OSPAR COMMISSION

JAMP assessment of the environmental impact of dumping of wastes at sea

Biodiversity Series

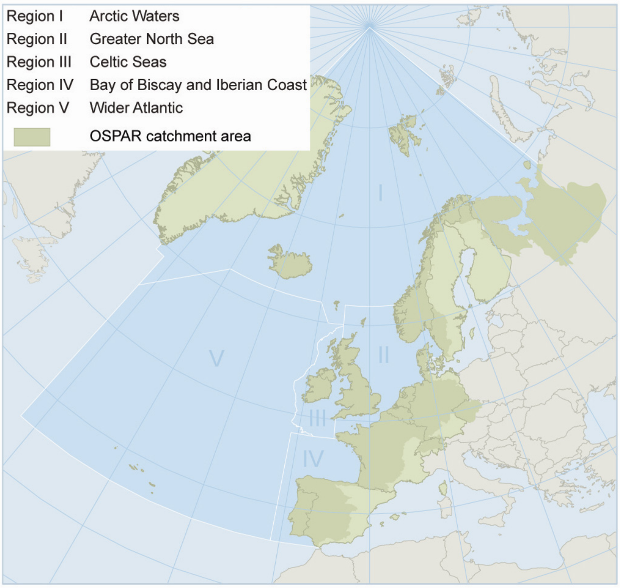
2009

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. It has been ratified by Belgium, Denmark, Finland, France, Germany, Iceland, Ireland, Luxembourg, Netherlands, Norway, Portugal, Sweden, Switzerland and the United Kingdom and approved by the European Community and Spain.

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.
La Convention a été ratifiée par l'Allemagne, la Belgique, le Danemark, la Finlande, la France, l'Irlande, l'Islande, le Luxembourg, la Norvège, les Pays-Bas, le Portugal, le Royaume-Uni de Grande Bretagne et d'Irlande du Nord, la Suède et la Suisse et approuvée par la Communauté européenne et l'Espagne.



The OSPAR maritime area and its five Regions

Acknowledgement

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Cover photo provided by Group De Cloedt

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Executive Summary

Dredged material is the most important category of waste or other matter that can still be dumped in the OSPAR maritime area and the reported amounts disposed of have remained stable since 1998. This activity is generally well managed by license and control systems, yet the physical, chemical and biological impacts on the marine environment are still not fully understood and require further investigation.

The pressure on the marine environment in the North Sea from dumping may be increasing

About 90% of all sediments annually disposed of in the OSPAR maritime area are dredged in the Southern North Sea to maintain navigation in ports, estuaries and coastal waterways. In 2007, 350 sites in the OSPAR maritime area had been licensed for the deposit of dredged material and the number is expected to increase due to more ship traffic and the increasing use of bigger ships which require deeper and wider navigation routes and berths.

Dredged material, especially from harbours, may contain harmful contaminants such as trace metals. There is potential that these contaminants are redistributed and released from the deposited sediments to the water column where they are more available for up-take in the food chain. The deposit of sediments on the seabed may bury benthos which may become smothered or crushed and may lead to changes in habitats and biological communities.

Contracting Parties follow OSPAR Guidelines for the Management of Dredged Material

The OSPAR Guidelines for the Management of Dredged Material recognize that the extent of the impacts on the marine environment depend on the characteristics of the dredged material and the physical and biological features of the dumping site, as well as the techniques and the timing chosen for the disposal. Contracting Parties have put in place license and control systems which consider the environmental impact of disposal activities in relation to a specific dumping site, time and technique and help minimise impacts through best environmental practice recommended by the OSPAR Guidelines.

Chemical pollution from dumping is variable

Contamination levels and sediment quality criteria have been set at national level to guide management decisions in licensing the deposit of dredged material at sea. Concentrations of total trace metal and trace metal in harbour dredging are highly variable from 1995 to 2007.
There is some evidence that PAH, PCB and TBT levels are decreasing.

Alternatives to dumping need more attention

Greater attention has recently been given to the beneficial re-use of dredged material for habitat enhancement, beach nourishment, or construction purposes. Yet, practical problems have been observed because the dredged material is not always available when required for its intended application. The physical, chemical and biological impacts of the use of fine sediments for habitat enhancement are still under investigation.

More effort is needed to investigate biological responses

Progress on investigating biological responses to the disposal of dredged material has been slow in OSPAR and more effort is needed for a wider and more systematic application of bioassays in the testing of dredged sediments. There is also scope for a more harmonized approach to the methodologies recommended under the OSPAR Guidelines to further reduce pollution from dredged material.

Récapitulatif

Les matériaux de dragage représentent la catégorie la plus importante de déchets et autres matières pouvant encore être immergés dans la zone maritime OSPAR. Les quantités immergées qui ont été notifiées sont stables depuis 1998. Cette activité est généralement bien gérée grâce à des systèmes d'autorisation et de contrôle. Les impacts biologiques, chimiques et physiques sur le milieu marin ne sont cependant pas compris complètement et doivent faire l'objet d'études supplémentaires.

La pression exercée par les immersions sur le milieu marin de la mer du Nord pourrait être en hausse

Environ 90% de la totalité des sédiments immergés dans la zone maritime OSPAR sont dragués dans la partie méridionale de la mer du Nord aux fins de la navigation dans les ports, les estuaires et les cours d'eau côtiers. En 2007, 350 sites de la zone maritime OSPAR ont été autorisés à déposer des matériaux de dragage et on s'attend à une augmentation car la navigation est en hausse et des navires plus grands sont utilisés ce qui exige des voies de navigation et des mouillages plus profonds et plus larges.

Les matériaux de dragage, provenant en particulier des ports, risquent de contenir des contaminants dangereux, tels que les métaux traces. Ces contaminants pourraient potentiellement être redistribués et relâchés, par les sédiments déposés, dans la colonne d'eau où ils peuvent plus facilement pénétrer la chaîne alimentaire. Le dépôt de sédiments sur le fond marin risque d'enfouir le benthos qui est alors étouffé ou écrasé ce qui risque d'entraîner des modifications des habitats et des communautés biologiques.

Les Parties contractantes suivent les Lignes directrices OSPAR sur la gestion des matériaux de dragage

Les Lignes directrices OSPAR sur la gestion des matériaux de dragage reconnaissent que l'étendue des impacts sur le milieu marin dépend des particularités des matériaux de dragage et des caractéristiques physiques et biologiques du site d'immersion, ainsi que des techniques et du calendrier sélectionnés pour l'élimination. Les Parties contractantes ont mis en place des systèmes d'autorisation et de contrôle qui considèrent l'impact environnemental des activités d'élimination propres à un site d'immersion, au calendrier et à la technique utilisés et qui permettent de minimiser les impacts en utilisant la meilleure pratique environnementale recommandée par les Lignes directrices OSPAR.

La pollution chimique provenant des immersions est variable

Les niveaux de contamination et les critères de qualité des sédiments ont été déterminés au niveau national à titre d'orientations pour les décisions de gestion s'agissant d'autoriser le dépôt de matériaux de dragage en mer. Les teneurs de la totalité des métaux trace et des métaux traces dans le dragage portuaire ont été très variables de 1995 à 2007. Il semblerait que les niveaux de HAP, PCB et PCT sont en baisse.

Il faut mieux étudier les alternatives à l'immersion

On a récemment accordé plus d'attention à la réutilisation bénéfique des matériaux de dragage pour l'enrichissement des habitats, le réapprovisionnement des plages ou aux fins de la construction. On relève cependant des problèmes pratiques car les matériaux de dragage ne sont pas toujours disponibles lorsqu'ils sont requis pour une application prévue. Les impacts biologiques, chimiques et physiques de l'utilisation des sédiments fins pour l'enrichissement des habitats est toujours en cours d'étude.

Des efforts supplémentaires sont nécessaires pour étudier les réactions biologiques

Les progrès réalisés dans l'étude des réactions biologiques à l'élimination des matériaux de dragage progresse lentement au sein d'OSPAR et des efforts supplémentaires sont nécessaires pour appliquer d'une manière plus étendue et plus systématique des essais biologiques afin de tester les sédiments dragués. Il est également possible d'adopter une approche plus harmonisée lors de l'application des méthodologies recommandées dans le cadre des Lignes directrices OSPAR afin de réduire encore plus la pollution provenant des matériaux de dragage.

1. Introduction

This assessment is a contribution to the assessment of human activities, BA-5 of the OSPAR Joint Assessment and Monitoring Programme (JAMP), which have been prepared as a contribution to the Quality Status Report 2010.

This assessment of the impacts of dumping of wastes or other matter includes:

a. a definition of the issue covered by the assessment;

b a description of the pressures on the marine environment from dumping of wastes or other matter and their evolution since 1998;

c. the impacts of dumping of wastes and their trends (especially since 1998);

d. a description of the measures taken (especially since 1998) to manage the impact of dumping of wastes;

e. an evaluation of the effectiveness of measures.

The assessment is closely linked to the assessment of the environmental impact of dredging for navigational purposes which also forms part of the QSR 2010. ➥ Dredging for navigational purposes (OSPAR 2008)

The assessment draws clear conclusions for each of the OSPAR Regions, where necessary stating separate information or conclusions for each Region or even sub-region (where relevant).

2. What are the problems? Are they the same in all OSPAR regions?

Dumping in this assessment is defined as: “The deliberate disposal in the maritime area of wastes or other matter from vessels or aircraft, from offshore installations, and any deliberate disposal in the maritime area of vessels or aircraft, offshore installations and offshore pipelines”. The term does not include disposal in accordance with MARPOL 73/78 or other applicable international law of wastes or other matter incidental to, or derived from, the normal operations of vessels or aircraft or offshore installations (other than wastes or other matter transported by or to vessels of offshore installations for the purpose of disposal of such wastes or other matter or derived from the treatment of such wastes or other matter on such vessels or aircraft of offshore installations).

The different categories of wastes or other matter considered in this assessment are:

a. dredged material;

b. inert materials of natural origin, that is solid, chemically unprocessed geological material the chemical constituents of which are unlikely to be released into the marine environment;

c. sewage sludge (phased out 1998);

d. fish waste from industrial fish processing operations;

e. vessels or aircrafts (phased out 2004).

Dumping activities may cause physical disturbance and may result in the redistribution, and possibility of changing the form, of contamination. Physical disturbance includes increases in suspended matter, which affects primary production and growth of filter-feeding organisms, burial of benthic organisms and changes in substrate character, which may affect benthic communities. Several effects of the disposal of dredged sediment at sea are distinguished in the literature review (OSPAR 2008a). The main effects are related to:

- chemical disturbances;
- increased nutrient input;
- change in sediment structure;
- enhanced sedimentation (burial and smothering);
- increased turbidity;
- enhanced suspended particulate matter.

Information on the dumping location, type of wastes dumped, and associated compounds in dumped waste in the Convention Area is supplied by Contracting Parties and published on an annual basis by OSPAR in 'Annual Dumping of Wastes at Sea Reports in the OSPAR Maritime Area' (according to the Format for Annual Reporting on Dumping Operations at Sea (OSPAR 2004b).

