessation or phase-out and the suspected endocrine disrupting potential of the substance.

The priority substances will be subject to cessation or phasing out of discharges, emissions and losses within an appropriate timetable that shall not exceed 20 years from the adoption of the Water Framework Directive (2000/60/EC), i.e. by 2020. Of the substances discussed in this report, cadmium, mercury, lead and lindane are on the priority substances list, while DDT and PCB are not.

7.3. Specific EU policies on the six hazardous substances (marketing, use, emissions, foodstuff limit values, environmental concentrations)

EU legislation relevant to **cadmium** relates to:

- general restrictions on emissions (Dangerous Substances Directive (76/464/EEC));
- waste management (concerning disposal of batteries — Directives 91/157/EEC, 93/86/EEC and 98/101/EC);
- limit values for discharges (Directive 83/513/EEC);
- concentration in foodstuffs (Directive 90/642/EC and Regulations (EC) Nos 466/2001 and 221/2002);
- the Water Framework Directive (EU) No 2000/60.

A range of EU legislation is relevant to **mercury**, including:

- general restrictions on emissions (dangerous substances directive);
- waste water directives (e.g. Directives 91/689/EEC and 94/67/EEC);
- discharge directives (82/176/EEC, 84/156/EEC and 88/347/EEC);
- certain foodstuffs (Regulation (EC) No 466/2001);
- the water framework directive.

EU legislation regarding **lead** relates to:

- directives on discharges (e.g. Directive 96/61/EC);
- use in paints (Directive 76/769/EEC);
- concentration in gasoline (Directive 85/210/EEC);

- hazardous waste treatment (Directives 89/369/EEC and 94/67/EC);
- concentration in foodstuffs (Directive 90/642/EC, and Regulations (EC) Nos 466/2001 and 221/2002);
- the water framework directive;
- a directive on air quality (Directive 82/844/EEC).

Water quality limits and quality objectives for discharges of **DDT** are regulated by:

- the Council Directive 86/280/EEC;
- List I of the dangerous substances directive (includes DDT and its metabolites).

Water quality limits and quality objectives for discharges of hexachlorocyclohexane (including **lindane**) are primarily regulated by:

- the Dangerous Substances Directive (76/464/EEC) for general restrictions on emissions and Council Directive 84/491/EEC;
- List I of the dangerous substances directive (water pollution by discharges of certain dangerous substances);
- the EU Pesticide Directive 91/414/EEC.

The disposal of **PCB** is primarily regulated by:

- general restrictions on emissions (Dangerous Substances Directive 76/464/EEC);
- the Council Directive 96/59/EC (Disposal of polychlorinated biphenyls and polychlorinated terphenyls);
- the water framework directive (limiting releases to water);
- the Council Directive 85/467/EEC (banning the marketing and use of PCB);
- List II of the Council Directive 76/464/EEC (Water pollution by discharges of certain dangerous substances).

It should be noted that, although EU legislation has set foodstuff limits for cadmium, mercury and lead in mussels and fish (Regulations (EC) Nos 466/2001 and 221/2002), there are no EU foodstuff limits for DDT, lindane and PCB in these matrices.

7.4. International policies

Measures to reduce input of hazardous substances and to protect the marine environment are also being taken as a result of various initiatives at different levels outside of the EU including the:

- UN global programme of action for the protection of the marine environment against land-based activities;
- Mediterranean action plan (MAP);
- Helsinki Convention 1992 for the protection of the marine environment of the Baltic Sea Area (HELCOM);
- OSPAR Convention 1992 for the protection of the marine environment of the North-East Atlantic;
- AMAP, the Arctic monitoring and assessment programme (1991).

OSPAR has made decisions or recommendations restricting the emissions of cadmium (OSPAR, 1985a, 1992a), mercury (OSPAR 1980a, 1982, 1985b, 1990) and lead (OSPAR 1992b). Furthermore, OSPAR (1980b) recommended that a standard of 0.3 mg/kg of mercury wet weight fish flesh should be the environmental standard for organisms compared to the EU limit of 0.5 mg/kg for foodstuffs for fish muscle (466/2001/EC).

