Marine Habitat Committee

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REPORT OF THE

Working Group on the Effects of Extraction of Marine Sediments on the Marine Ecosystem

Ostend, Belgium
1–5 April 2003

International Council for the Exploration of the Sea
Conseil International pour l'Exploration de la Mer

Palægade 2–4 DK–1261 Copenhagen K Denmark

Contents

1 Introduction

The Working Group on the Effects of Extraction of Marine Sediments on the Marine Ecosystem (WGEXT) was welcomed to Ostend by Brigitte Lauwaert of MUMM and Hans Hillewaert of DvZ. Later in the week this welcome was extended to WGEXT by Rudy De Clerck, ICES Delegate and Bureau Member for Belgium and Director DvZ.

Professor Jon Side thanked MUMM and DvZ for their welcome, and for hosting and providing facilities for the meeting. He provided feedback to WGEXT on the 2002 ICES Statutory Meeting, noted progress on the paper presented by WGEXT members to the ICES Journal of Marine Science, and discussed the proliferation of intent in acoustic and remote sensing survey technologies and marine habitat mapping within other ICES Working Groups. He outlined responses from ICES and OSPAR to, in particular, the new ICES Guidelines for the Management of Marine Sediment Extraction, and invited Denmark (lead country in OSPAR on this matter) to table OSPAR observations and requests to ICES WGEXT on this matter.

The Chair thanked all WGEXT members and participants who had provided electronic copies of their reports prior to the meeting. A number of regular contributors had sent apologies for not attending, though many had been able to provide reports and contributions by correspondence. A complete list of contributors to the meeting is appended as Annex 1 to this report.

2 Terms of reference, opening of meeting and adoption of agenda

ICES C. Res 2002/2E07: The Working Group on the Effects of Extraction of Marine Sediments on the Marine Ecosystem [WGEXT] (Chair: J. Side, UK) will meet in Oostende, Belgium from 1–5 April 2003 to:

a) review data on marine extraction activities, developments in marine resource mapping, information on changes to the legal regime (and associated environmental impact assessment requirements) governing marine aggregate extraction,
b) review scientific programmes and research projects relevant to the assessment of environmental effects of the extraction of marine sediments;
c) review the template and electronic submission procedures for recording and collating national reports;
d) receive feedback on the use of the new ICES Guidelines for the Management of Marine Sediment Extraction, and consider whether further specific guidance is required in special cases of extraction activities where unusual environmental conditions prevail, discussing also any feedback received on observations for procedures dealing with transboundary issues;
e) continue work on the planned *Cooperative Research Report*, and in particular to this end:
    i) provide a review of the quantity, quality, location and uses of marine sediments extracted annually since 1980;
    ii) continue to review the application of risk assessment methods as a tool for the management of marine sediment extraction;
    iii) continue to assess localised impacts from aggregate extraction on fisheries, and the means to adequately protect known areas sensitive for fisheries resources, e.g.,, herring spawning beds in the vicinity of extraction operations, particularly in the light of methods for determining impacts and the use of risk assessment;
    iv) review progress made by individual authors in scoping the detail of the content of sections of the report;
f) consider opportunities for subsidiary groups of the Fisheries Technology Committee to provide products and support.

WGEXT will report by 22 April 2003 for the attention of the Marine Habitat and Resource Management Committees and ACME and ACE.

The agenda was adopted; this and the scientific justification for the terms of reference, appear as Annex 2 to this report.

3 Review of national marine aggregate extraction activities

Table 3.1. Summary table of national aggregate extraction activities in 2002.

Country	Aggregate extracted (m^3)	Non-aggregate extracted (m^3)	Aggregate exported (m^3)	Beach replenishment (m^3)	Maps published in 2002	New legislation	EIA initiated	EIA ongoing	EIA finished	EIA published
Belgium	1,620,200	0	0	0	Yes	Yes	Yes	Yes	No	No
Canada	0	0	0	0	No	N/D	No	Yes	No	No
Denmark	5,570,000	2,400	70,000	2,800,000	Yes	Yes	Yes	Yes	Yes	No
Estonia	0	0	0	0	No	No	Yes	No	No	No
Finland	0	0	0	0	No	No	N/D	N/D	N/D	N/D
France	2,427,000	470,000	0	0	Yes	Yes	No	Yes	No	No
Germany	N/D	N/D	N/D	N/D	No	No	No	Yes	Yes	No
Ireland	0	7,700	0	6,300	Yes	No	No	No	No	No
The Netherlands	32,300,000	290,000	2,340,000	16,180,000	Yes	Yes	Yes	Yes	Yes	Yes
Norway	0	115,000	0	0	N/D	N/D	N/D	N/D	N/D	N/D
Poland	532,000	0	167,000	365,000	No	No	No	No	No	No
Sweden	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D
United Kingdom	12,830,000	0	3,620,000	655,000	Yes	No	Yes	Yes	Yes	Yes
United States	7,180,000	0	0	6,080,000	Yes	No	Yes	Yes	Yes	No

N/D: no data

Most of the countries reported that extraction of marine aggregates for construction purposes had remained fairly stable over the last few years. Dredging for land reclamation and beach replenishment varied more widely, often reflecting demand from one or two large-scale projects. Significant quantities of material were taken for coastal defence measures. The Netherlands with 16.18×10^6 m^3 was by far the largest, followed by the USA, Denmark, Germany (mainly Baltic), the UK and Poland. Exports are restricted to a relatively few countries; the UK with 3.6×10^6 m^3 is the largest followed by The Netherlands, Poland and Denmark.

The largest volume of material extracted is sand, the overwhelming majority coming from The Netherlands. The next largest producer is the UK, but the material is mainly aggregate (sand plus gravel). The proportion of sand and gravel extracted by other countries varies considerably from 100 % aggregate in France to very predominantly sand in the USA.

Extraction figures for the Baltic are not complete but appear to represent between 5–10 % of the total taken from the Northeast Atlantic.

Only two countries, France and Ireland, reported the extraction of maerl and in Denmark, small quantities of glacial till (boulders) were reported. Specific data from individual countries can be found in Annex 3.

4 Review of national seabed resource mapping programmes

Seabed resource mapping programmes have been (or are being) undertaken by most participating countries at different levels. Some countries have already published maps of the seabed within their territorial waters at the reconnaissance level, and for some areas at a more detailed resource assessment level, and have no current programmes. In a number of countries more thematic mapping programmes (e.g., habitat mapping) are also being undertaken.

The national reports (reproduced in Annex 4) vary in their content and detail. Some provide information on completed and ongoing programmes, while others report activity during 2002 only. The summary below focuses only on mapping activity and the related publication of maps for 2002.

In Belgium, the Ministry of Economic Affairs is undertaking mapping of the sandbanks in zone 2 of the Belgian continental shelf by multibeam. The Kwintebank map has been finished and maps of the Buiten Ratel and Oost Dijck are under development.

The Canadian regional systematic multibeam mapping project called "SEAMAP" is still active, but is unfunded at present.

Mapping continues in Denmark at a lower level than in the previous years. In 2002 the Geological Survey of Denmark and Greenland (GEUS) carried out mapping of sediment transport and resources along the Jutland west coast. No maps have been published in 2002.

Finland is conducting a survey of late-Quaternary deposits on the seabed using acoustic and seismic methods to acquire data on the distribution and thickness of sediments, and to provide information on stratigraphy, mineralogy and geochemistry of deposits. New methods of sounding, sampling and data processing are also being developed and tested. The annual goal of seabed survey is 700 km^2. In 2002 about 800 km^2 was surveyed.

In France, the Marine Geosciences Department of IFREMER has been undertaking seabed mapping since 2000. This includes side-scan sonar, multibeam bathymetry, echosounder, high resolution seismics, grabs, corers and video techniques. In 2003 a seabed map from Guadeloupe and Martinique has been published. Future marine resource mapping programmes will cover areas in the Atlantic and Channel coast.