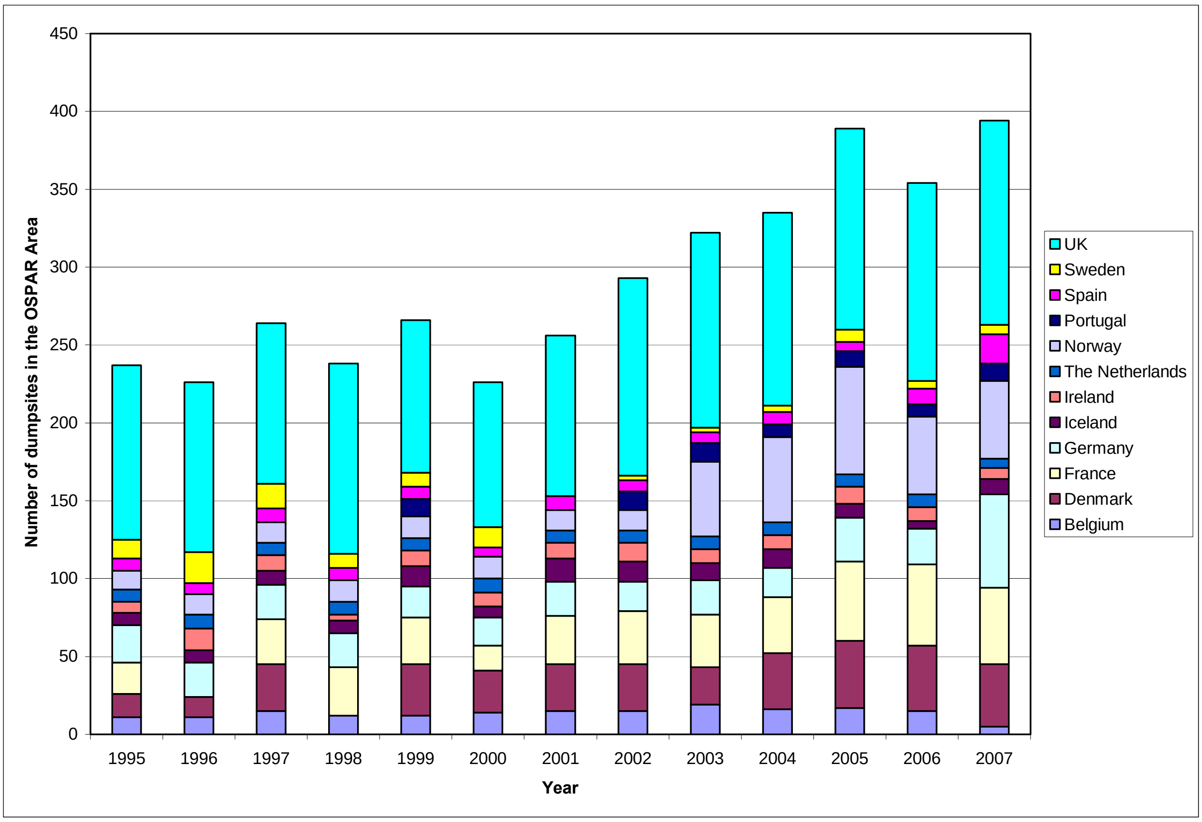

Figure 2.1: *Overview of the number and distribution of dumpsites within the OSPAR area*
Source: annual OSPAR Reports on Dumping of Wastes at Sea

Dumpsites tend to be in estuarine, coastal or near-shore areas in the vicinity of dredging locations (harbours and shipping channels). Two hundred and thirty seven dumpsites were licensed throughout the Convention Area in the mid 1990s. This increased to 383 in 2005 (see Figure 2.1 and 2.2). This increase is partly an artefact of incomplete reporting in the mid 1990s, but there has also been an increase in capital and maintenance dredging for major port extension projects. In future there might be a further increase in dredging due to increasing ship traffic and the use of bigger ships which require deeper and wider navigation routes, as well as an increased maintenance dredging requirement for enlarged port facilities. However, available data do not show any specific trends in the OSPAR Maritime Area.

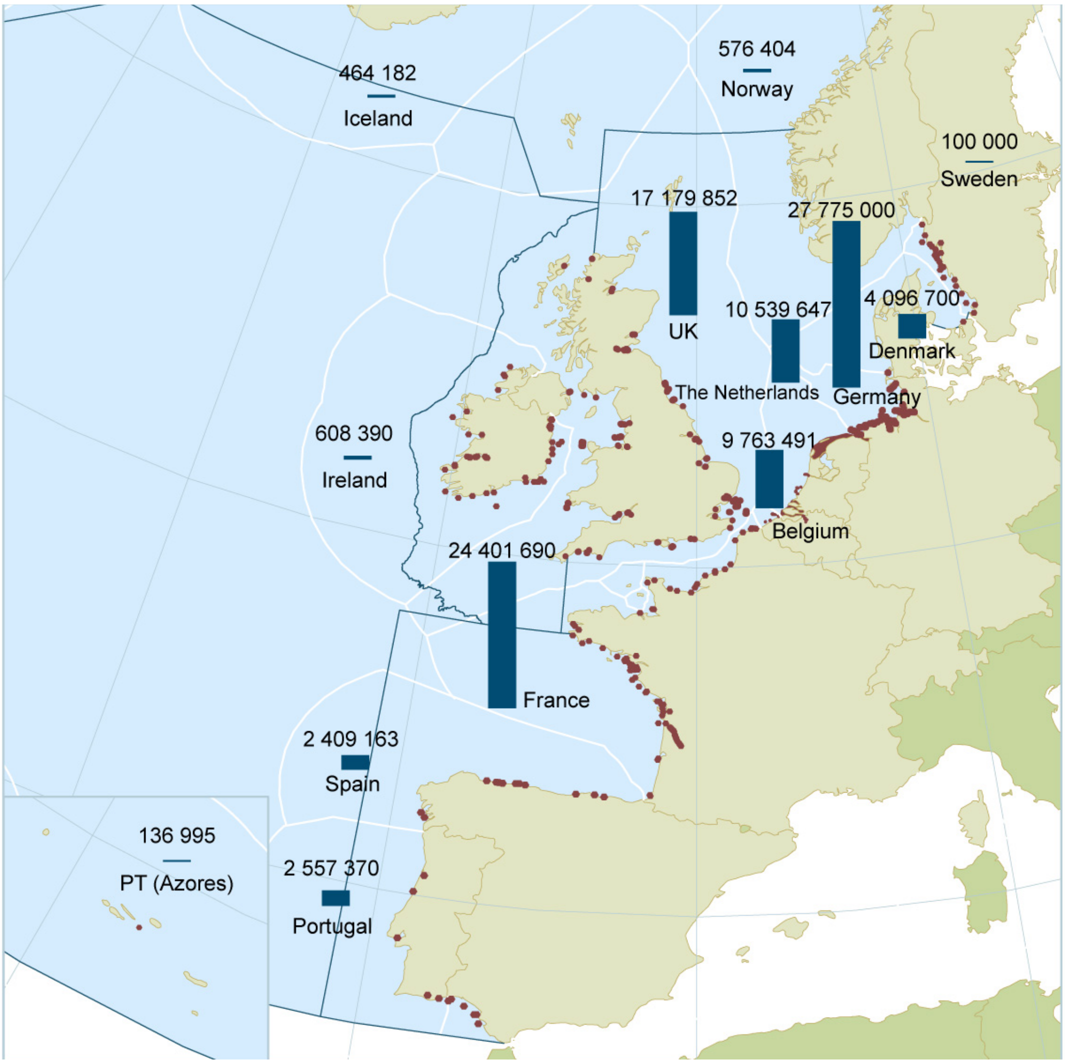

Figure 2.2: *Dumpsites and current volumes disposed of in the OSPAR Maritime Area*

3. What has been done?

The Oslo Convention on the Prevention of Marine Pollution by Dumping from Ships and Aircraft, was signed on 15 February 1972 and came into force on 6 April 1974.

The Oslo Convention focused efforts on industrial wastes, radioactive wastes, sewage sludge and wastes for incineration at sea. Environmental concerns led to the revision of the Oslo Convention in the early/mid 1990's and a series of Ministerial North Sea Conferences in the late 1980's and early 1990's agreed to phase out the dumping of industrial wastes at sea (except inert materials of natural origin) and sewage sludge and also to halt incineration at sea for chemical wastes in the North Sea area. These decisions were implemented within the Oslo Convention framework bringing to an end:

- dumping of industrial wastes at sea by 31 December 1989 in the North Sea and in other parts of the Convention Area by 31 December 1995
- dumping of sewage sludge at sea by 31 December 1998
- use of incineration at sea for chemical wastes by 31 December 1991.

With the formation of OSPAR in 1992, it was agreed to phase out the dumping of vessels and aircraft at sea by 31 December 2004. France and the United Kingdom also relinquished their options to dump radioactive wastes.

The current OSPAR Guidelines for the Management of Dredged Material (OSPAR 2009) were designed to assist Contracting Parties in the management of dredged material to prevent and eliminate pollution and protect marine habitats in accordance with OSPAR's overarching objectives. OSPAR has also developed guidance for disposal of fish wastes (OSPAR 1998b). So far guidance on inert waste has not been produced.

Dumping has in practice ceased with the entry into force of the OSPAR Convention, with the exception of the dumping of dredged material, inert material and fish waste from industrial fish processing operations. On a worldwide level, the London Convention and its 1996 Protocol that entered into force in March 2006 regulate dumping of waste and other matter and place particular emphasis on the need to identify and control sources of contamination for dredged materials.

In general, dumping of dredged material is well managed by licences from national and local authorities.

Many OSPAR Contracting Parties also have regulatory controls on contaminant levels in dredged material but not on total loads. According to the OSPAR Dredged Material Guidelines (OSPAR 2009), measures to keep the volume of dredged material to a minimum are regarded as Best Environmental Practice for minimising the effects on the environment.

The OSPAR Guidelines are harmonized, as far as possible, with similar guidelines to the London Convention. Some countries have implemented these guidelines in special national guidelines like the HABAK (Directive for the handling of dredged material in coastal waterways for the federal water and shipping administration, 1999) in Germany, or the Technical Rules for Excavation/Dredging and Management of Dredged Material (Ministry Order, nº 141 – June, 1995) in Portugal.

Most OSPAR countries have developed sediment quality criteria (*i.e.* action levels) or equivalent measures for the assessment of dumping of dredged material at sea. The incorporation of action levels in the London and OSPAR Conventions' dredged material guidance has stimulated much thought and discussion on their development, and eleven OSPAR countries have now produced action levels for dredged material assessment (OSPAR, 2004a and 2008c). The approaches used to derive these 'action levels' have varied greatly from a factor times background/mean levels to those derived from ecotoxicological studies. The approach to their derivation is the subject of on-going discussions within the OSPAR Commission. In most OSPAR countries these action levels are not incorporated in any statutes or regulations but are there to guide the regulatory authorities/agencies in their decision-making.

In recent years, in addition to substances listed in Annexes I and II of the OSPAR Convention, other compounds such as brominated flame-retardants, booster biocides used in anti-fouling preparations (for example irgarol) and endocrine disruptors have become of concern in relation to dredged material disposal. A number of countries developed quality standards or criteria for contaminants in sediments to be used in their assessments of dredged material and several incorporated them into statutes or regulations.

Overviews of national action levels for dredged material are presented in OSPAR (2004c) and OSPAR (2008c). Most Contracting Parties use a "3 category action level" approach which means that 2 concentrations are provided. Concentrations of contaminants in the material falling below the lower limit represent those of little concern. Those falling between the lower limit and the upper limit may trigger further investigation of the material proposed for dumping. Those concentrations above the upper value generally mean that the material should be considered unsuitable for disposal at sea.

Where action levels have not been developed, a case by case approach is taken for each application considered individually. Large differences in the action levels of individual elements/compounds per Contracting Party were observed (see Table 3.1 and OSPAR, 2004c). Notwithstanding differences in methodologies that exaggerate the discrepancies, the wide range of action levels suggests that in some cases dredged material may legally be disposed of at sea that might be prohibited in the waters of a different Contracting Party. However, due to the aforementioned variations in analytical methodologies used and particle size fraction analysed, such simplistic comparisons must be treated with caution. The compilation of the national action levels for dredged material of the Contracting Parties also revealed that action levels are only established for a limited number of compounds and that this number can vary significantly between the Contracting Parties. In addition, no action levels exist for 'contaminants of recent concern' such as brominated flame-retardants.