OSPAR continues to work towards the reduction of discharges, emissions and losses of hazardous substances, which could reach the marine environment, to levels that are not harmful to humans or nature. It aims towards the elimination of these substances. The OSPAR Commission will implement this strategy progressively by making every endeavour to move towards the target of the cessation of discharges, emissions and losses of hazardous substances by the year 2020 (OSPAR, 1998a).

As targets have been formulated for emissions but the current indicator presents input loads into the coastal waters, only an approximate comparison is possible between the measured input and the reduction target. The Ministers at the fifth international conference on the protection of the North Sea in March 2002 stressed that increased efforts are necessary in order to meet the OSPAR target.

HELCOM has adopted numerous recommendations concerning mercury, cadmium, lead and other heavy metals (HELCOM 1985b, 1992a, 1993, 1995, 1996b, 1997, 2002a-e) and a recommendation with regard to PCB/PCT (1985a). In March 1998, HELCOM Recommendation 19/5 concerning the HELCOM objective with regard to hazardous substances was adopted. This objective is to prevent pollution of the convention area by continuously reducing discharges, emissions and losses of hazardous substances towards the target of their cessation by the year 2020, with the ultimate aim of achieving concentrations in the environment near background values for naturally occurring substances and close to zero for man-made synthetic substances.

Although DDT and PCB are not on the EU's list of priority substances (2455/2001/EC), these substances are on the OSPAR list of 15 chemicals for priority action (OSPAR 1998a). They are characterised as 'severely hazardous' on UNEP's list of 31 chemicals in need of strict control (see http://www.pic.int). Within the framework of HELCOM, DDT and PCB, which are both on their list of priority hazardous substances, are banned substances according to Annex I, Part 2 of the 1992 Helsinki Convention. In addition, protocols have been agreed to prohibit the discharge of organohalogens, which includes PCB, in the Mediterranean (CPM, 1995b, 1996) and Black Sea (CPB 1992b, 1992c). The Stockholm POPs Convention prohibits the production and use of PCB, and restricts the production and use of DDT.

8. Future development

8.1. Is sufficient data available?

This report assesses the inputs and concentrations in mussels and fish of only six hazardous substances for which sufficient data are available for an assessment. These substances are: cadmium, mercury, lead, DDT, lindane and PCB. Four of these are on the list of 33 priority substances identified in the EU water framework directive (see 2455/2001/EC).

Inputs

The study of time trends of inputs covers a relatively short period with comparable data. The usefulness of the results depends on sampling and analytical procedures, and on variations in both freshwater run-off and suspended solids content. For each river inflow there is a need for frequent flow measurements, frequent sampling and analyses of (often hardly detectable) hazardous substance concentrations, and calculation of yearly input loads. It is difficult to obtain enough information. As a consequence, the data in the OSPAR and HELCOM databases are incomplete, and the data on riverine inputs are not always reliable and comparable. Also some data on direct inputs in the databases are national estimates (i.e. not measured). Data on inputs before 1990 are not reliable and are therefore not used. The number of stations included in input measurements for each country are presented in Tables A.2–A.6. They show large spatial and temporal gaps as well as some questionable irregularities in the time series.

Determining atmospheric inputs also demands frequent sampling and adequate spatial coverage to obtain reliable estimates of inputs to the sea. For this report, only data for metals for the North Sea were available. The atmospheric input data are estimated using wet deposition measurements, which could possibly lead to overestimates (OSPAR, 1998b).

The OSPAR riverine input database is updated annually, except for atmospheric input data, which are updated at irregular intervals. The HELCOM database is also updated regularly. No data for the Mediterranean or the Black Sea are available. Better assessments could be attained if data from all EEA member countries were available and if standardised European protocols/guidelines for monitoring existed.