The Irish National Seabed Survey in Zone 2 (50–200 m depths) has been continued under the direction of the Geological Survey of Ireland and undertaken by the Marine Institute. It is a full geophysical survey including multibeam, gravity, magnetic and sub-bottom profile data acquisition. In 2002/2003 a number of maps have been published, including Gravity and Magnetic overview maps of >200 m depths and bathymetry contours, sun-illuminated relief and backscatter maps. The Marine Institute is funding a desk study to review inshore mapping activities and to recommend a management strategy to map inshore resources.

The Netherlands reported that in the last year the emphasis on resource mapping in the Dutch North Sea has shifted gradually to dedicated and targeted resource inventories following clear needs on one hand and conceptual prospects on the other hand. This implies that the traditional systematic mapping programmes are slowing down and increasingly depend on the results of specific resource inventories for their advancement. Also, during surveys and studies links between aggregate and ecological inventories are becoming more frequent. Six sheets of the reconnaissance surveys 1:250,000 series published since 1984 are now available in digital format. The Seabed Sediment map of Terschelling Bank (53°–54°N, 4°–6°E) is in an advanced state of preparation. The Quaternary map of the same area is in preparation.

5 Review of developments in national authorisation and administrative framework and procedures

Seven countries provided updated information on their legislative or procedural frameworks for managing the extraction of marine sediments. Specific information from individual countries can be found in Annex 5.

Belgium reported that the implementing decrees required to amend their procedures for granting authorisations and defining exploitation zones have yet to come into force. They continue, for the time being, to apply their Royal Decrees of 7 October, 1974 and 16 May, 1977.

Denmark reported the introduction of new legislation which modifies their Raw Materials Act to allow the extraction of materials other than sand and gravel from international protected areas and from water depths of less than 6 m. This brings the extraction of materials such as shells under the same legislative provisions as sand and gravel. Permission will only be granted when it can be shown that a valuable resource can be extracted from such areas without a deterioration of the local environment.

France proposes to introduce new regulations to simplify the existing requirements for obtaining an authorisation to dredge, and to make the decision-making process more transparent. To encourage the identification of new dredging areas, authorisations for research licences and preliminary prospecting will be free, if the volume to be removed is less than 10,000 m^3.

In Germany, the Federal Act of Nature Conservation was changed in April 2002 to give the Ministry of Environment and the Federal Agency for Nature Conservation the responsibility for identifying and implementing Natura 2000 sites in the German EEZ of the North Sea and the Baltic Sea.

Ireland indicates that policy development on marine aggregate extraction may be completed within three to four years. This will enable the findings of their inshore habitat mapping programmes to be included.

The Netherlands has modified its approach to setting a threshold for EIA to include consideration of the volume of material to be extracted (>10×10^6 m^3), in addition to the existing requirement in terms of area (>500 hectares).

The UK reported the continued preparation of Regulations to bring the extraction of marine aggregates under statutory control, and the development of related guidance. Policy guidance was published in May 2002.

6 Review of approaches to environmental impact assessment and related environmental research

As in previous years, many of the national reports indicate a great deal of activity on the assessment of the effects of marine aggregate extraction, either as part of the application process for dredging authorisations, or as research (see Annex 6).

Estonia provided information on an EIA being undertaken in relation to the extraction of 1.3×10^6 m^3 of sand from the Gulf of Finland, for the construction of a new berth in the Port of Muuga. The assessment includes consideration of the impacts on benthic communities, fish, fisheries, seabirds and seals, as well as coastal impacts and impacts on seabed morphology.

France reported the start of a research programme to investigate the impacts of sandpits on bottom morphology in shallow water areas. The first step has been to test the ability of a state-of-the-art morphodynamic model to reproduce morphological evolutions in a wave tank, and to apply the model to a real site for which morphological evolutions have been monitored over 15 years.

Germany reported that until 2001, an EIA was not required for new dredging activities in areas already licensed. It is now obligatory to undertake an EIA if the extraction area exceeds 10 hectares or when the rate of extraction exceeds more than 3000 tonnes per day. Information was provided on an EIA undertaken in 1999 in relation to the deepening of the Elbe Estuary, and on post-dredging monitoring of the macrobenthos undertaken in 2001 and 2002. The investigation is to finish in 2004. Two research projects finished in 2002, the results of which will be published shortly. One looked at the regeneration of extraction areas in the North Sea and Baltic Sea. The other assessed the effects of sediment extraction on sensitive macrobenthic species in the southern Baltic Sea.

Information on three EIAs was provided by the Netherlands, covering areas off the coast of South Holland, the Cleaverbank and for sand extraction for the Westerschelde Container Terminal in the southern part of the North Sea. An update was provided of the PUTMOR study, which is determining the changes in physical parameters inside and outside a large pit situated 10 km off the Dutch coast near Hoek van Holland. The final report is expected in December 2003. Two archaeological maps have been produced. The first provides an indication of the areas with a high chance of finding archaeological and cultural heritage values on the seabed. The second gives the location of archaeological remains, mainly wrecks. A separate project has prepared a map of areas with geomorphological and geological value on the Netherlands Continental Shelf. It is expected in 2003.

The UK published guidance on the issues to be considered as part of an EIA scoping study. Procedural guidance on undertaking benthic surveys was also published. The research into cumulative impacts is finished and a final technical report is expected later in 2003. Research on the recovery of dredged sites continues, as does work on the role of seabed mapping techniques in environmental monitoring and management. Work on the scoping study for a development plan for marine aggregate dredging continues and will finish shortly. In addition four new projects have just started, and will report in March 2004. These will consider:

- Seabed characterisation and the effects of soil structure on the benthos and on benthos recolonisation;
- Impacts of overboard screening on the seabed and associated benthic biological community structure;
- Preparation of good practice guidance on assessing the impacts of aggregates dredging;
- Gauging the effects of aggregate extraction on pre-historic deposits on the seabed.

Details of a Regional Environmental Assessment undertaken in the Eastern English Channel are provided. The assessment included consideration at a regional scale of the existing environment, physical impacts, plume effects, marine biology, fish resources, fishing activity, shipping and navigation, and marine archaeology, in addition to potential transboundary effects.

The United States of America reported on a number of studies, including consideration of regional sediment management, biological monitoring off the Atlantic Coast of New Jersey, and evaluation of the effects of fishing gear on local benthic habitats.

7 Review of the electronic template for collating national reports that was adopted during WGEXT 2001

The Working Group reviewed a draft form for submitting regional data through the Internet. The submission form will be further trialled in reporting data to WGEXT in 2004.

It consists of an HTML form which can be filled out and then sent as an e-mail message to the member(s) that manage(s) the database. The form will be adapted to the format of, amongst others, the summary output table, and be forwarded to members soon.

Some members showed concern on the quality control and the consistency of data submitted by the Internet. Electronic submission was however perceived by the Working Group as the most suitable mechanism for future data collation.