Table 3.1: *Range of Contracting Parties' national action levels for dredged material (Source: OSPAR, 2008c)*

Contaminant	TARGET ("action level 1") VALUES in mg kg^{-1}		LIMIT ("action level 2") VALUES in mg kg^{-1}	
	<2 mm fraction	fine fractions (<63 µm and 20 µm)	<2 mm fraction	fine fractions (<63 µm and 20 µm)
As	20 – 80	30 – 80	29 – 1000	150 – 200
Cd	0.4 – 2.5	1 – 2.5	2.4 – 10	5 – 12.5
Cr	40/50 – 300	150 – 200	120 – 5000	750 – 1000
Cu	20 – 150	40 – 100	60 – 1500	200 – 400
Hg	0.3/0.25 – 0.6	0.6 – 1	0.8 – 5	3 – 5
Ni	20/30 – 130	50 – 100	45 – 1500	250 – 400
Pb	50 – 120	100 – 120	110 – 1500	500 – 600
Zn	130 – 700	350 – 500	365 – 10000	1750 – 3000

A comparison of the permits and the quantities of dredged material licensed reflect the different licensing procedures between the Contracting Parties. Some Contracting Parties issue a few permits for large quantities of dredged material, for example Belgium and the Netherlands with 5 permits for more than 10 million tonnes of dredged material. In contrast, Norway has issued more than 50 permits for approximately 700 000 tonnes. In other Contracting Parties, a general permit (Iceland) or 2-yearly permits (Belgium) or no formal permits are issued (Germany, for some operations) or reported (Spain).

3.1 Implementation of international and EU measures

Several of OSPAR's key objectives in terms of pollution prevention and habitat protection are supported through obligations within the framework of other international agreements to which the OSPAR Contracting Parties are signatory. EU directives apply to member states and to Norway and Iceland as members of the European Economic Area.

Water Framework Directive

EC Water Framework Directive (2000/60/EC) aims to *'establish a Community framework for the protection of inland surface waters, transitional waters, coastal waters and groundwater, in order to prevent and reduce pollution, promote sustainable water use, protect the aquatic environment, improve the status of aquatic ecosystems and mitigate the effects of floods and droughts'.* It applies to all water bodies, including estuaries and coastal waters out to at least one nautical mile (for biological parameters) and to 12 nautical miles (chemical parameters) and is therefore relevant to dumping of wastes. The daughter directive (Directive 2008/105/EC) proposes environmental quality standards for Priority Substances. It aims at a 'progressive reduction of emissions, discharges and losses' of Priority

Substances. It sets environmental quality standards for surface waters of 41 dangerous chemical substances including the 33 priority substances and eight other pollutants that pose a particular risk to animal and plant life in the aquatic environment and to human health. The development of sediment and biological quality criteria is up to individual EU Member States.

Marine Strategy Framework Directive

The Marine Strategy Framework Directive (2008/56/EC) aims at the Protection and Conservation of the Marine Environment. This Marine Strategy Framework Directive will influence activities occurring at sea (including disposal of dredged material) through establishing a framework within which EU Member States shall take the required necessary measures to achieve good environmental status. One of the tasks is to draw up an initial assessment for the marine region. The initial assessment will look at the essential characteristics, the current environmental status, the predominant pressures and impacts (including disposal of dredged material at sea), the economic and social analysis of the use of the sea and estimates of the cost of degradation. For OSPAR Contracting Parties, this initial assessment will be based to a large extent on the QSR 2010 or maintain good environmental status in the marine environment by the year 2020 at the latest. For the implementation of the Directive, EU Member States shall make every effort to use existing cooperative mechanisms such as the OSPAR Commission and other Regional Sea Conventions.

Birds and Habitats Directives

The European Directive 'On the conservation of natural habitats and of wild fauna and flora', commonly referred to as the Habitats Directive (1992/43/EEC) and the Birds Directive (1979/409/EC) have already had a significant influence on port developments, as well as capital dredging and spoil disposal projects. One of the objectives is to establish a European network of conservation areas, the Natura 2000 network. EU Member States must designate strictly protected areas on the basis of certain habitat types and species. Human activities that impact such sites are strictly controlled with decisions based on the conclusions of an Appropriate Assessment by a competent authority (for example fisheries). The Birds Directive recognises that habitat loss and degradation are the most serious threats to the conservation of wild birds. It therefore places great emphasis on the protection of habitats for endangered as well as migratory bird species, especially through the establishment of a coherent network of Special Protection Areas (SPAs) comprising all the most suitable territories for these species. Since 1994 all SPAs form an integral part of the NATURA 2000 ecological network.

Environmental Impact Assessment (EIA) Directive

The EC EIA Directive 85/337/EEC, (as amended by 97/11/EC) requires Member States to adopt all measures necessary to ensure that, before consent is given, all likely (significant) effects of projects on the environment are assessed. For the majority of new dumpsites within the OSPAR area, contracting parties will go through the EIA process. The systematic assessment of a project's likely significant environmental effects are reported in an Environmental Statement to a level of detail sufficient to provide the public and competent authorities with a proper understanding of the importance of the predicted effects and the scope for reducing them (mitigation measures). When following the Environmental Statement and, there are no (significant) knowledge gaps, decision-making on the project can go through. Within a monitoring and evaluation programme, during and after the construction/operation phase, predicted effects of the project are compared to the actual observed effects (generally through field studies).

4. Did/does it work?

Impacts, their trends and effects in the marine environment

The OSPAR Reports on Dumping of Wastes at Sea (OSPAR, 2002, 2003, 2004a, 2007 and 2008d) consider the quantities of wastes dumped and the associated contaminant loads. They also aim to identify issues of concern related to data and information reported by Contracting Parties. Initially, the assessments were also intended to provide reliable data on contaminant inputs arising from dredged material. However, it was recognised that the contaminant loads reported were overestimated because the relocation of sediments may result in an observed increase at a specific location and that is not because of any increased inputs.

Observing trends in the amounts dumped and contaminant loads over a period of several years can help to assess the effectiveness of measures to reduce the quantities of dredged material as well as the associated contamination. At present, only the amounts dumped from 1995 – 2007 are comparable, as the reporting requirements changed from wet weight of dredged material to dry weight in 1995. As mentioned above, it may be even more difficult to establish trends in contaminant loads of dredged material. This is mainly due to incomplete data sets and incomparability of the data provided by Contracting Parties.

Quantities of wastes dumped

Although several types of wastes are still dumped in the OSPAR area, more than 99% of the overall amount licensed since 1998 is dredged material.

Disposal of vessels which was phased out in 2004, decreased as indicated in Figure 4.1. These data show that implementation of the ban has been successful.

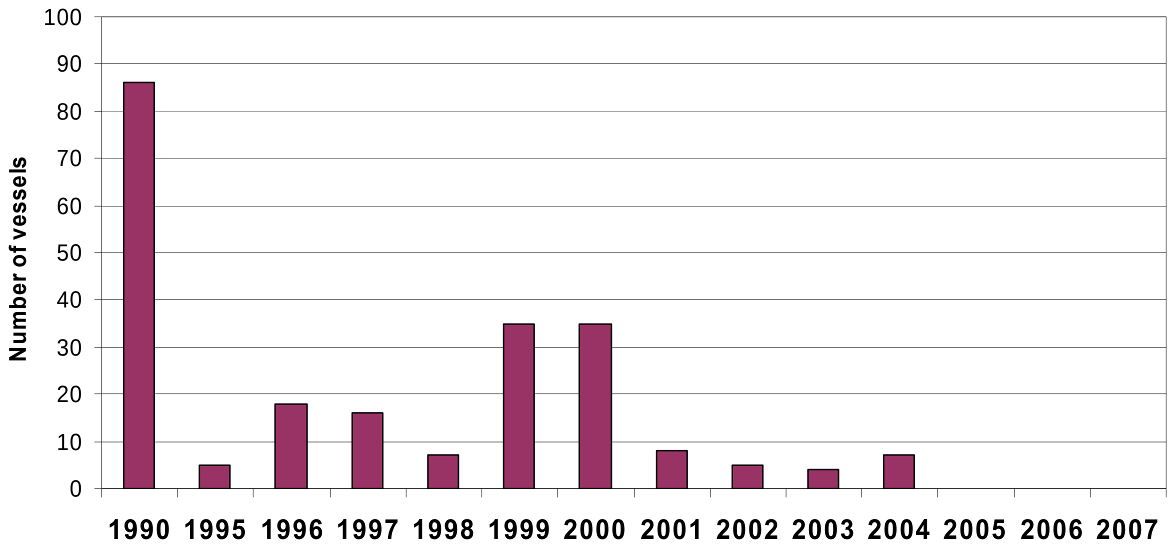

Figure 4.1: *Total number of vessels disposed of from 1990 to 2007 within the OSPAR area*
Source: Annual OSPAR Reports on Dumping of Wastes at Sea

The disposal of industrial wastes and sewage sludge at sea ceased in 1995 and 1998, respectively, and are not considered here. Disposal of inert material including for example rock and mining wastes decreased significantly from several million tonnes per annum in the early nineties to less than 200 000 tonnes by 1995. Since then, there have been years when significantly larger quantities have been dumped, but there is no discernable trend between 1996 and 2007 (see Figure 4.2). The quantities of inert bulky material (for example steel wire and concrete) disposed of at sea are comparatively small. Quantities varied from less than 100 tonnes in most years to more than 1000 tonnes in 1991 and 1997 to zero from 2001 onwards.

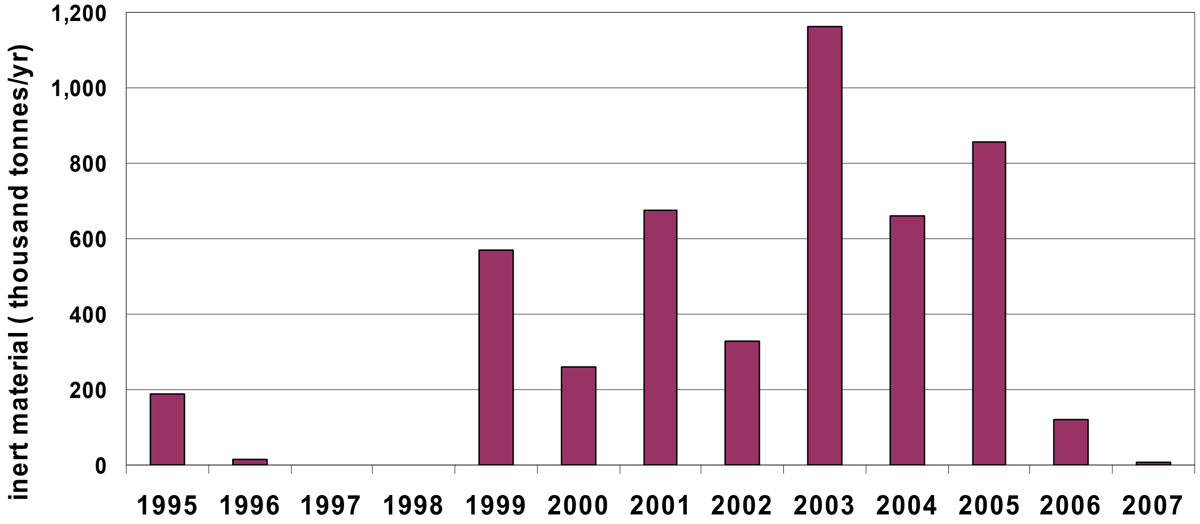

Figure 4.2: *Inert material disposed of from 1995 to 2007 within the OSPAR area*
Source: Annual OSPAR Reports on Dumping of Wastes at Sea

Disposal of fish waste amounted to less than 1000 tonnes per year except in 1992 and 1993, and decreased from about 400 – 500 tonnes of fish waste disposed of at sea in the mid 1990s. Relatively little fish waste was dumped within the OSPAR area in the years 2003 – 2007 (Figure 4.3). Norway reported 160 tonnes and 100 tonnes in 2006 and 2007 respectively. The United Kingdom disposed of 1203 and 1469 tonnes of fish waste into the intertidal zone over the same period, but this is not classified as dumping under the terms of the Convention.