Concentrations

Validated data sets for concentrations of the hazardous substances in question are available from Belgium, France (Mediterranean coast), Germany, Greece, Iceland, Ireland, Netherlands and Norway. However, the lack of data from other countries (or areas in France) weakens the quality of regional assessment of general levels and trends in the North-East Atlantic or the Baltic, Mediterranean and Black seas. Although available data indicated some positive trends (decreasing inputs, lower concentrations in mussels and fish), it is difficult to establish the significance of these. Aggregated data for regional assessments does not necessarily convey the uncertainty of the data on which the aggregation is based. In general terms, the more validated data are available the more reliable the assessments that can be derived.

Some of the time series for biota are reasonably good, while others have incomplete temporal coverage, or lack important information. Inadequate reporting of observations below the detection limit is a problem in some data sets. This is particularly important for contaminants where the detection limit has decreased over time due to analytical developments. Incomplete meta data about the basis of measurement (wet weight, dry weight, lipid weight) is another important deficiency in some data sets. For some data sets, the basis is different from one year to another, without the country providing adequate information about conversion factors for each sample. This limits the usefulness of the data sets for time trend analysis.

For mussels and fish, spatial and temporal trend assessments depend on the choice of time series, which in turn depends on choice of sampling strategy, completeness and duration of sampling, and quality of the chemical analyses. For example, concentrations of hazardous substances in organisms may be sensitive to seasonal variations, age and sex of the organism (AMAP, 2000). Sampling strategies generally aim to control the influence of these variables. How well these strategies are followed is paramount to the quality of the results. Long time series may be needed to clearly determine trends, due to relatively long half-lives of some hazardous substances in organisms, the slow change of expected exposure and large individual variability.

The assessment of concentration levels can be improved by using agreed European classification schemes. At the moment, EU legislation provides only limits for cadmium, mercury and lead in some foodstuffs. Implementation of the water framework directive will, in future, provide environmental quality standards (first for water concentrations, and later for concentrations in biota and sediments since these are more difficult to develop). A two-level classification is envisaged under the water framework directive:

Where a body of water achieves compliance with all the environmental quality standards, it shall be recorded as achieving good chemical status (blue colour code in map). If not, the water body shall be recorded as failing to achieve good chemical status (red colour cod in map).

For time trend analysis, the Mann-Kendall test is a robust and widely accepted approach, but it has been applied here only on a series-by-series basis. For independent observations within and between time series, about 5 % of trends will be deemed significant if in fact there is no trend. The time series analysed here may have both serial correlation in time and spatial correlation between locations. This means that the overall significance of trends cannot be based on the frequency of significant individual trends, without reservation.

8.2. Do sufficient limit/target values and statistical trend methods exist?

Regulation of the priority hazardous substances on the EU's priority list of substances concerns cessation or phasing out of discharges, emissions and losses by 2020. This covers exposure from all sources of pollution, including leaching from contaminated lands or sea beds. Harbour sediments are often highly contaminated and may represent a persistent exposure of contaminants to food webs. Of the substances considered in this report, cadmium, mercury, lead and lindane are on the priority substances list. Directives concerning DDT and PCB relate to 'discharges' and 'disposal'. There are well-documented cases where elevated concentrations of DDT and PCB have been found in mussels and fish that were remote from known point sources.

Directives for foodstuffs provide limits to judge the levels of some contaminants (cadmium, mercury and lead) for some indicator species in relation to protecting human health. Suggested 'low' and 'high' concentrations are derived from a variety of sources, both from international practices and from scientific research, such as background reference levels or ecotoxicological assessment criteria. Unfortunately, these latter limit values have only scientific value and have not been given official status by OSPAR, which weakens their value in assessments. Determination of the effectiveness of measures would be further enhanced if the statistical power of the assessment could be agreed internationally.