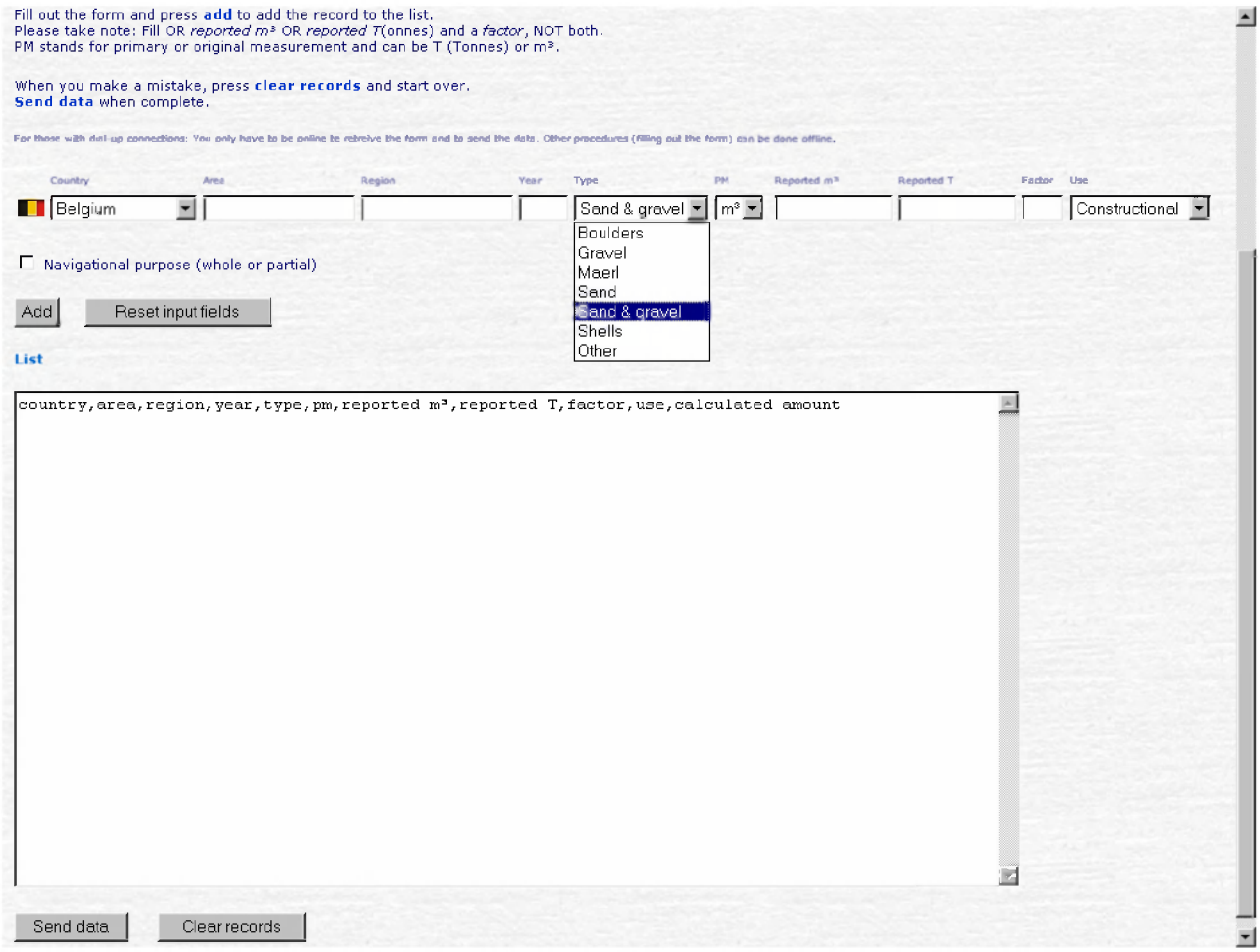

Figure 7.1. Electronic template for collecting national reports.

8 Response to OSPAR request for WGEXT to gather data for the OSPAR region (tabled by Denmark)

WGEXT welcomed the request from OSPAR to gather data for the entire OSPAR region on aggregate extraction activities. A discussion highlighted some specific difficulties that require to be overcome.

- There are certain countries for which extraction data have never been received by WGEXT (particularly Spain, Portugal, Iceland, with additionally for Denmark no extraction data for either Greenland or the Faroes). In some cases WGEXT has members representing these countries (Spain, Portugal and Denmark) who should be able to assist.

- There are certain countries who report regularly to WGEXT but not on an annual basis. In recent years this includes Finland, Norway, Ireland and Germany. In these cases WGEXT members from these countries must be appraised of the importance of regular annual reports.

- A consideration of the OSPAR region suggested that for certain countries specific adjustments to the data supplied may be required in order to separate extraction data for the OSPAR region. In the case of France and Spain this requires the separation of data for Atlantic coasts and the English Channel from the Mediterranean. It was noted that there are no extraction activities by France in the Mediterranean Sea area. Germany would have to continue to supply North Sea data separately, as it has done in recent reports. Extraction activities in Finland will be in the Baltic Sea and thus would be excluded. Sweden and Denmark have the most difficult task in delivering those parts of their EEZ which are within the OSPAR region. As there are no extraction activities in Sweden at the present time this is simple. Denmark noted that it undertakes this delineation already and that it is fairly straightforward.

These particulars are summarised in Table 7.1 below.

Table 7.1. Specific matters highlighted in response to the OSPAR request for ICES WGEXT to supply national data.

OSPAR COUNTRIES FOR WHICH DATA HAVE NEVER BEEN RECEIVED
SPAIN PORTUGAL ICELAND GREENLAND AND FAROES (DENMARK)
OSPAR COUNTRIES REPORTING TO ICES WGEXT BUT NOT ANNUALLY IN RECENT YEARS
FINLAND NORWAY IRELAND GERMANY
DATA ADJUSTMENTS FOR SPECIFIC COUNTRIES NECESSARY TO DISTINGUISH DATA FOR THE OSPAR REGION
SPAIN – Atlantic coast activities only (exclude Mediterranean) FRANCE – Atlantic coast and English Channel activities only (exclude Mediterranean) GERMANY – North Sea activities only (exclude Baltic) FINLAND – Exclude Baltic activities SWEDEN)- Delineate activities in the Baltic area which fall within the boundaries of the OSPAR 1992 DENMARK) - Convention and exclude those outside the OSPAR area

In response to the specific request from OSPAR SEABED of the licensed area and the actual areas over which extraction activities occur in any one year, the UK and Denmark provided the data in Table 7.2.:

Table 7.2. Licensed area and actual areas over which extraction occurs.

Country	**Licensed Area**	**Area in which extraction activities occur**	**Area in which over 90% of extracted material is taken**
UK (data for 2001)	1413 km^2	173 km^2	13.3 km^2
Denmark (estimate for recent years)	800 km^2	30 km^2	n/a

A number of other countries agreed that in principle these data could be provided in future (at least contrasting the licensed area with the area within which extraction activities occur in any one year). It was noted that this information had to be taken from an analysis of electronic monitoring data and that this is not a simple task. It was anticipated, however, that in all countries the pattern observed for UK and Danish data would be similar, in that the areas within which the vast majority of extraction activities occur, would be a very tiny portion of the licensed area.

All countries are asked to report back to WGEXT 2004 on whether such data can be provided on an annual basis.

WGEXT agreed:

- to welcome in particular the initiative from OSPAR SEABED that "Contracting Parties should submit to the (OSPAR) Secretariat with a copy to Denmark by 1 January 2003 contact details for their national authorities responsible for data on sand and gravel in identifying the relevant sources of data on sand and gravel extraction activities". The WGEXT Chair requested that this information be made available to WGEXT as soon as possible.

- to request authorisation from the ICES Secretariat to contact these national authorities on behalf of ICES, and stress the importance of this request from OSPAR for those countries presently not regularly submitting data on an annual basis.

- to seek support of existing WGEXT members and participants in this attempt to improve and extend reporting of national data to WGEXT in order to satisfy the OSPAR request.

9 Response of WGEXT to observations on, and the review of, the ICES Guidelines for the Management of Marine Sediment Extraction, by OSPAR

Denmark provided three documents for consideration by WGEXT (see Annexes 7, 8 and 9 for relevant extracts):

1) Draft OSPAR Agreement on Sand and Gravel Extraction (25 March 2003) (Annex 7);
2) Summary record of the SEABED Committee meeting of 19–21 November 2002 (BDC 03/4/1) (Annex 8);
3) Summary Record of the Biodiversity Committee (BDC) meeting of 20–24 January 2003 (BDC 03/10/1-E) (Annex 9).

WGEXT welcomed the very valuable observations made by OSPAR on the WGEXT Guidelines. It was agreed that the Guidelines should be amended to reflect more explicitly the need to:

- Adopt an ecosystem approach to the assessment of the effects and management of marine sediment extraction;

- Recognise in assessments of the potential effects of marine sediment extraction that some ecologically sensitive species and habitats are not subject to specific protection and/or conservation measures under International, European or National legislation, but nonetheless require special consideration.