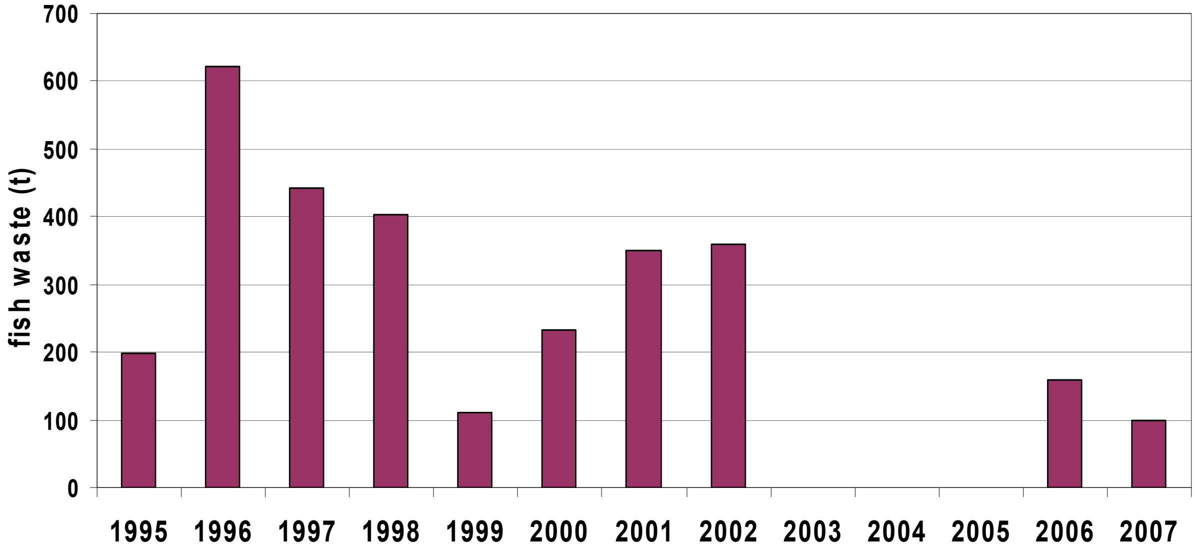

Figure 4.3: *Fish waste disposed of from 1995 to 2007 within the OSPAR area*
Source: Annual OSPAR Reports on Dumping of Wastes at Sea
Dumping of dredged material

As disposal of dredged material may have physical impacts on the marine environment, total amounts of material disposed of are included in this assessment. The overall amounts of material disposed of at sea have varied significantly between approximately 100 – 131 million tonnes per year (dry weight).

No real trends in the overall amounts can be observed from 1995 to 2007 (Figure 4.4). About 90% of the dredged material reported to OSPAR is generally dumped by only five Contracting Parties (Belgium, France, Germany, The Netherlands, United Kingdom) (Figures 4.5a and 4.5b). Because the quantity of dredged material to be dumped is influenced by natural conditions, dumping strategies, sediment disposal criteria and episodic capital dredging activities (which occasionally contribute huge amounts to the total amount of dredged material disposed of at sea), trends in the amounts dumped are difficult to predict.

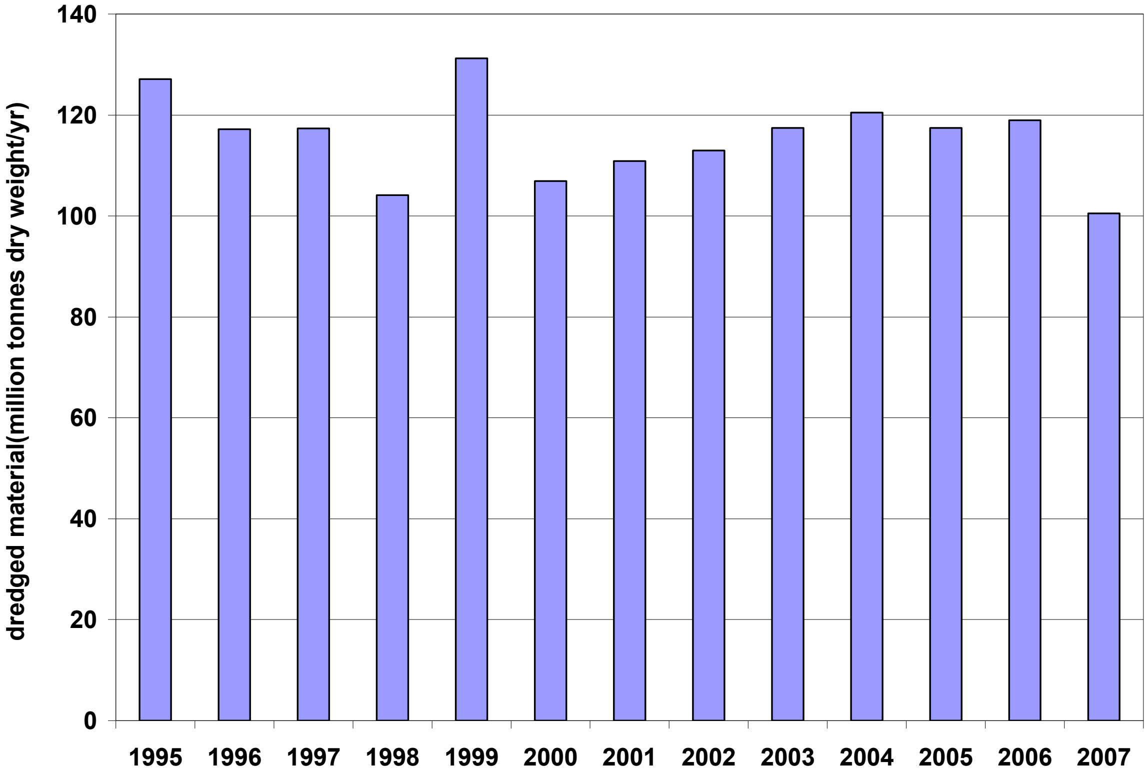

Figure 4.4: *Amounts of dredged material disposed of from 1995 to 2007 within the OSPAR area Source: Annual OSPAR Reports on Dumping of Wastes at Sea*

The quantities of sediments that are dredged and dumped by Contracting Parties can change significantly from year to year (Figures 4.5a and 4.5b).

- In Denmark, dumping of dredged material increased by a factor 9 from 500 000 tonnes in 1995/1996 to 4.7 million tonnes in 2004. Following a reduction to less than 2.3 million tonnes in 2006, dumping of dredged material increased to over 4 million tonnes in 2007
- Iceland has disposed of between 100 000 and 800 000 tonnes per year, in a slightly increasing trend.
- Quantities dumped by both Ireland and Norway have fluctuated since 1995 but are generally around 1 million tonnes per year.
- Portugal has increased dumping of dredged spoils markedly from approximately 500 000 to over 25 million tonnes in 2005 and 3.6 million tonnes in 2007. No data are available from Portugal for 2007.
- The quantities dumped by Spain have fluctuated significantly between 1 million tonnes to over 5 million tonnes per annum.

- Quantities disposed of in Sweden decreased significantly from 1995/1996 to 2003 by about a factor 20 and increased again in 2004 up to 2.7 million tonnes dredged material before falling again to approximately 30 000 tonnes in 2007.
- For Belgium, amounts of dredged material fluctuate between 22 – 33 million tonnes disposed of annually between 1995 and 2006, with a sharp fall to 9.7 million tonnes in 2007.
- In France, quantities disposed of increased from approximately 19 million tonnes in 1997 to about 38 million tonnes in 2003 – 2004 and decreased to 24 million tonnes in 2007.
- Dredging activities in the Elbe, Ems and Weser estuaries in Germany generated approximately between 19 and 28 million tonnes per year between 1996 and 2007.
- In the Netherlands, variations of the amount of material dredged may be due to varying amounts of dredged material from Rotterdam Harbour. They fluctuate between 8 – 16 million tonnes dredged material.
- In the United Kingdom, quantities decreased from over 20 million tonnes between 1995 and 1998 to below 18 million tonnes between 2004 and 2007. A transient peak in 1999 of 32 million tonnes was caused by one large capital dredging operation that generated approximately 17 million tonnes dredged material.

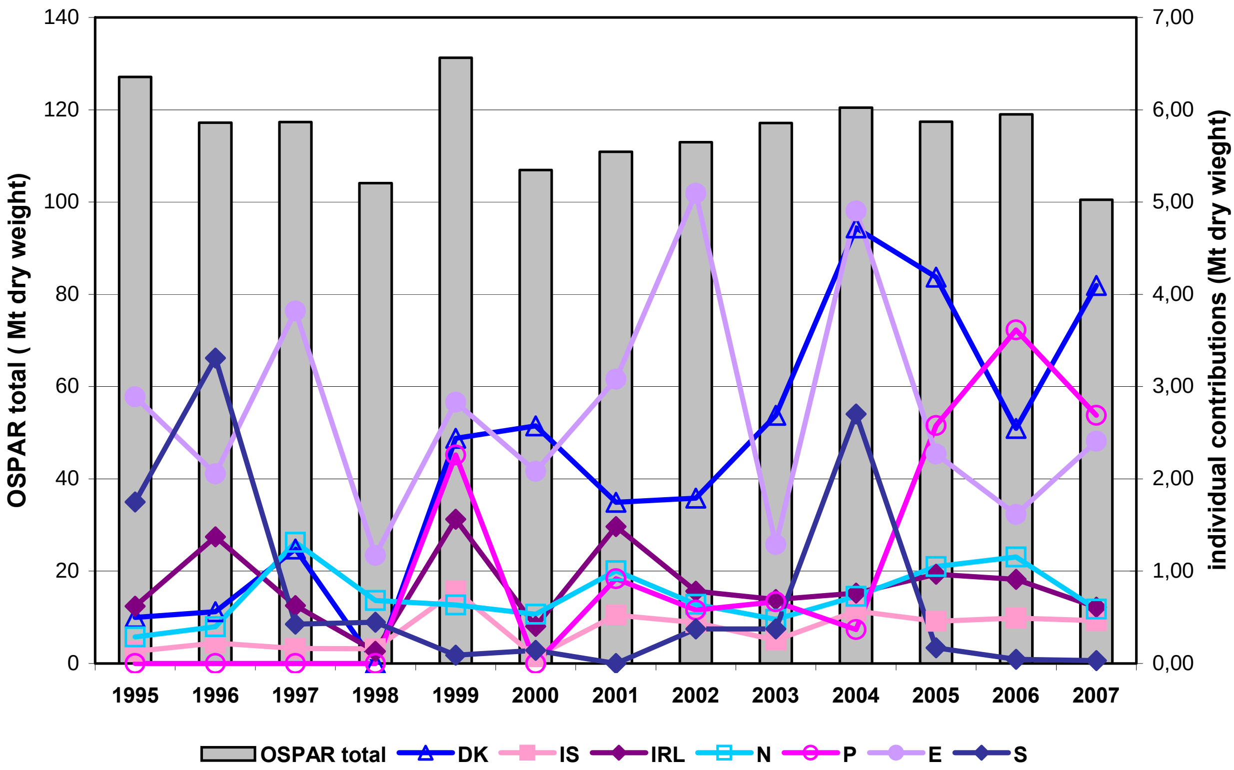

***Figure 4.5a**: National amounts of dredged material disposed of from 1995 to 2007*
Source: Annual OSPAR Reports on Dumping of Wastes at Sea