The persistence of many hazardous substances and their potential to bio-accumulate warrant a need for clearer measures and target values of concentrations in indicator media and / or an acceptable level of biological effects. Indicators for biological effects would be particularly useful to determine ecological impacts of hazardous substances, an assessment that is not really possible from chemical data alone.

As mentioned, environmental quality standards have been proposed for the water column for the 33 priority substances listed in the water framework directive (EC, 2003). Similar work needs to be undertaken for the widely used mussel and fish state indicators.

8.3. Recommendations

- The data availability on hazardous substances should be improved to assess more listed hazardous substances than the six presented here. For these latter, the data availability needs to be improved and made more consistent.

- As a basis for input indicators, a European database for atmospheric and direct and riverine inputs should be established, based on existing regional initiatives and following the waterbase approach of the

European Environment Agency. The database should be able to accommodate spatially non-aggregated data so that 'local' variations could be assessed individually and compared to local variations in other state indicators, such as mussels and fish. Eurowaternet guidelines for priority dataflow on transitional, coastal and marine waters should take this into account.

- At European level, a harmonised monitoring strategy for measuring and calculating loads should be developed. There is also a need to standardise and harmonise sampling and analysing procedures. Regular annual reporting (on sampling conditions, meta data and on the representativeness of the samples) should be mandatory.

- The methods for time trend assessments should be further developed by a body such as ICES, taking into account serial correlation in time, as well as spatial correlation between locations, in order to make regional assessments. A broader spectrum of methods should be considered (smoothers, parametric models). There must be further investigation as to how missing or incomplete data can be taken into account.

- There is a need at country level for more regular spatial and temporal trend monitoring of hazardous substances. At European level, a monitoring strategy for concentrations in sediment and biota in marine and coastal waters should be developed, leading to standardised and harmonised sampling, chemical / statistical analytical procedures and yearly reporting. Long-time series from fixed representative stations for state indicators sediment or organisms are essential for time trend assessment. Sampling the same stations each year will best ensure comparability between years. The implementation of the water framework directive in coastal waters should give priority to measurements of priority substances in biota such as mussels and fish.

- Temporal trend assessment can be greatly improved by applying knowledge of local influences and by consistent monitoring of representative stations where appropriate sampling strategies have been applied. More information about the purpose and context of monitoring (information on pressures and emissions) at the different locations would help in targeting the statistical analysis towards answering defined questions. For instance, locations strongly influenced by a point source (impact station), and with possible event-dominated variations in levels, should be considered separately from locations representing a general regional development (representative station).

- Development of management tools such as environmental quality standards (EQS), background reference concentrations (BRC) or ecotoxicological assessment criteria (EAC) for marine waters would enhance and speed up the evaluation process of hazardous substances for each indicator media involved. This development should take into consideration different hazardous substances and different media, as well as the costs and benefits of using such tools.

- An improvement of the classification system for concentrations in biota is needed. The water framework directive classification of chemical status will not cover all substances which are hazardous to the marine environment. An extension of the water framework environmental quality standard system to include hazardous substances monitored by marine conventions in sediment and biota is necessary.

- The development of indicators for the biological effects of hazardous substances will contribute to the assessment of ecological impacts of groups of hazardous substances and combined toxicity. It will show potential impacts of more than the selected hazardous substances. Existing national and international programmes where biological effects are monitored need to be assessed with the aim of determining their feasibility in international monitoring.

9. Conclusions

- All of the six assessed hazardous substances (cadmium, mercury, lead, DDT, lindane and PCB) pose a serious risk to human health and the marine ecosystem since they are toxic, persistent and liable to bio-accumulate. DDT and PCB are endocrine disruptors.

- The direct discharges and riverine inputs of cadmium, mercury, lead, lindane and PCB into the North-East Atlantic indicate decreasing trends in the period 1990–1999.

- The atmospheric inputs of cadmium, mercury and lead to the North Sea also indicate decreasing trends in the period 1987–1995.