The guidelines were therefore revised accordingly. The revised version is appended as Annex 10.

WGEXT reiterated its commitment to the ecosystem approach and noted that it had changed its name several years ago to reflect its changing emphasis away from consideration of environmental and fishing impacts to the examination of the effects on the whole marine ecosystem. WGEXT also noted that while the adoption of an ecosystem approach was an important statement of intent, rather like the wider concept of sustainable development, it was not something that could be described in a prescriptive manner. Rather it embodies a way of thinking about the impacts of human activities that encourages more holistic assessments of impacts on the entire ecosystem.

WGEXT also reiterated its support for Strategic Environmental Assessment (SEA). Reference was made to the EU Directive 2001/42/EC on the assessment of the effects of certain plans and programmes on the environment (the "SEA Directive"), which seeks to provide for a high level of protection of the environment through the integration of environmental considerations into the preparation and adoption of plans and programmes by national, regional, or local authorities which are considered likely to have significant effects on the environment. It was agreed that further development of the approach to SEA in the context of marine sediment extraction was needed.

10 Continued work on the *Cooperative Research Report*

10.1 Review of the quantity, quality, location and uses of marine sediments extracted annually since 1980

This information will be contained within the second chapter of the report. This chapter will review developments that have taken place in marine aggregate extraction activity within the ICES area since the last Cooperative report – with national statistics presented within a separate annex. Developments in the understanding of marine sand and gravel resources (distribution, identification and definition) will be reviewed in terms of resource management and regulatory implications, with further links made to developments in dredging technology and extraction techniques.

Throughout the chapter, consideration will be given to future changes that may take place within the themes identified – against the background of an ongoing requirement for marine aggregates and the need for good management and sustainable use. This in turn should highlight areas where future work may be necessary.

A proposed structure is presented below;

2.i Extraction of marine sediment
- Introduction – ICES map highlighting areas of activity
- Status of marine aggregate extraction in the ICES area–10 year review (Annual dredging figures by country in an annex)

2.ii Sustainable use of aggregate resources
- Need for marine aggregates
- Uses of marine aggregate – ongoing and new (coastal feeding)
- Supply and demand in ICES region, and trends for the future
- Appropriate use (beach replenishment specifications)
- Alternative sources (secondary/recycled) and limitations
- Taxation

2.iii Marine aggregate resources
- European distribution of sand/gravel resource
- Development of new interest areas: deep water, overburden, spoil recovery, beneficial use, and the implications (scale, cumulative/ in-combination issues, regional consideration)
- Development in understanding of resource (scale, extent, orientation, composition) linked to environmental implications and management/production issues
- Need for further development in understanding of seabed processes – for resource quality, environmental implications and resource management

2.iv Management of aggregate dredging activities
- Responsible management/best practice – regulation and management
- Environmental perspective – regulation
- Resource perspective – management
- Area licensed vs. area dredged (importance of EMS/black box data)
- Cumulative footprint
- Intensive vs. extensive dredging – static vs. trailing and links to resource understanding and limitations as well as mitigation measures
- Competition for sea space – Update comparison of spatial extent of various sea use activities presented in first cooperative report

2.v Dredging technology
- Dredging techniques employed in the ICES area (trailing/static)
- Technical implications arising from future resource development
- Screening – need, techniques and implications
- Positional control – dredge management
- Technical cross-over from capital/maintenance dredging industry

10.2 Further review of the application of risk assessment methods as a tool for the management of marine sediment extraction

A sub-group of WGEXT reviewed risk assessment methods drawing from material presented in the previous WGEXT report and recent experience of these techniques for evaluating the consequences of marine sediment extraction. It was recognised that a number of marine industries employ formal risk assessment procedures for evaluating the consequences of environmental risk. The most experienced sector in applying risk assessment techniques for evaluating environmental risks in the marine environment was viewed to be the offshore oil and gas industry. It was considered useful to explore the utility (in broad terms) of such approaches and experience for assessing the likelihood of environmental risks arising from marine sediment extraction operations. Hazard assessment is another area where procedures for evaluating risk are well developed, e.g., the PEC/PNEC risk assessment technique applied in the Netherlands.

The group observed that the setting of threshold values or EcoQOs was one approach for judging the acceptability of environmental risks arising from anthropogenic activities. However, the difficulties of deriving EcoQOs in environments where sediment extraction is ongoing were noted. In particular, it was observed that the derivation of scientifically robust EcoQOs for ecological parameters was problematic, due to the absence of any long time-series data sets for deriving and then testing the behaviour of potential measures. Despite such obvious difficulties, it was noted that there are an increasing number of examples where threshold levels have been set in order to protect the marine environment from the adverse consequences of marine sediment extraction. An illustration of this approach is provided by the Øresund fixed link, where during its construction, targets for vulnerable receptors (e.g., eelgrass and bird species) and overspill material were established. In this instance, monitoring programmes were instigated to ensure that the agreed threshold levels were not exceeded. In the UK, the sole monitoring programme at Hastings provides another example of a scheme where acceptable limits for a vulnerable receptor were set.

GIS techniques were also suggested as a tool for undertaking spatial and temporal analysis of complex data sets which could be modified to include risk assessment models.

The Group observed that more informal risk assessments were often carried out by permitting authorities in arriving at decisions on extraction applications, which may take into account political aspects of the extraction operations.

The following structure was adopted as the basis for progressing this topic for inclusion in the *ICES Cooperative Research Report*, and the names identified against each section are those individuals that indicated a willingness to provide text for the report.

- The role of GIS in environmental risk assessment (Gerry Sutton).
- The use of formal risk assessment techniques by marine industries, particularly oil spill risk assessment by the oil industry (Jon Side).
- Approaches for evaluating risk in relation to impacts of marine aggregate extraction on fish populations and species (Jon Side and Stuart Rogers?)
- Assessing the risk of marine extraction operations on sensitive benthic species and biotopes (Jochen Christian Krause)
- Risk assessment: The regulator's perspective (to include consideration of mitigation measures, monitoring and the EIA process in risk management) (Ad Stolk and Chris Vivian)
- Applicability of the PEC/PNEC risk assessment process for managing the effects of sand and gravel extraction operations (Jan van Dalfsen)
- Risk assessment methods employed in the construction of the Øresund fixed link (Poul Erik Nielsen).

10.3 Methods to assess localised impacts of aggregate extraction on fisheries and the means to adequately protect known areas sensitive for fisheries resources

See Chapter 4 - Effects of extraction activities on the marine ecosystem, below.

10.4 Progress made by individual authors in scoping the detail of the content of sections of the report

Chapter 2 and the review of risk assessment and risk management have been covered above in Sections 10.1 and 10.2.

Chapter 3 - Environmental Research

This chapter should give an overview of the available techniques to measure the necessary information identified in each bullet point below. Different quality levels will be explained using examples and appropriate techniques to address dredging activities and effects will be identified.

3.1. Introduction

key words: thematic approach on all relevant environmental information addressed, country-specific information provided in an annex

- Bathymetry (Ceri James)
- Hydrodynamics (Brigitte Lauwaert)

- Water quality (Jochen Krause) Analysing of extraction in areas which are within the jurisdiction of Water Framework Directive
- Mineral Resources (Resource mapping) (Ruud Schüttenhelm)
- Superficial and subsurface sediments (Ceri James, Ingemar Cato, Szymon Uscinowicz)
- Sediment dynamics (Ceri James, Ingemar Cato, Szymon Uscinowicz)
- Seabed Topography and Morphology (Ceri James, Ingemar Cato, Szymon Uscinowicz)
- Other Uses (Jon Side)
- Biological Environment (Siân Boyd, Jochen Krause)
- Sensitive Habitats and Species (Michel Desprez, Jochen Krause)
- Habitat Mapping (Jan van Dalfsen, Stig Helmig)
- Conservation Designation (Michel Desprez, Jochen Krause)
- Archeology (Jon Side, Bob Forbes)

3.2. Review of the adequacy/reliability of available information according to all bullet points on the list

3.3. Identification of the gaps and recommendation of how to fill the identified gaps
Summary

Annex - country-specific information

Chapter 4 - Effects of extraction activities on the marine ecosystem

A review of information on the environmental effects of marine sand and gravel extraction will form the basis of Chapter 4 of the Cooperative Report. This Chapter will begin with a review of findings from recently completed and ongoing case studies. Such studies will be used to illustrate the environmental responses of benthic species and habitats to the effects of dredging. Following this review, a Table will be produced documenting environmental conditions at a range of study sites (to include historic investigations and current studies). A template for this Table will be created in advance of next year's meeting and will be placed on the WGEXT website, so that members of the group can insert relevant data.