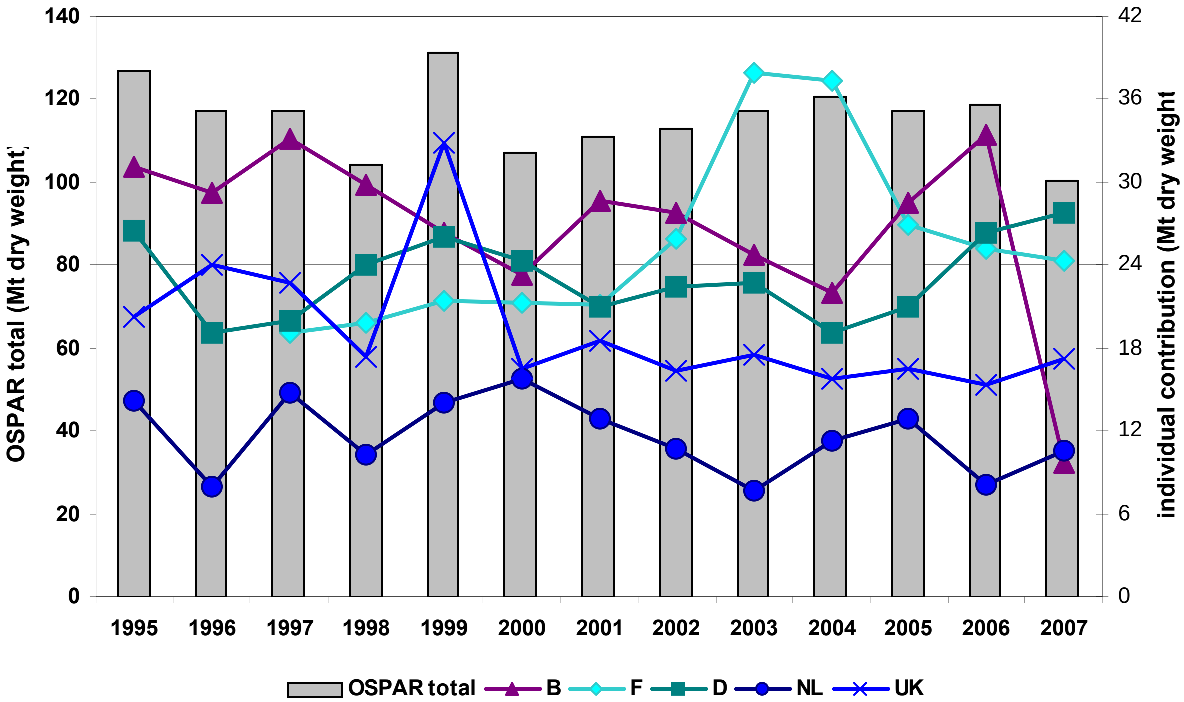

Figure 4.5b: *National amounts of dredged material disposed of from 1995 to 2007*
Source: Annual OSPAR Reports on Dumping of Wastes at Sea

As shown in Figure 2.2, the amount of dredged material received by disposal sites varies significantly between Contracting Parties. Belgium, Germany and the Netherlands disposed of large quantities of dredged material per site for example in 2004, 16, 19 and 8 dumping sites received 22 Mt, 19 Mt and 11 Mt of dredged material respectively). In comparison, in 2005, Iceland and Norway disposed of about 0.5 Mt and 1.0 Mt dredged material at 9 and 69 dumping sites respectively. This indicates that some sites receive much higher amounts of dredged material than others.

The dumping reports do not include information on the size of disposal sites that may differ significantly. Consideration should be given to evaluating how the impacts on the seabed vary depending on the intensity of dredged material disposal at a given site (for example amount per unit area). Furthermore, the licensed areas are in practice usually larger than the area actually used thus intensity data are particularly useful in assessing dumping activity. An example of spatial intensity analysis is presented below, derived from Belgian data for *1 April 2006 - 31 March 2007*.

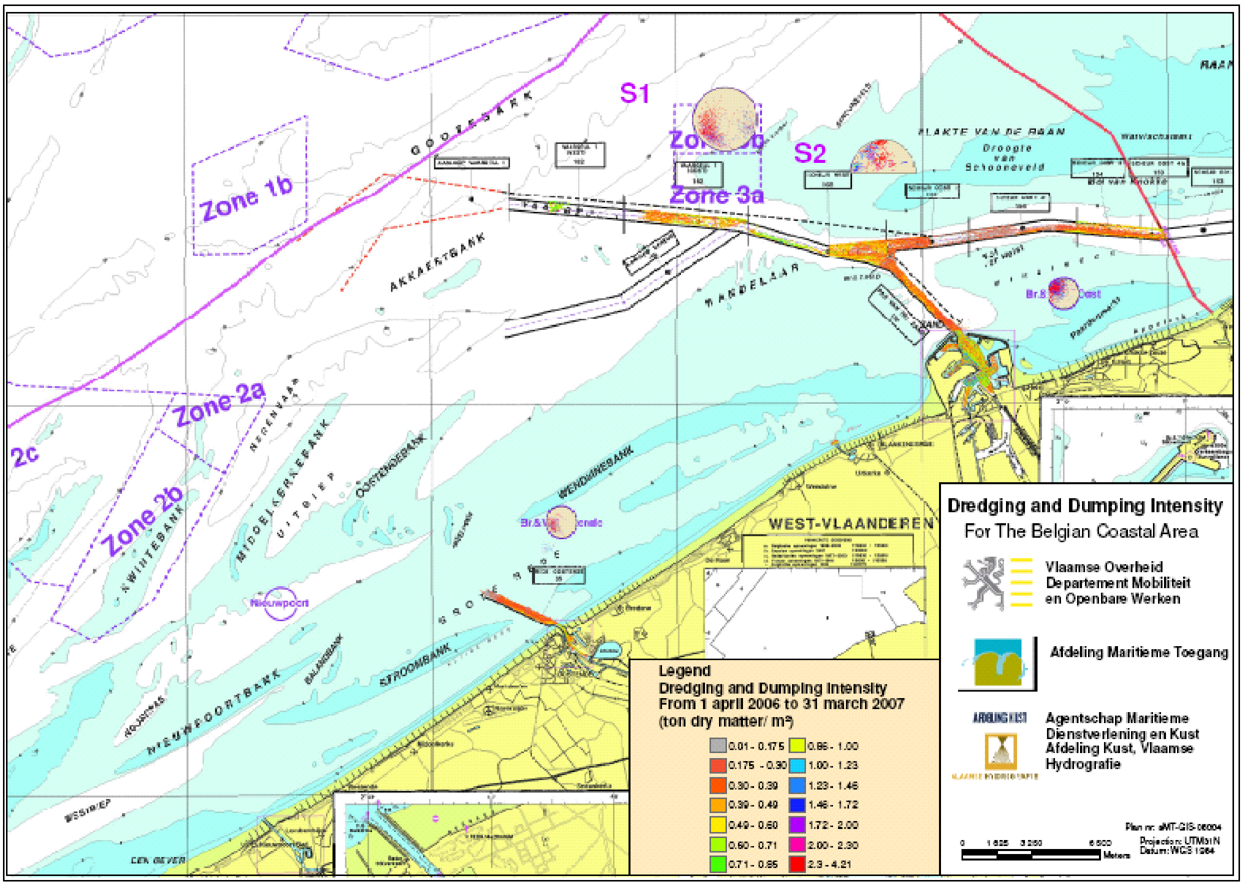

Figure 4.6: *An example of a dredging and dumping intensity map for the Belgian Coast. Source: Lauwaert et al. (2008).*

For most Contracting Parties, the bulk of dredged material originates from maintenance dredging and amounted to 95% in the period 2001 – 2005. In Iceland, more than 80% of the material comes from capital dredging, whereas in Belgium, Germany (except 1999/2000), the Netherlands and Norway no or only very small amounts originate from capital dredging. The quantity of capital dredged material shows a peak in 1999/2000 caused by high quantity of material from Belgium, Germany, Spain and the United Kingdom (see Figure 4.7b). In 1999/2000 the proportion of capital dredged material was about 25%, whereas in the other years it amounts to about 10 – 15%.

The quantities of dredged marine and estuarine material exceed those from harbours over the period 1995 – 2007 with harbour dredging forming 29 – 51% of the total dredged amount.

The distribution of dredging effort is quite different for individual Contracting Parties. The bulk of dredged material in Belgium, Denmark and Germany originates from estuaries and sea channels, whereas Iceland, The Netherlands and Norway generally report dredging only from harbours. This pattern has been relatively constant since 1996.

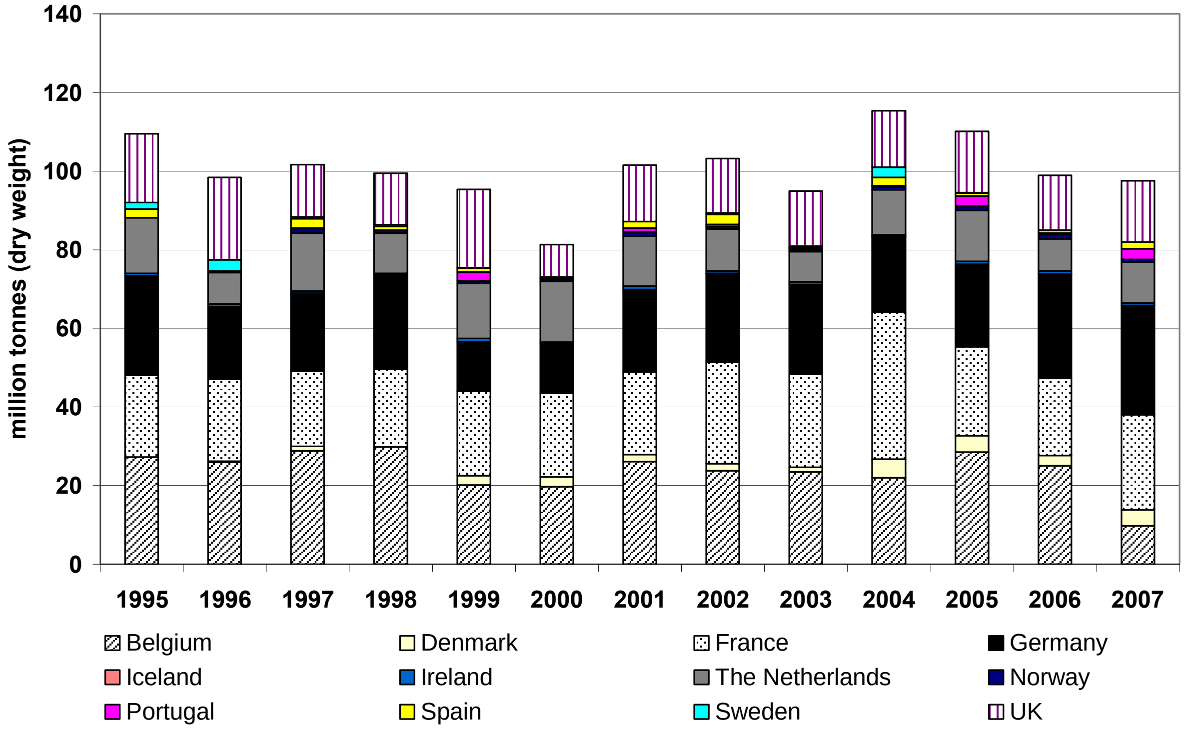

Figure 4.7a: *Maintenance dredged material disposed of from 1995 to 2007*
Source: Annual OSPAR Reports on Dumping of Wastes at Sea