- The concentrations in marine organisms indicate decreasing trends for all six hazardous substances in mussels in the North-East Atlantic and the Mediterranean Sea. Decreasing trends for concentrations in fish in the North-East Atlantic and Baltic Sea are less obvious and lead in Baltic fish is increasing.

- Assessments of local levels and trends as presented in a series of maps show:

⇒ **Cadmium**: levels of cadmium for mussels (both *Mytilus edulis* and *M. galloprovincialis*) indicate that concentrations were elevated in the estuaries for large rivers, in areas with point discharges and in some harbours. No ‘high’ concentrations were found for any fish. At seven coastal locations, increasing trends in cadmium concentrations in mussels and fish were observed. These locations were different from the observed hot spots.

⇒ **Mercury:** levels of mercury in blue mussels in Europe were somewhat higher than background levels in most areas. The general picture indicates a diffuse exposure of coastal mussel populations to mercury, presumably mainly atmospheric, but with no real hot spots. Concentrations were at background levels in fish in the North East Atlantic and Baltic Sea. Only four coastal locations showed increasing trends in mercury concentrations in mussels and fish.

⇒ **Lead:** concentrations of lead in blue mussels from areas remote from local or regional sources were at background levels. However, concentrations of the metal were above background level along most coasts of Europe. At several locations, levels of lead in blue mussels were above the limits for human consumption, indicating several hot spot areas. Lead concentrations were generally low in the liver of Atlantic cod and in herring muscle in the Baltic Sea. Increasing lead concentrations were observed at nine coastal locations. In most cases, these were different from the observed hot spots.

⇒ **DDT:** concentrations of DDT in blue mussels and fish were low in the North-East Atlantic and Baltic Sea. Levels were generally ‘low’. No increasing trends were observed except for fish at one location.

⇒ **Lindane:** data availability was limited to the Mediterranean and Black Sea. Levels of lindane in mussels along the French Mediterranean coast indicated low concentrations and no increasing trends.

⇒ **Polychlorinated biphenyls (PCB_7):** levels of PCB_7 in blue mussel reflect the general exposure pattern for this group of substances. Long-distance atmospheric transport is less important in temperate parts of Europe than regional or local sources. Concentrations of PCB_7 in mussels in the North-East Atlantic at several locations are at ‘high levels’ (more than 10 times above OSPAR background reference concentrations). Concentrations in fish in the Baltic Sea and northern North-East Atlantic Ocean show only one hot spot. Time trend analysis showed no increasing trends.

- Data quality of the six substances: The data sets used in this assessment are the best available data and have provided a reasonable basis for the assessment, but improvements should be made in future. The data sets do not cover all European Seas equally. Improvements are necessary for all seas, especially for the Black Sea, Mediterranean and Baltic Sea, to give a proper European overview on concentration levels and trends. The data sets do not cover the same number of measurements each year and do not cover all years. More regular monitoring by countries is required to improve spatial and temporal data coverage, which is the basis for high quality assessments. The data sets on input data have methodological inconsistencies, which reduces their reliability.

- Data on other hazardous substances in the marine environment are not widely available. Some national monitoring is undertaken and some substances like Tributyltin (TBT) and polyaromatic hydrocarbons (PAHs) are covered by marine convention monitoring, but there is no regular monitoring for all hazardous substances listed in the various legislations. The water framework directive will provide data on its priority list substances for transitional and coastal waters. However, for the marine environment, future assessments of hazardous substances, other than the six covered in this report, will rely to a large extent on data provided by research or one-off surveys.

- Measures on the six substances included here cover marketing, use, emission, foodstuff limit values and environmental concentrations. These measures are quite comprehensive. The substances have already been regulated for several years. This is reflected in the overall decrease of concentrations of these substances in inputs and marine organisms. However, several other hazardous substances are listed by EU water directives and marine conventions but are not regulated to the same degree regarding marketing, use, emissions, foodstuff limit values, etc. The data availability of these other substances is too poor to currently make assessments, but trends might be less positive than in the present report.