Accumulated field data (contained within the above Table) on the responses of benthic fauna to the effects of marine extraction will be drawn upon in later sections of the report to model the responses of assemblages to sediment extraction. The aim of this section of the report will be to produce simplified models to describe the recovery process, acknowledging that there are numerous factors and processes involved in the physical and biological recovery of dredged sediments. Since variability also exists in both the dredging history and the dredging practices which different study sites have been exposed to, it is anticipated that there will be some difficulty in generalising about the effects of commercial aggregate extraction. Nevertheless, it is considered that some progress can be made in producing simplified models of responses to disturbance, i.e., responses to dredging in predominantly sandy sediments and in gravelly sediments. It is considered that such models will have value since they may provide a useful framework for the selection of trial locations, the evolution of sampling strategies and their time-scales, and could be used to evaluate post-cessation recolonization and recovery rates. These models will be derived following the outcome of a brainstorming session at next year's meeting. In parallel, effort will be devoted to numerically quantifying the responses of benthic fauna to marine dredging and these numerical expressions of collated data may eventually provide a reliable predictive capability. This exercise will rely for input on primary biological measures such as numbers of species, abundance and biomass.

The above information will be used in conjunction with data on the total area dredged within the ICES region (contained within Chapter 2 of the report) to derive estimates of the total loss of biomass from benthic organisms removed as a result of dredging activity. Assumptions of the quantity of biomass returned to the marine system as a result of recolonization processes and/or through biomass enhancement due to dredging activity will be acknowledged. This section will be followed by a general discussion of the implications of biomass loss for other components of the ecosystem, particularly fishes.

Recognising the progress made in understanding the impacts of marine sediment extraction on marine fish species and populations, a review of case studies on this topic will also be included in this Chapter. This will be supplemented by a consideration of appropriate models for describing the impacts of dredging on commercial fish species. Since the publication of *Cooperative Research Report* No. 247, a number of investigations have been carried out which have increased the understanding of the effects of dredging activity on commercial fishing activity and these will be summa-

rised in the following section. Finally, in addition to describing the effects of dredging activity on a range of environmental receptors, the report will highlight the implications of dredging activity for particular vulnerable/sensitive and rare systems (e.g., biotopes) and species.

A proposed structure for this Chapter of the report is presented below:

4.1. Case studies of the environmental responses of benthic fauna to the effects of dredging

- Dieppe recolonisation study (France) [Michel Desprez]
- Kriegers Flak (Denmark) [Poul Erik/Stig Helmig]
- Kwintebank (Belgium) [Hans Hillewaert]
- Baltic Studies (Germany) [Jochen Christian Krause]
- North Sea Borrow and sand extraction sites (Netherlands) [Jan van Dalfsen]
- Area 408 (UK) [Siân Boyd]
- Area 222 (UK) [Siân Boyd]
- Hastings (UK) [Siân Boyd/Keith Cooper]

4.2 Table 1- Main characteristics of studied extraction sites [Siân Boyd/Hans Hillewaert] This table will contain information where available on:

- extraction rates
- volumes dredged
- intensity of dredging
- Scale and duration of dredging disturbance
- type and nature of dredging (e.g., whether screening of the cargo was undertaken)
- type and nature of sediment and sediment stability
- water depth
- biotope description
- changes to biological parameters as a result of dredging

The above list is not exhaustive and is provided by way of an illustration of the type of information that will be summarised in the Table. [All WGEXT to contribute available data on WGEXT website]

4.3 Models describing the effects of disturbance on marine benthic assemblages [input from all WGEXT members]

- Empirical responses of benthic fauna to dredging activity [Siân Boyd/Jon Side]

4.4 Effects of extraction on benthic biomass within the ICES Region [Jon Side]

4.5 Trophic implications of biomass loss for various components of the ecosystem [Jon Side]

4.6 Case studies of the environmental responses of fish species and populations to the effects of dredging [Jon Side, Michel Lemoine, Stuart Rogers]

- Black Sea Bream

- Irish Sea Herring Spawning Grounds
- Hastings Crab & Sole populations
- Other case studies

4.7 Temporal and spatial variability of the use of spawning grounds by commercial fish species [Jon Side, Michel Lemoine, Stuart Rogers]

4.8 Impacts of extraction operations on commercial fisheries [Jon Side, Michel Lemoine, Stuart Rogers]

4.9 Implications of dredging activity for vulnerable/sensitive and rare systems (e.g., biotopes) and species [Michel Desprez and Jochen Christian Krause]

Chapter 5 - Management

Regulating regime, Risk assessment, EIA approach

Goals:

- To show the development of EU and OSPAR regulations. To review regulating regime and EIA approaches over the past 5 years (1998–2003).
- To show the differences in approach in several countries, without propagating a special approach.
- To emphasise that the countries are free to organise this in their own way, but must be transparent about their regulations, both to the industry and to the NGOs.
- To identify general trends, both in regulations and in EIA approaches

Text:

- Relatively short general text for chapter 5 with flow diagrams of the regulations of each country in annexes. The flow diagrams should also show the financial aspects of regulation.
- In the general text there will be attention to legislation, regulation, EIA and monitoring, to show the various ways to approach these items.
- Detailed information goes into the annex.
- Too detailed information will not be mentioned.

Planning:

- April 2003; identification of contributors in each country. (action Ad Stolk)
- End of May 2003; invitation for text and flow diagram to contributors (accompanied by an example flow diagram of the Belgium regulation system). (action Brigitte Lauwaert and Ad Stolk)
- End of September 2003; Send text and diagram to Ad Stolk (action contributors)
- February 2004; draft text for these parts of chapter 5 to members of WGEXT for discussion in April 2004. (action Ad Stolk and Chris Vivian.)

11 Opportunities for subsidiary groups of the Fisheries Technology Committee to provide products and support

There was some discussion on a proposal that a suitable means of collaboration between the various ICES Working Groups and Study Groups whose work involved an examination of remote sensing techniques would be to prepare a *Cooperative Research Report*. This could serve to pull together the increasing interest and work on acoustic and video survey techniques being reviewed in several ICES Working Groups, and their use in a variety of contexts—from impact studies to marine habitat mapping studies.

WGEXT agreed that its priorities were to its own forthcoming *Cooperative Research Report*, but individual members may be willing to contribute to such an initiative.

12 Recommendations and draft Council Resolutions

The Working Group on the Effects of Extraction of Marine Sediments on the Marine Ecosystem [WGEXT] (Co-Chairs: Prof. J. Side, and Dr S. Boyd, UK) will meet on the Isle of Vilm, Germany from 30 March–2 April 2004 as guests of the Federal Agency for Nature Conservation in order to:

a) review data on marine extraction activities, developments in marine resource mapping, information on changes to the legal regime (and associated environmental impact assessment requirements) governing marine aggregate extraction;
b) review scientific programmes and research projects relevant to the assessment of environmental effects of the extraction of marine sediments;
c) provide a summary of data on marine sediment extraction for the OSPAR region that seeks to fulfil the requirements of the OSPAR request for extraction data to be provided by ICES;
d) receive feedback from OSPAR on WGEXT 2003 proposals for gathering these data for the OSPAR region on an annual basis;
e) receive feedback and any specific observation from OSPAR on the WGEXT 2003 revision to the ICES Guidelines for the Management of Marine Extraction;
f) compile and collate drafts of individual contributions to the *Cooperative Research Report*, and in particular to this end:
   i) consider recommendations for the use of risk assessment methods as a tool in the management of marine sediment extraction activities;
   ii) review the variability of data emerging from observed impacts of marine sediment extraction in scientific research programmes with a view to developing understandings and possible models for the explanation of these;
   iii) consider opportunities for further developing the ecosystem approach to the management of marine sediment extraction;
   iv) review progress and text of the draft report.