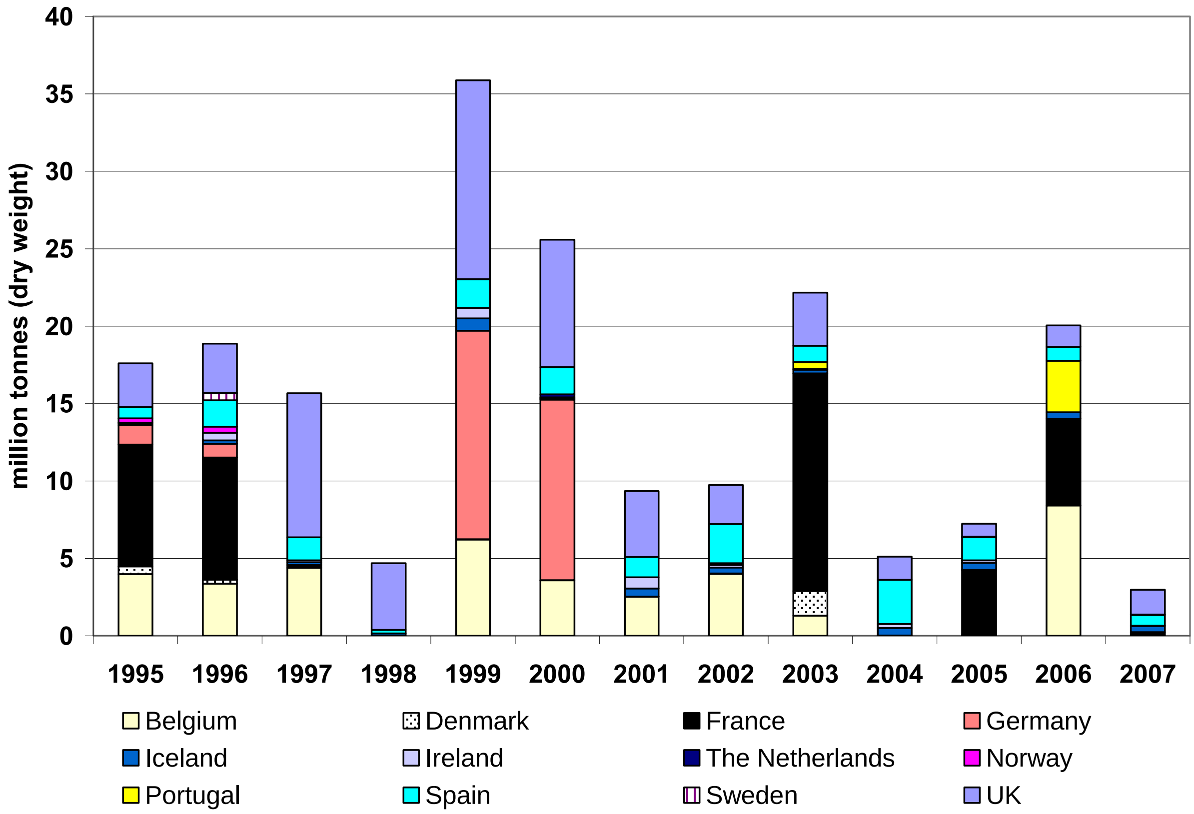

Figure 4.7b: *Amounts of capital dredged material disposed of from 1995 to 2007*
Source: Annual OSPAR Reports on Dumping of Wastes at Sea

Effects due to chemical disturbances

All Contacting Parties only permit marine disposal of sediment within specific quality standards. The chemical impact of this sediment is therefore considered to be zero or acceptably low. In most studies, ecotoxicological tests showed that the sediments collected at dumpsites were not toxic to slightly toxic. Based on the literature review, it can be concluded that the disposal of dredged sediments, when sediments comply with the sediment quality criteria, causes no or minimal chemical disturbances (OSPAR, 2008a).

Trend assessment of total contaminant loads is not regarded as an appropriate means to evaluate the effectiveness of measures for the reduction of contaminant inputs from the disposal of dredged material at sea. This is because contaminant loads at any given location are influenced by several factors such as the amounts of dredged material, the origin of the material dumped and possible relocation of material from other areas. Furthermore, not all data are collected and reported to the same standard. Assessment of contaminant concentrations in dredged material from selected harbour areas has proven to be a more effective tool for this purpose, as demonstrated in the overall assessment from the mid-1980s to 2001 (OSPAR, 2003). For this assessment, the same approach has been adopted with information updated to 2007.

Data from Belgium, the United Kingdom, the Elbe Estuary and Rotterdam Harbour demonstrated that there was a rapid decline of Mercury (Hg) and Cadmium (Cd) concentrations with a reduction of approx 60 – 80% from 1986/1987 to 1991 (see Figure 4.8a – 4.8d). In addition, data from Belgium, the Netherlands, and the United Kingdom showed a steady decline in concentrations of Copper (Cu), Nickel (Ni), Lead (Pb) and Zinc (Zn) with a reduction of approx. 40 – 60% in the same period while concentrations of these trace metals in the Elbe Estuary showed only little or no decrease. A similar decrease of about 50% was reported for PCB and PAHs in Rotterdam Harbour. It is worth noting that the actual concentrations also vary markedly between different regions.

From 1991 to 2007 most contaminant concentrations did not decrease significantly, except PCB, PAH and TBT concentrations which, according to the most recent measurements, continue to fall. Nonetheless, trends suggest that most contaminants are closer to background levels than they were 10 – 15 years ago. Despite some uncertainty in the early data, TBT concentrations have decreased over the last decade. In addition, chromium (Cr) concentrations in dredged material from Belgium and Rotterdam Harbour decreased by about 50 – 60%. However, in Germany and the United Kingdom little or no decline could be observed over the same period, though a slight decrease is evident over the last five years.

Specific local trends can be summarised as follows:

- In the United Kingdom, Cd, Hg, Cr and Zn decreased very slightly from 1995 – 2007 and As and Pb concentrations increased slightly.
- Trace metal concentrations from the Netherlands over the period 1995 – 2007 do not show discernible trends, confirmed by the analysis of the contaminant concentrations from Rotterdam Harbour over this time period.
- In Belgium, trace metal concentrations decreased slightly over the period 1995 – 2006 except for As, Cr and Cu.
- Total trace metal concentrations from France increased slightly from 1995 – 2007 (as did the total quantity of dredged material).
- In Germany, total trace metal concentrations decreased slightly over the period 1995 – 2007.

In future, a further steady downward trend in some trace metals, PCB, PAHs and TBT inputs may be expected as a result of reduction measures such as better control on contaminant sources and on land-based disposal. However, few data are available for organic contaminants and TBT in dredged material, and no proper assessment can thus be carried out. The OSPAR Guidelines for the Management of Dredged Material (OSPAR 2009) do not require organic substances to be analysed in all circumstances, thus, complete data sets for these substances are lacking.

The reported trace metal data are considered to be sufficient for an assessment. However, it should be kept in mind that due to incomplete reporting and differences in the analytical approaches, there is significant uncertainty when comparing national total trace metal loads between Contracting Parties. Therefore, the overall total trace metal load for all Contracting Parties can only be regarded as an order of magnitude estimate of loads.

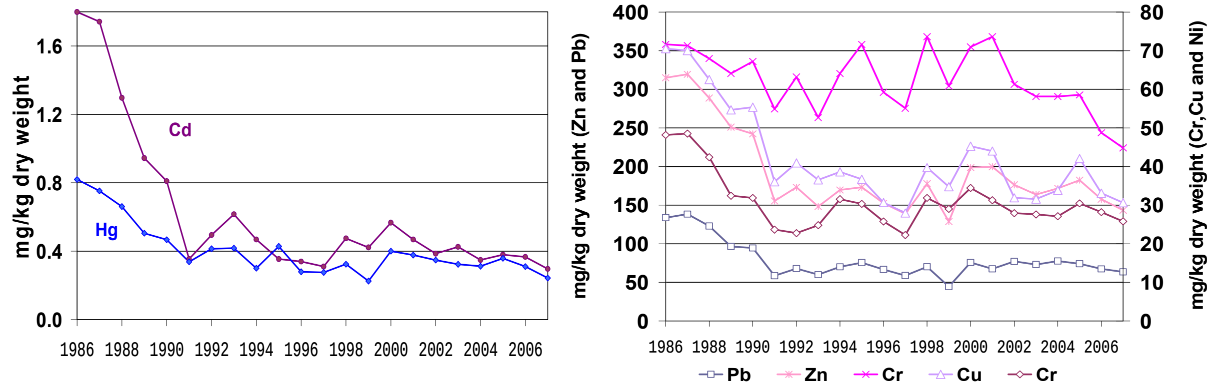

Figure 4.8a: *Trends in trace metal concentrations in dredged material disposed of at sea in the United Kingdom (average concentrations in sediment fraction < 2mm)*
Source: Cefas Regulatory Assessments Team

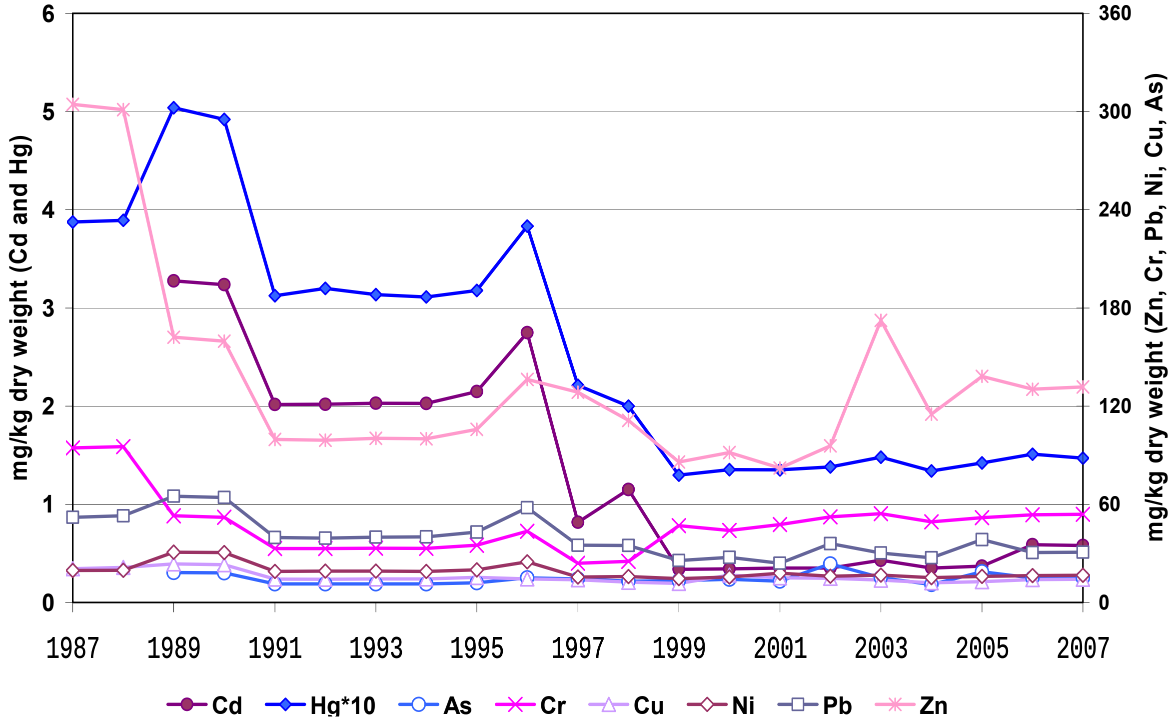

Figure 4.8b: *Trends in trace metal concentrations in dredged material disposed of at sea in Belgium (average concentrations in sediment fraction < 2 mm)*
Source: Annual OSPAR Reports on Dumping of Wastes at Sea

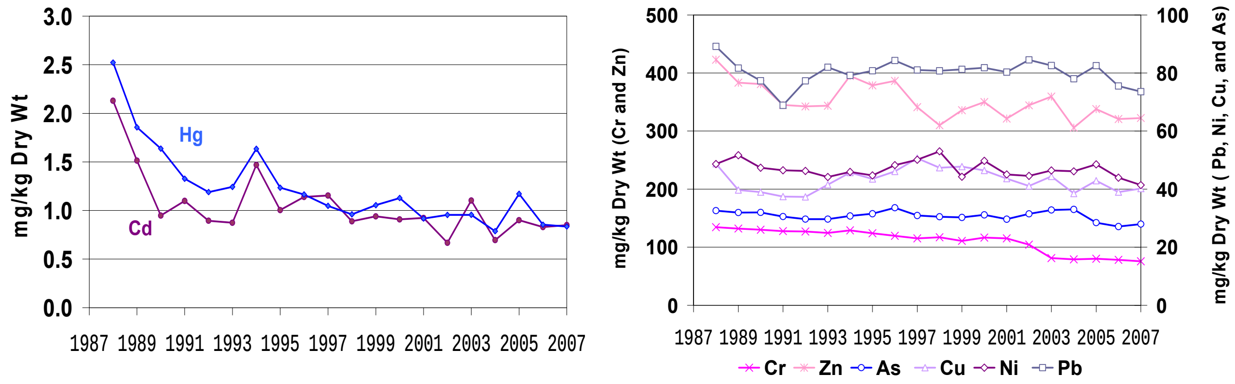

Figure 4.8c: *Trends in trace metal concentrations in dredged material from Elbe Convention area disposed of at sea in Germany (average concentrations in sediment fraction < 20 µm)*
Source: Bundesanstalt für Gewässerkunde (Federal Institute of Hydrology), unpublished.