Glossary

AI	Atmospheric input
ALA-D	d-amino levulinic acid dehydrase inhibition (biomarker)
AMAP	Arctic monitoring and assessment programme
BHC	Benzenehexachloride
BRC	Background reference concentration
CAMP	Comprehensive atmospheric monitoring programme (under OSPAR)
Cd	Cadmium
CHL	Chlordane
COM	Commission of the European Communities
CPB	Convention on the protection of the Black Sea against pollution
CPM	Convention for the protection of the marine environment and the coastal region of the Mediterranean (Barcelona Convention)
DDD	Dichlorodiphenyldichloroethane (metabolite of DDT)
DDE	Dichlorodiphenyldichlororethylene (principal metabolite of DDT)
DDT	Dichlorodiphenyltrichloroethane (synthetic organochlorine insecticide)
DPSIR	Driving forces, pressures, state, impacts and responses (a reporting framework)
DRI	Direct and riverine input
EAC	Ecotoxicological assessment criteria
EC	European Commission
EEA	European Environmental Agency
EEC	European Economic Community
EINECS	European inventory of existing commercial chemical substances
EIONET	European Environment Information and Observation Network
ELINCS	Existing list of notified chemical substances
EPER	European pollution emission register
EQS	Environmental quality standard
ETC–MCE	European Topic Centre–Marine and Coastal Environment (under EEA)

EU	European Union
GDR	East Germany
GLM	General linear model
HCB	Hexachlorobenzene
HCH	Hexachlorocyclohexane (including lindane)
HELCOM	Helsinki Commission of the Convention for the protection of the marine environment of the Baltic Sea
Hg	Mercury
ICES	International council for the exploration of the sea
IPPC directive	Integrated pollution prevention and control directive
JAMP	Joint assessment and monitoring programme (under OSPAR)
MAP	Mediterranean action plan
Marinebase	Database on aggregated data for the coastline of the Mediterranean, Atlantic, North Sea, Skagerrak, Kattegat and Baltic (under EEA)
MEDPOL	Long-term programme for pollution monitoring and research in the Mediterranean
MON	Working group on monitoring (under OSPAR)
NIVA	Norwegian Institute for Water Research
NRC	National reference centres
NSC	North Sea conference
OSPAR	Oslo and Paris Commission of the Convention for the protection of the marine environment of the North-East Atlantic
Pb	Lead
PCB	Polychlorinated biphenyls
PCB7	Sum of congeners: 28, 52 101, 118, 138, 153 and 180
PCT	Polychlorinated terphenyls
POP	Persistent organic pollutants
PVC	Polyvinylchloride
QSR	Quality status report
REACH	Registration, evaluation and authorisation of chemicals
RID	Riverine inputs and direct discharges
SIME	Working group on concentrations, trends and effects of substances in the marine environment (under OSPAR)

TBT	Tributyltin
TTR	Transthyretin
UK	United Kingdom
UN-ECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
USA	United States of America
UV	Ultra violet
WFD	Water framework directive

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Annex: Available data sets on concentrations in biota

The following tables give the number of stations included in indicator calculations (median and / or trend) of concentrations of cadmium in mussels (blue mussel — *Mytilus edulis*, Mediterranean mussel — *M. galloprovincialis*) and fish (Atlantic cod — *Gadus morhua*, herring — *Clupea harengus* or flounder — *Platichthys flesus*).