As requested by ICES Secretariat the full resolution on terms of reference and the accompanying scientific justification, explanations and administrative details are attached as the final annex to this report, Annex 17.

13 Close of meeting and adoption of the report

14 Annexes

Annex 1 List of contributors to the 2003 report

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Annex 2 Agenda adopted by WGEXT 2003 Annual Meeting at SFD (dvz), Oostende, Belgium. 1–5 April 2003

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Tuesday 1 April 2003

10.00 – 10.10	Assemble at SFD, Coffee
10.10 – 10.20	Welcome by representative(s) of SFD/MUMM
	Welcome by WGEXT Chairman
	Appointment of Rapporteur – Combination of Siân and Sarah have expressed a willingness to act in this capacity!
	Terms of Reference (see ICES Res. 2002/2E07 attached)
	Adoption of Agenda
10.30 – 12:00	Terms of reference item (a) – please supply material on disk
12.00 – 13.00	Lunch
13.00 – 14.45	Terms of reference item (a) – report on item (c) [Siân]/[Hans]
14.45 – 15.00	Coffee
15.00 – 18.30	Terms of reference (b) and finalise (c) – looking also at the possibility of collecting this data for other ICES/PARCOM/HELCOM countries in future.
18:30 –	Reception as guest of SFD
	Aim to complete (a), (b) and (c) by day 1

Wednesday 2 April

09.00 – 10.30	Terms of reference item (d) –
	Please forward any comments/feedback from other groups received on the guideline in relation to putting these into practice.
	Note I made minor amendments to the guidelines following some suggestions from ICES – this slightly revised version was circulated by email some time ago and I assume is now or will be shortly published as the ICES Guidelines.
10.30 – 10.45	Coffee
10.45 – 12.00	Terms of Reference item (d) – we need to consider also in this context special cases of extraction activities, where unusual environmental conditions prevail, and also any specific procedures for dealing with transboundary issues.
12.00 – 13.00	Lunch
13.00 – 14.45	Terms of reference item (d) – contd
14.45 – 15.00	Coffee
15.00 – 18.30	Parallel groups Terms of Reference items (e)i and (e)ii – please advise if you have material to review/contribute.
	Aim to know what we have to do on e(i-ii) and d, if required.

Thursday 3 April

09.00 – 10.30	Continue (and Report back) items (e)i (e)ii and formulate report on these
10.30 – 10.45	Coffee (and Group photographs).
10.45 – 13.30	Terms of Reference item (e)iii
13.30 – 14.15	Lunch
14:30	Terms of reference (e)iii, followed by an excursion
	Aim to have all but item (e)iv and (f) and Recommendations and Summary completed
Times to be confirmed	Visit to the Zwin and Dinner as guests of MUMM

Friday 4 April

09.00 – 10.30	Terms of Reference item (e)iv and (f)
10.30 – 10.45	Coffee
10.45 – 12.00	Work on any outstanding agenda items/new agenda items/Executive Summary Any outstanding presentations
12.00 – 13.00	Lunch
13.00 – 14.45	Final agenda items and Recommendations for follow-up work
14.45 – 15.00	Coffee
15.00 – 17.00	Agree text of Working Group Annual Report for 2003. Review and agree Recommendations for next Annual Meeting. Date and place of next Annual Meeting Close of Annual Meeting
Saturday 5 April **9:30 – 14:00**	Final session for reviewing ongoing EU research projects involving WGEXT Members (SUMARE/EUMARSAND and EU SAND PIT) End User considerations. Discussion on future research projects e.g., EXEMPLAR and related initiatives.

Scientific Justification

Supporting Information (for the terms of reference)

Priority:	Current activities are concerned with developing the understanding necessary to ensure that marine sand and gravel extraction is managed in a sustainable manner, and that any ecosystem (and fishery) effects of this activity are better understood so that mitigative measures can be adopted where appropriate. These activities are considered to have a very high priority.
Scientific Justification:	a,b) An increasing number of ICES Member Countries undertake sand and gravel extraction activities and others are looking at the potential for future exploitation. Each year relevant developments under these headings are reviewed and summarised. This provides a useful forum for information exchange and discussion. National reports are submitted electronically prior to the meeting and this year a new electronic reporting format has been trialed . National Reports should be submitted, using the new reporting template, no later than 16 March 2003. c) This request was made by ACME and a reporting format was adopted at WGEXT 2001. It will be tested for electronic data returns in the coming year and reviewed at WGEXT 2003.

	d) The new Guidelines (finalised at WGEXT 2002) incorporate both guidance on EIA for aggregate extraction activities and guidance contained in the previous ICES Code of Practice on sand and gravel extraction. WGEXT will monitor whether there are special cases of extraction activity that would not normally be covered by this guidance, and also any responses to its observations on extraction projects with transboundary environmental implications. e) This work is ongoing and responds in particular to the recommendations contained in previous *Co-operative Research Reports* (Nos. 183 and 247). It will also incorporate the most recent work undertaken by WGEXT on risk management and on effects of sediment extraction activities on fisheries, together with the review of all major research projects on the ecosystem effects of sediment extraction activities. This is seen by WGEXT as a major periodic deliverable from its work.
Relation to Strategic Plan	The principal focus of WGEXT work is in relation to Objective 2 (c.), but other terms of reference also relate to Objectives 1(a), 1(c), 1(e) and 4(a).
Resource Requirements:	Most countries collect data and information routinely on aggregate extraction activities. The additional work in presenting these data in a standardised form for the new electronic template is considered small, but ion the long-term should result in a reduction of effort. Review of research activity are of programmes that are already underway and have resources committed.
Participants:	WGEXT is normally attended by 20-25 members
Secretariat Facilities:	WGEXT 2003 will be hosted by MUMM and DvZ in Belgium
Financial:	No additional financial implications
Linkages to Advisory Committees:	ACME, ACE
Linkages to other Committees or Groups:	BEWG, WGMHM, WGECO, WGFAST, SGASD
Linkages to other Organisations:	Work is of direct interest to OSPAR and HELCOM
Cost share	ICES 100%

Annex 3 Review of national marine aggregate extraction activities

A detailed breakdown of each country's sediment extraction dredging activities is provided below:

3.1 Belgium

During 2002, 1,619,216 m^3 sand has been extracted on the Belgian continental shelf in two clearly defined extraction areas (see Figure A3.1). It should be noted that the quantity extracted represents approximately only 25 % of the quantity licensed.