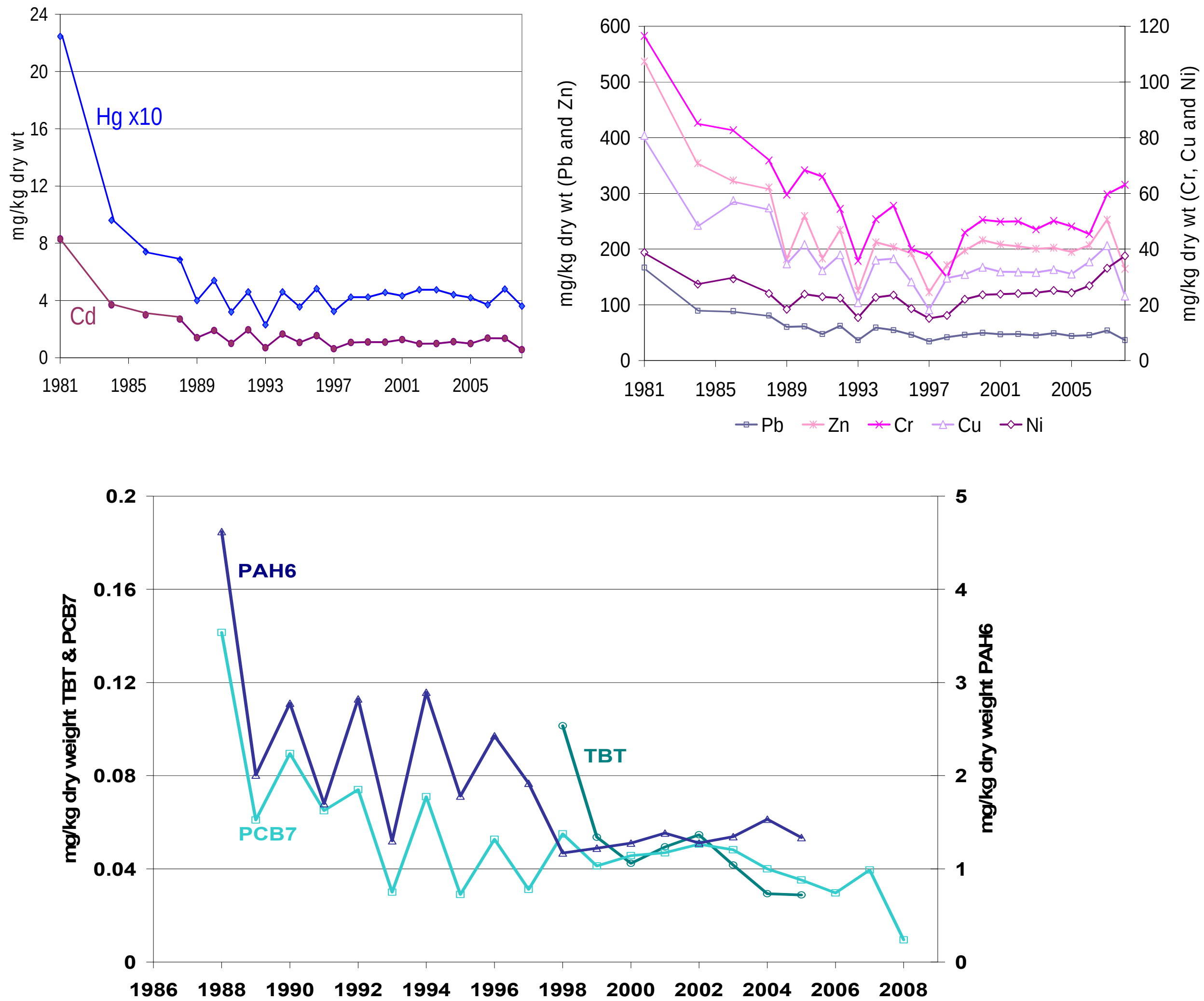

Figure 4.8d: *Trace metal, PCB, PAH and TBT concentrations in dredged material disposed of in Rotterdam Harbour (average concentrations in sediment fraction < 2mm)*
Source: Annual OSPAR Reports on Dumping of Wastes at Sea

The total trace metal concentrations from 1995 to 2007 are highly variable (Figure 4.9a and Figure 4.9b). In general, trace metal loads increased slightly from 1995-2002 and have subsequently decreased from 2002 – 2005, despite quantities of dredged material being higher in 2003 – 2005. The exception is Cd increased sharply in 2003. This is caused by the high Cd load at one particular deposit site in Belgium in 2003. The high Cu and Zn loads in 2002 are caused by increased loads from France and Portugal.

Harbour dredging follow the same pattern. The proportion of metals contributed by harbour dredging has decreased from about 60% to about 40% of the reported total trace metal loads from 1995-2007. The mean percentage of Cr, Cu, Ni, Pb and Zn loads in dredged material from harbours decreased from 70% in the mid-1990s to about 40 – 50% of the reported total trace metal loads in 2007.

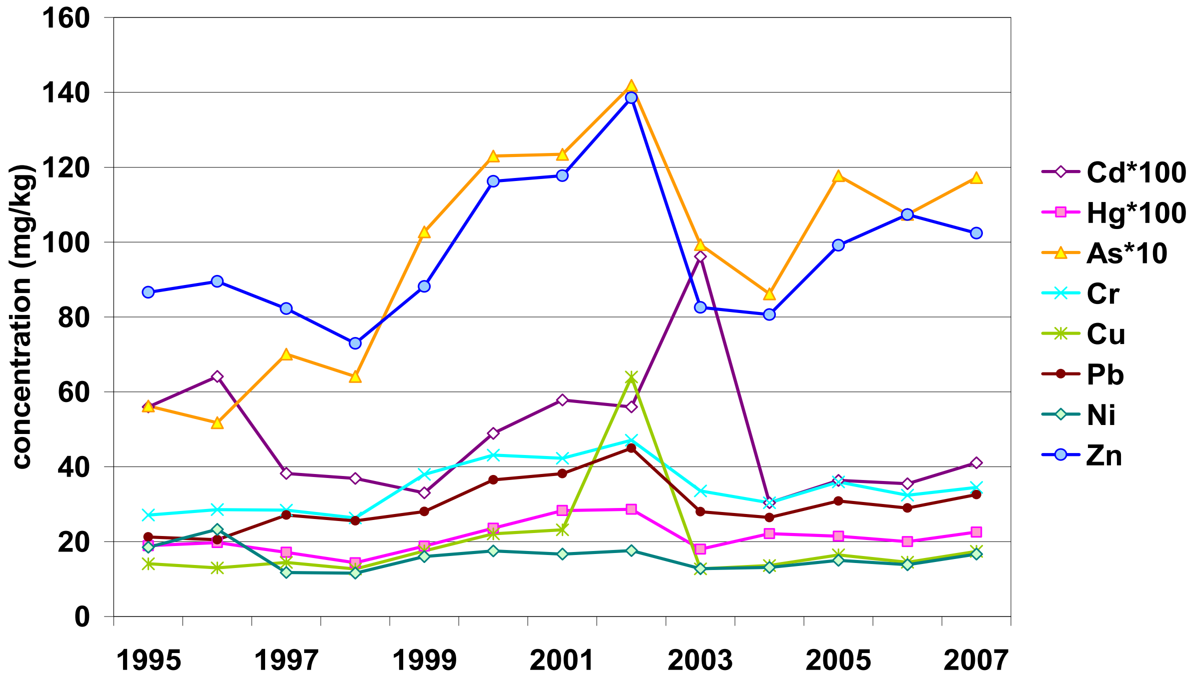

Figure 4.9a: *Calculated total trace metal concentrations within the OSPAR area 1995-2007*
Source: Annual OSPAR Reports on Dumping of Wastes at Sea

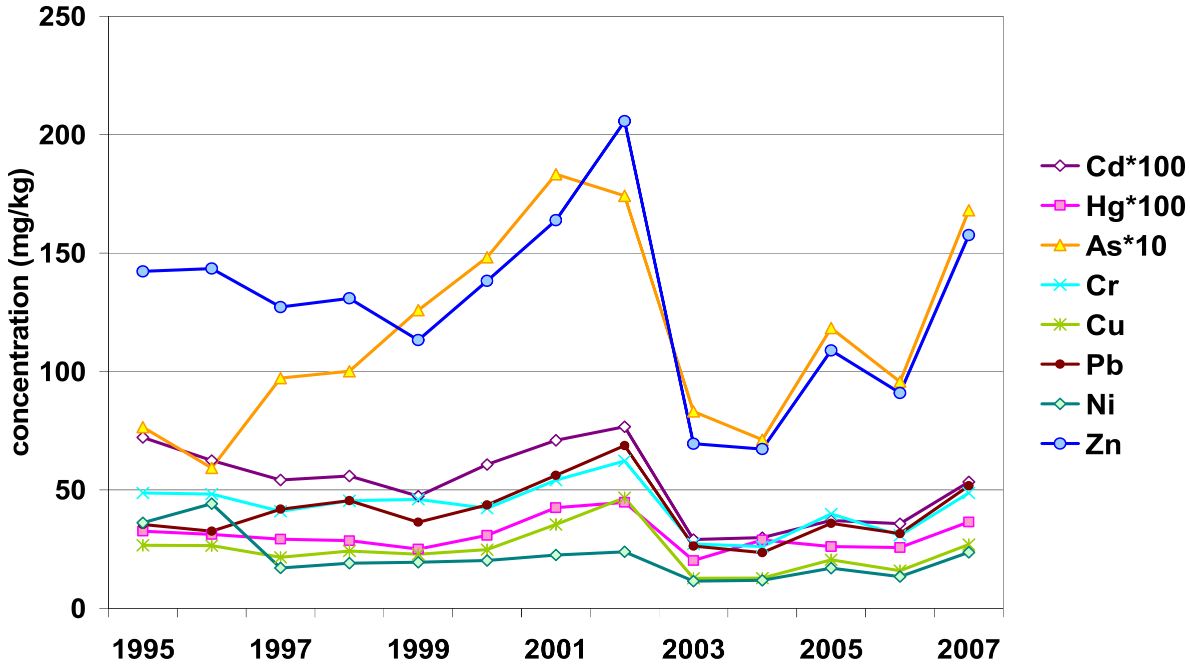

Figure 4.9b: *Calculated trace metal concentrations in harbour dredging in the OSPAR area, 1995-2007 Source: Annual OSPAR Reports on Dumping of Wastes at Sea*

The total contaminant loads reported to OSPAR are considered to be much higher than the actual inputs to the OSPAR maritime area. This is because reported loads also include elements in mineral matrices as well as pre-exiting material redistributed through re-dredging and other activities. At present there is no way to distinguish the proportion that represents new inputs from the marine disposal of dredged material from the relocation within the system.