Cadmium — number of stations Table A.1

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
MUSSELS															
NE Atlantic															
Belgium		1		1	1	1	1	1	1	1	1	1		1	1
France		8	13	13	8	16	7	7	8	11	11	11	6	6	
Germany		5	4	1	5	8	2	9	7	9	3	3			
Iceland						3	9	9				9	11	9	7
Ireland								6	11	10	9	9			
The Netherlands		3	2	2	2	3	2	2	2	2	2	1	2	2	2
Norway		8	13	13	13	19	22	24	26	27	30	26	20	18	18
Spain						8	8	7	7	7	10	7	7	7	7
Sweden		1	2	2	2	2	2	2	1	2	2	1			
United Kingdom		1	1												
Mediterranean															
France	15	17	16	16	16	18	18	18	18	18	18	18	18	16	16
Greece									4	3	5	11	15	5	
COD															
Belgium		1	1	1	1		1	1	1	1	1	1		1	
The Netherlands		1		1											
Norway		2	4	4	4	7	7	7	6	9	11	8	8	8	8
Poland			3	3	1	2	2	1	1						
Sweden		2	2	2	2	2	2	2	2	2	2	1			
HERRING															
Finland		5	5	5	4	5	5	4	5		3	4			
Poland			3	3	5	3	3	1	1	1	1				
Sweden		5	5	4	5	5	5	5	5	5	5	2	1	1	1
FLOUNDER															
Belgium		1	1	1	1	1	1	1	1	1	1	1		1	1
Denmark		2	2	2	1	1	1	2	2	1		1	1		
France		1	1	1	1	1	1	1	1		1	1			
Germany		4	3		6	4		8	8	4		2			
The Netherlands		3	3	3	3	3	4	5	3	3	3	2	3	3	3
Norway		1	1	2	2	2	2	2	2	2	2	3	2	3	2
Sweden		1	1	1	1	1	1	1	1	1					

Table A.2 **Mercury — number of stations**

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
MUSSELS															
NE Atlantic															
Belgium		1		1	1	1	1	1	1	1	1	1		1	1
France		8	13	13	8	16	7	7	8	11	11	11	6	6	
Germany		5	4	1	5	8	3	9	7	9	3	3			
Iceland								7				9	11	9	7
Ireland								7	11	10	10	10			
The Netherlands		3	2	2	2	3	2	2	2	2	2	1	2	2	2
Norway		8	13	13	13	18	21	25	26	26	30	26	20	17	17
Spain						7	4	7	6	7	10	7	7	7	7
Sweden		1	2	2	2	2	2	2	1	2	2	1			
United Kingdom		2	2												
Mediterranean															
France	15	17	16	16	16	18	18	18	18	18	18	18	18	16	16
Greece									4	3	5	6	7	1	
COD															
Belgium		2	2	2	2	1	1	1	1	1	1	1		1	
The Netherlands		1		1											
Norway		2	4	4	4	7	7	7	6	9	11	8	8	8	8
Poland			3	3	1	2	2	1	1						
Sweden		2	2	2	2	2	2	2	2	2	2	2			
United Kingdom		1	1	1	1	1	1		1	1		1			
HERRING															
Finland		5	5	5	4	5	5	4	5		3	4			
Poland			3	3	3	3	3	1	1	1	1				
Sweden		5	5	4	5	5	5	5	5	5	5	4	1	1	1
FLOUNDER															
Belgium		2	2	2	2	2	1	1	2	1	1	1		1	1
Denmark		2	2	2	2	1	1		2	1		1	1		
France		1	1	1	1	1	1	1	1		1	1			
Germany		4	3		6	4		8	8	4		2			
The Netherlands		3	3	3	3	3	4	5	3	3	3	2	3	3	3
Norway		1	1	2	1	2	2	2	2	2	2	3	2	3	2
Sweden					1	1	1	1	1	1					