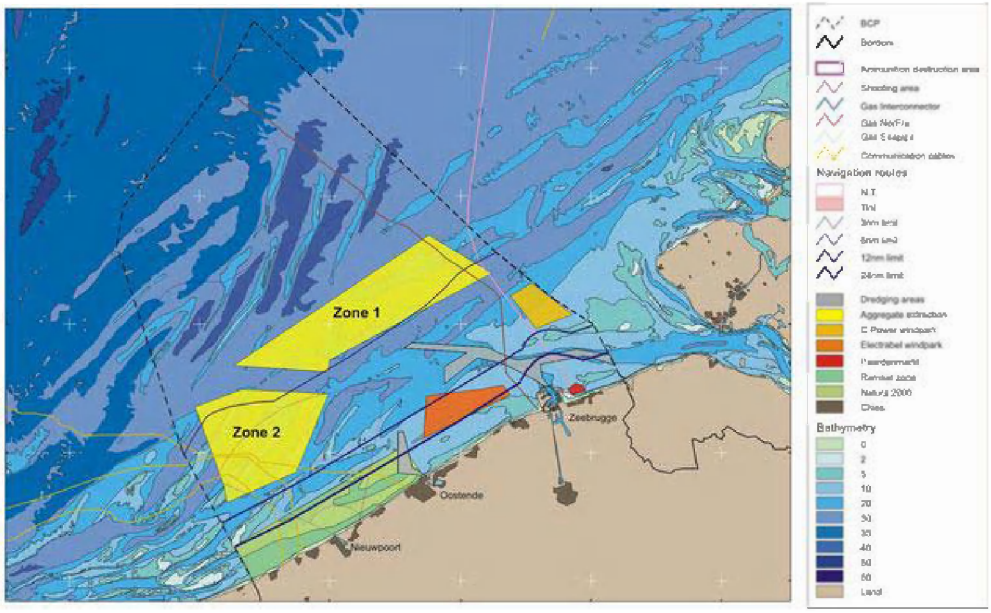
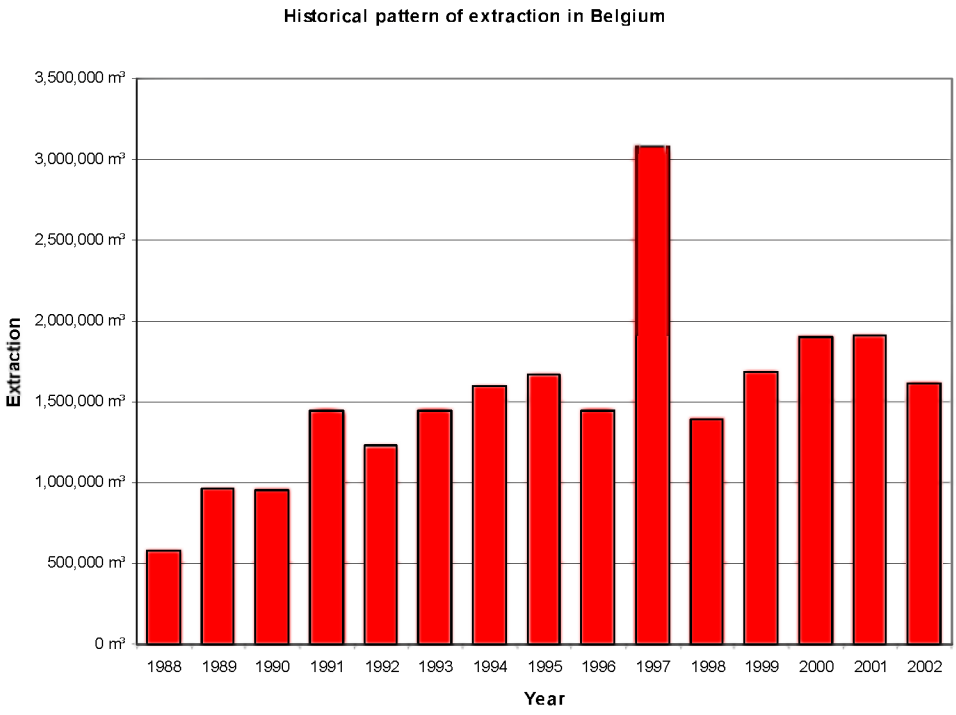


Figure A3.1. Extraction areas on the Belgian continental shelf.



Today sand and gravel is being extracted by 13 licence holders. Three applications are still being processed. A historical review of all extraction since 1988 is given in Figure A3.2.

Figure A3.2. Historic pattern of extraction in Belgium.

3.2 Canada

Last year Natural Resources Canada decided to discontinue any work on marine aggregate extraction. There were no extraction activities in the past year, although industry is still pursuing some interests on the West coast of Canada.

3.3 Denmark

Table A3.1. Marine aggregate (sand and gravel) extraction figures for 2002.

DREDGING AREA	AMOUNT in 10^6 m^3
North Sea	3.50
The Baltic	2.07

Table A3.2. Description of aggregate extraction activities in 2002/2003.

Total Extraction 2002 in 10^6 m^3			
Sand	Fine Gravel	Coarse Gravel	Sand Fill
0.53	0.39	1.23	3.43

Table A3.3. Non-aggregate (e.g., shell, maerl, boulders etc) extraction figures for 2002/2003.

DREDGING AREA	MATERIAL	AMOUNT in m^3
Danish seabed	Glacial till	2,370

Description of non-aggregate extraction activities in 2002/2003

Beneficial use of dredged materials from capital dredging

Table A3.4. Exports of marine aggregate in 2002/2003.

PORT (landing)	AMOUNT m^3
Germany	70,000

Table A3.5. Amount of material extracted for beach replenishment projects in 2002.

DREDGING AREA	MATERIAL	AMOUNT in 10^6 m^3
West coast of Jutland	Sand	2.8

Description of beach replenishment schemes in 2002

The consumption of sand for beach nourishment at the West Coast of Jutland has shown a pronounced increase from 40,000 m^3 in 1980 to more than 3.5×10^6 m^3 in 1998 (Fig. 3, Annex 11). The consumption in 2002 was 2.8×10^6 m^3.

Table A3.6. Historic patterns of marine aggregate extraction (m^3).

	Sand	Fine gravel	Coarse gravel	Sand fill
1978	384119	683327	1904767	1612006
1979	346155	634581	1501931	2510836
1980	325511	599196	1558817	1061980
1981	305166	375295	987804	1053639
1982	295824	382439	736976	1860431
1983	762283	490549	739255	1751575
1984	267184	319053	680047	1323477
1985	395987	549108	611723	1063045
1986	341506	545454	653545	1660300
1987	342777	588560	719410	3974459
1988	318613	582879	577566	2086910
1989	1383547	695067	535312	5061802
1990	976751	237504	591975	3935535
1991	1064515	451140	886705	3995591
1992	733971	191837	1095091	2358284
1993	896984	215649	1114988	2095997
1994	1061538	208074	1335400	2569030
1995	1115118	210936	1159739	2820421
1996	886777	196362	1094138	4144540
1997	802537	206378	1547764	3846215
1998	832905	188698	1026735	4613347
1999	622536	330485	1155375	9927152
2000	648054	377800	1068413	5022076
2001	715250	359826	1151693	3136889
2002	530404	391983	1226755	3425071

Description of historic extraction activities for 1990–2002

The production of construction aggregates has remained stable in the last 5 years. However, the production of coarse aggregates has been very slightly increasing since 2000.

The dredging of sand fill for land reclamation has varied markedly during the last 15 years caused by several large construction works in coastal areas.

A major enlargement of the harbour of Århus has required more than 8×10^6 m^3 of sand fill. The construction works started in the autumn of 1998 and was completed in 2000. A total of 8×10^6 m^3 has been dredged from 2 areas in Århus Bight. The spill from the dredging operations has been 3.7 %.

Only a few reclamation projects have been carried out in 2002. Approximately 70,000 m^3 of sand fill has been exported to Germany in 2002.

The consumption of sand for beach nourishment at the West Coast of Jutland has shown a pronounced increase from 40,000 m^3 in 1980 to more than 3.5×10^6 m^3 in 1998. The consumption in 2002 was 2.8×10^6 m^3

Summary of current licence position and forecasts for future exploitation of marine aggregates

The process of converting the temporary dredging area from 1997 in accordance with the new act has started in 2002. The first permissions will be given in 2003. It is expected that up to 80 areas will be evaluated and receive a permission before 2007.

A number of permissions for dredging in international protected areas will expire in 2005. It is expected that only one or two permissions will be renewed.

3.4 Estonia

Table A3.7. Marine aggregate (sand and gravel) extraction figures for 2002/2003.