The trace metal concentrations as shown in Figure 4.9a and 4.9b are calculated by dividing the total loads of contaminants by the total amounts of dredged material. However, some countries only reported the total amount of dredged material and not the contaminant load, leading to some over-estimation of concentrations.

5. How does this affect the overall quality status?

There are ecological impacts at the local level and regional level, in particular for certain ecosystem types, for example estuaries and intertidal mud flats and associated species in the southern and eastern North Sea. Generally, Contracting Parties have put in place license and control systems which help minimise impacts through best environmental practice recommended by the OSPAR Guidelines. The literature review indicates that physical, biological and chemical impacts do occur, but are localised within or close to (< 5 km) the boundaries of the disposal site (OSPAR, 2008b). Though disposal is regulated so that only sediments that meet established environmental quality criteria (action levels) are dumped, it is noted that defined action levels can vary strongly between Contracting Parties. In addition, there are only action levels for a limited number of contaminants and for example none for “new” substances such as brominated flame retardants.

Dredged sediment can have a relatively high content of organic matter. It is concluded from field studies that dredged sediment with a relatively high content of organic matter can act as a food supply for benthic organisms, which can result in an increase in opportunistic species (for example worms) at the disposal site. In this case, the disposal of dredged sediment results in a change in the benthic community structure (OSPAR (2008b).

Dredged sediment disposal can adversely affect the benthic community both by direct burial and habitat alterations due to a change in sediment structure (Zimmerman *et al.*, 2003). Direct burial will often result in the immediate mortality of benthos. Habitat alteration can have long-term effects on the benthic community (Morton, 1977). Habitat alterations have been observed due to the deposition of fine-grained sediments on coarse grained natural sediments (BfG, 2001; Stronkhorst *et al.*, 2003; Zimmerman *et al.*, 2003; Van Dalfsen and Lewis, 2006). It is concluded that dredged sediment disposal can adversely affect the benthic community if the sediment structure of the dredged sediments differs too much from the sediment structure of the natural occurring sediments at the disposal site. Negative effects due to a change in sediment structure can be minimized by selecting receiving sites that have similar sedimentary characteristics to the dredged sediments to be disposed.

Enhanced sedimentation is the most cited impact of dredged sediment disposal. Excessive deposition of dredged sediment leads to burial, smothering or crushing of the benthos. Most benthic organisms live in the top 10 cm of the seabed and must maintain some connection to the sediment-water interface for ventilation and feeding (Miller *et al.*, 2002). This connection is disturbed by excessive sediment deposition. In cases where the quantity of sediment disposed does not differ greatly from natural sedimentation in high energy systems, the effects are relatively small as many of the species are capable of migrating up through the deposited sediments (for example Bijkerk, 1988; Essink, 1999; Schratzberger *et al.*, 2006; Wilber *et al.*, 2007). Often however, the amount deposited is too great to allow species to survive burial and recovery occurs via recolonization of and/or immigration to the new sediment surface (for example Stronkhorst, 2003; Bolam *et al.*, 2006a, 2006b). The long-term effects in such cases may be more severe since recovery of benthic communities, a major food source for many other animals (for example fish) will be more prolonged. Relocation/disposal in high energy systems like tidal estuaries or coasts has less effect than relocation/disposal in low energy systems like for example lagoons with merely moving sediments.

Disposal of dredged material will cause local and temporal (re)suspension of sediments, causing increased turbidity. High turbidity results in low levels of transmitted light and can therefore negatively affect functioning of light-dependent organisms such as phytoplankton, eelgrass and visual predators, for example fish and fish-eating birds (Essink, 1999). Increased turbidity can be both caused by natural processes, such as storm events and tides, and human activities, for example the disposal of dredged sediment at sea. Phytoplankton production is directly dependent on light penetration into the water column. Increased water turbidity results in a decrease in light penetration, which is likely to affect phytoplankton adversely (Essink, 1999). However this effect will be localised in space and time and therefore have little impact on the total primary production of an estuary or of a tidal basin in which disposal took place. From field studies, it is concluded that disposal of dredged sediments will cause local and temporal (re)suspension of sediments causing increased turbidity. However, it is also concluded that naturally occurring turbidity elevations, induced by flood tides and weather activities, have a more significant effect than the periodic increased levels caused by disposal activities of dredged sediment. This means that the impact of dredged sediment disposal of light-dependent organisms due to increased turbidity is unlikely to have a greater impact than naturally occurring turbidity elevations, induced by flood tides and weather activities. By selecting appropriate time windows during which dredged sediment may be disposed of, possible adverse effects of increased turbidity can be minimized (Essink, 1999).

During disposal of dredged sediment at sea large amounts of sediment may be brought into suspension (Essink, 1999). Increased suspended particulate matter (SPM) concentrations may interfere with food intake of filter-feeding benthos (bivalves) and copepods, and functioning of gills of fish may be impaired due to clogging (Essink, 1999). According to Widdows *et al.* (1979) growth of filter-feeding bivalves may be impaired at SPM concentrations > 250 mg/l. Bolam *et al.* (2006a, 2006b) used a number of numerical techniques to assess impacts at 18 different disposal sites. They concluded that ecological effects associated with dredged sediment disposal were site-specific and any assessment of the consequences of sediment disposal at sea must take account of site-specific variation in prevailing hydrographic regimes and in ecological status, along with information on the disposal activity itself (mode, timing, quantity, frequency and type of material). Impacts to the benthic community at disposal sites typically are near-field and short-term (for example Leuchs and Nehring, 1996; Bolam and Rees, 2003; Stronkhorst *et al.*, 2003; CEFAS, 2005; Bolam *et al.*, 2006a, 2006b). At the disposal site of Loswal Northwest, on the Netherlands Continental Shelf, Stronkhorst *et al.* (2003) determined the impacts of sediment disposal at the disposal and an 8 km eastwards transect. During the time of disposal, the species richness and abundance of benthic invertebrates declined over an area extending about 1-2 km eastwards. Leuchs and Nehring (1996) determined the spatial impact of the disposal of dredged sediment in the Elbe Estuary, Germany. They showed that the disposal had an impact on macrozoobenthos in an area extending about one kilometre upstream and downstream of the disposal site.

In many studies the impacts of disposal are monitored in time (for example Harvey *et al.* 1998; Blanchard and Feder, 2003; Stronkhorst *et al.*, 2003; Bolam *et al.*, 2006a and review of recovery rates in Bolam and Rees, 2003). Often these studies are conducted to determine the time needed for the fauna to recover. De Grave and Whitaker (1999) suggest that recovery is not a suitable term to apply when assessing re-colonization after a disturbance since recovery implies return to faunal compositions and associated ecological pathways developed over many years (Blanchard and Feder, 2003). They suggest that "re-adjustment" rather than recovery is the appropriate terminology. The recovery rate of the species richness, (relative) abundance and diversity at different locations in the OSPAR maritime area varies from 3 months (Bolam *et al.*, 2006a) to more than 2 years (Stronkhorst *et al.* 2003; Bolam and Whomersley, 2005; Van Dalfsen and Lewis, 2006). At some locations the benthic community never recovers because sediment is disposed there more or less continuously. Repeated disturbances, such as described by Leuchs and Nehring (1996), to a benthic system results in a succession that never proceeds beyond the initial re-adjustment phase within a restricted area (dumpsite and close surroundings). Community structures, however, often fail to converge with reference sites within the monitoring period (no recovery). It should however be noted that because reference sites are not identical to the impact areas and that communities often occur in dynamic clusters, some discrepancy is to be expected (Armonies 2000).

The significance of effects of physical disturbance depends to a large extent on relocating/disposing within a high or within a low energy system.

6. Conclusions

Lessons learnt

At present, disposal of dredged material at sea is common practice within the OSPAR area. Although no trends in the scale of dumping and dredging activities can be observed, it can be assumed that the need will remain on the same level or slightly increase due to increasing use of bigger ships which require deeper and wider navigation routes. The annually updated reports on dumping operations at sea allow an assessment of the location, scale and (potential) chemical disturbance of dumping operations at sea in the OSPAR maritime area. Disposal of dredged material is appropriately regulated by Contracting Parties and there is no need for the OSPAR Commission to develop further related measures. However, the need for consistent data reporting and data calculating remains, especially for contaminant loads. Such data reporting varies greatly between different countries, at times even in magnitude and this could use a more uniform approach.

There are several opportunities to minimise the impacts of dredged sediment disposal that should be applied across the OSPAR area. The impact of the disposal of dredged sediment will be minimized if:

1. dredged sediment has similar characteristics to those of the receiving site;
2. contaminant concentrations in dredged material do not exceed background values;
3. the disposal of dredged sediment is adjusted to the natural processes. By quantifying natural sedimentation rates and the susceptibility of macrofauna to these natural processes, environmental impacts of dredged sediment disposal can be better predicted and disposal schemes can be tuned to these natural processes;
4. the disposal method systematically distributes a number of shallow layers of sediment over the disposal site giving mobile macrofauna the opportunity to migrate upwards between passes of the barge;
5. the sediment is disposed during an appropriate time windows to reduce impacts.

Concepts and methods for cumulative impact assessment should be developed and used for the assessment of human activities, including dredging and dumping. Environmental Impact Assessments should be used to assist cumulative impact assessments.

In the last 10 years progressively greater attention has been paid to exploring the beneficial options for use for dredged sediments. This has partly been driven by the revised guidelines produced by the Conventions but also by the more widespread acceptance and application of waste or other matter management hierarchy. In the early part of the last decade, the focus tended to be upon the beneficial use of coarser sediments, for example sand and gravel, as shown for the United Kingdom by Murray (1994), since these options were most readily achievable. Increasing attention has been paid in recent times to the beneficial options for use available for finer material including salt marsh feeding, habitat creation, tidal flat regeneration, topsoil production and its re-introduction into estuaries to feed through to tidal flats, salt marshes *etc*. (Dearnaley *et al.* 1995). However, the physical, chemical and biological impact of dredged sediments when used for habitat enhancement (*i.e.* beneficial use) is still under investigation (for example Wallasea case study, 2007). Matching the material available in a particular timeframe to projects that may be able to use that material is still challenging.

The potential utility of biological indicators that integrate a wide range of impacts has long been recognised and indeed used, for example in the case of benthic community analysis to monitor impacts at disposal sites. In the last decade there has been a significant effort made in North America to develop bioassays for the assessment of sediments (DGE, 2007), including dredged material. The use of bioassays in assessing the impact of dredged material has proceeded much more slowly in the OSPAR area than in the North America. However, in the last 5 years there has been a significant effort in a number of OSPAR countries to develop bioassay tests (whole sediment, pore water and elutriate) to support the dredged material assessment process, with pilot schemes for their implementation only being developed very recently. We should therefore expect to see a more widespread application of these techniques in a number of OSPAR countries in the very near future, although probably on a limited basis initially. Sediment management, including dredged material, will gain importance not only regarding possible harmful effects within the marine ecosystem but also with respect to sea level rise and the necessity for coastal and shelf protection.

What do we do next?

Existing regulations, including EU legislation, should be fully implemented across the OSPAR area and its effectiveness evaluated. However, further efforts are needed to better understand the actual effects of dumping activities on the marine ecosystem. Progress on investigating biological responses to the disposal of dredged material has been slow in OSPAR and more effort is needed for a wider and more systematic application of bioassays in the testing of dredged sediments. Also harmonized assessments of TBT, organic substances and new contaminants such as brominated flame retardants in dredged spoil should be considered. There is also scope for a more harmonized approach to the methodologies recommended under the OSPAR Guidelines to further reduce pollution from dredged material. The development of local or regional sediment management plans, recognising in particular sensitive marine areas such as OSPAR Marine Protected Areas and NATURA 2000 sites, should be promoted. The beneficial use of dredged material should be increased including the protection of coastal and shelf stability.

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