Lead — number of stations Table A.3

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
MUSSELS															
NE Atlantic															
Belgium		1		1	1	1	1	1	1	1	1	1		1	1
France		8	13	13	8	16	7	7	8	11	11	11	6	6	
Germany		5	4	1	5	8	4	9	7	9	3	3			
Iceland						1	6	6				8	7		
Ireland								6	11	10	9	9			
The Netherlands		3	2	2	2	3	2	2	2	2	2	1	2	2	2
Norway		8	13	13	13	19	22	24	26	27	30	26	20	18	18
Spain						8	8	7	7	7	10	7	7	6	7
Sweden		1	2	2	2	2	2	2	1	2	2	1			
United Kingdom		2	2												
Mediterranean															
France	15	17	16	16	16	18	18	18	18	18	18	18	18	16	16
Greece									3	3	9	10	7	5	
COD															
Belgium		2	2	2	2	1	1	1	1	1	1	1		1	
Norway		2	4	4	4	7	7	6	5	6	6	4	6	6	6
Poland			3	3	1	2	2	1	1						
Sweden		2	2	2	2	2	2	2	2	2	2	1			
HERRING															
Finland		5	5	5	4	5	5	4	5		3	4	1		
Poland			3	3	5	3	3	1	1	1	1				
Sweden		5	5	4	5	5	5	5	5	5	5	2	1	1	1
FLOUNDER															
Belgium		2	2	2	2	2	1	1	1	1	1	1		1	1
Denmark		2	2	2	1	1	1		1	1		1	1		
France		1	1												
Germany		4	3		6	4		8	8	4		2			
Norway		1	1	2	2	2	2	2	2	2	2	3	2	3	2
Sweden		1	1	1	1	1	1	1	1	1					

Table A.4 **DDT — number of stations**

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
MUSSELS															
Belgium						1	1	1	1	1	1	1		1	1
France								7	8				6		
Germany								6	6	9	3	4			
Iceland							8	8				10	11	10	9
Ireland						20			11	14	5	8			
Netherlands		2	2	2	2	2	2	2	2	2	2	2	2	2	2
Norway					12			23	21	23	25	24	23	17	21
Poland		2													
Sweden		1	2	1	2	2	2	2	1	2	1	1			
COD															
Belgium								1	1	1	1	1		1	
Denmark													1		
Finland		1													
Iceland							4	3				1	3	3	3
Norway		2	2	4	14	7	7	7	7	9	11	8	8	8	8
Poland		1	3	3	1	3	2	1	1						
Sweden		2	1	2	2	2	2	2	2	2	2	2			
United Kingdom		1	1	1	3	5	4		1	1		1			
HERRING															
Finland		5	5	5	5	5	5	5	5		5	5			
Iceland						1		1							
Poland		1	3	3	3	3	3	1	1	1	1			1	1
Sweden		5	5	4	5	5	5	5	5	5	5	5	1	1	1
United Kingdom							3								

Table A.5 **Lindane — number of stations**

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
MUSSELS															
Mediterranean															
France	15	17	16	16	16	18	18	18	18	18	18	18	18	16	16

PCB — number of stations Table A.6

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
MUSSELS															
Belgium						1	1	1	1	1	1	1		1	1
France								7	8	11	11	11	6		
Germany		1			2	5	1	6	6	8	3	2			
Iceland							7	7				7	9	7	6
Ireland									9	9	2	5			
The Netherlands		3	2	2	2	2	2	2	2	2	2	1	2	2	2
Norway			5	7	11	11	13	17	18	21	24	24	19	16	17
Spain						6	6	7	7	7	9	7	7	7	7
Sweden				1	2	2	2	2	1	2	1	1			
COD															
Belgium						1	1	2	2	2	2	2		2	
Norway					3	14	14	14	12	18	22	16	16	16	16
Sweden			2	2	2	2	2	2	2	2	2	2			
HERRING															
Finland		2	2	4	4	5	5	3	5		3	3			
Poland														1	1
Sweden			2	3	5	5	5	5	5	5	5	4	1	1	1
FLOUNDER															
Belgium						2	2	2	2	2	2	2		2	2
France				1	1		1								
Germany		3	2		4	2		6	6	2					
The Netherlands		3	3	3	3	3	4	5	3	5	5	4	3	3	3
Norway					2	4	4	4	4	4	4	6	4	6	4
Sweden				1	1	1	1	1	1	1					

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