DREDGING AREA	AMOUNT m^3
Baltic Sea, Gulf of Finland, Island Prangli coastal sea, sand	1,300,000 planned in 2003

3.5 Finland

Sand and gravel extraction from Finnish coastal areas has been negligible in recent years. Since 1996 no major marine sand or gravel extraction has been reported. However, the Harbour of Helsinki has permission to extract 8 million m^3 off Helsinki but the extraction has not started. In 2002 the Forest and Park Service got a permission to extract 3 million m^3 of sand off Helsinki between 2002 and 2011, and the extraction work is supposed to start in the spring 2003. The Environmental Impact Assessment for this project was completed in 2001.

3.6 France

Table A3.8. Marine aggregate (sand and gravel) extraction figures for 2002/2003.

DREDGING AREA	AMOUNT in m^3
Normandy	444,000
Brittany	38,000
Atlantic coast	1, 945,000
total	2, 427,000
Siliceous aggregate : 1.6 t/ m^3	

The amount of aggregate extraction has remained stable in France for many years.

Table A3.9. Non-aggregate (e.g., shell, maerl, boulders etc) extraction figures for 2002/2003.

DREDGING AREA	MATERIAL	AMOUNT in m^3
North Brittany	maerl	215, 000
North Brittany	Shelly sands	143, 000
West Brittany	maerl	2, 700
West Brittany	Shelly sands	26, 700
South Brittany	maerl	82, 000
	total	469, 400

Note that for calcareous aggregate: 1.3 t/m^3 has been used

Current licence position and forecasts for future exploitation of marine aggregates

- 12 sites are being exploited
- 2 licences for exploitation are under consideration

- 2 licences for research purposes are under consideration

3.7 Germany

Baltic Sea (German Länder: Schleswig-Holstein, Mecklenburg-Vorpommern)

For 2002 the amount of dredged material in the German Baltic Sea region is not available.

Table A3.10. Marine aggregate (sand and gravel) extraction figures for 2001.

DREDGING AREA	AMOUNT
Adlergrund Nord	20,100 m3
Adlergrund Nordost	0
Greifswalder Bodden	67,417 m3
Kühlungsborn	29,980 m3
Markgrafenheide	0
Plantagenetgrund	4,247 m3
Plantagenegrund Nordwest	4,247 m3
Tromper Wiek	0
Tromper Wiek I	0
Tromper Wiek II	92,370 m3
Total	218,361 m3

Description of aggregate extraction activities in 2002/2003

The extracted quantities in the Table above are provided by the Lead Country Report for HELCOM Rec. 19/1 on Marine Sediment Extraction in the Baltic Sea in 2003. The reporting period for this report was 1999 to 2001.

Licensed extraction fields which were not used during the report period are indicated by "0".

In the German Baltic Sea a total amount of 218,361 m^3 of sand and gravel was extracted as industrial raw material.

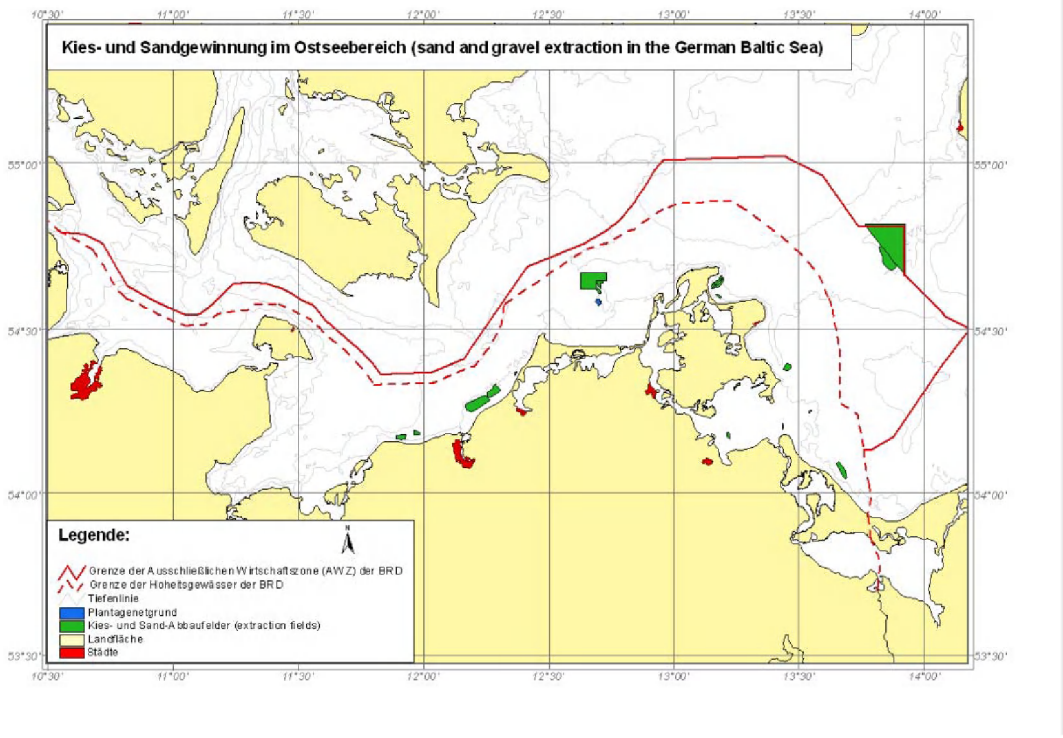


Figure A3.3. Map of the sand and gravel extraction sites used from 1999 to 2001 in the German Baltic Sea of Mecklenburg-Vorpommern.

Table A3.11. Amount of material extracted for beach replenishment projects in 2001.

DREDGING AREA	MATERIAL	AMOUNT *
Graal Müritz	Sand	0
Heiligendamm	Sand	412,910 m3
Koserow	Sand	0
Plantagenetgrund SE 2	Sand	533,457 m3
Plantagenetgrund SE 4	Sand	431,144 m3
Prorer Wiek	Sand	0
Tromper Wiek	sand	0
Wustrow	Sand	0
Total		1,377,511 m3

Description of beach replenishment schemes in 2001

The extracted quantities in the Table above are provided by the Lead Country Report for HELCOM Rec. 19/1 on Marine Sediment Extraction in the Baltic Sea in 2003. The reporting period for this report was 1999 to 2001.

Licenced extraction fields which were not used during the report period are indicated by "0".

In the German Baltic Sea a total amount of 1,377,511 m^3 of sand and gravel was extracted as coastal defence measures.

Table A3.12. Historic patterns of marine aggregate extraction.

Extraction Area	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Total 1990–2001
German Baltic Sea ($\times 10^6 m^3$)	no data	no data	0.4	0.5	0.8	0.9	2.2	2.3	1.6	1.8	2.7	1.6	14.6

Description of historic extraction activities for 1990–2001

Since 1992, the amount of dredged material increased mostly because of a growing demand for sands for coastal defence measures. In the last five years the amount has remained stable.

Summary of current licence position and forecasts for future exploitation of marine aggregates

On the coastal shelf there are 17 extraction fields for which permission has been granted by national authorities. The majority of the extraction sites are used for coastal defence purposes. They have been designated by governmental decree in 1997 (Ministry of Economy of the State Mecklenburg-Vorpommern). Since then no new licence has been granted.

3.8 Ireland

Table A3.13. Marine aggregate (sand and gravel) extraction figures for 2002/2003.

No commercial extraction was undertaken during this period.

Table A3.14. Non-aggregate (e.g., shell, maerl, boulders etc) extraction figures for 2002/2003.

DREDGING AREA	MATERIAL	AMOUNT
e.g., Bantry Bay	maerl	Approx 7600 m^3

Conversion figure = 1.3t/m^3

Exports of marine aggregate in 2002/2003

No exports during this period

Amount of material extracted for beach replenishment projects in 2002/2003.

No material was extracted for beach replenishment projects during this period

Table A3.15. Historic patterns of marine aggregate extraction.

Extraction Area	1995	1996	1997	1998	1999	2000	2001	2002	Total 1990–2002
Codling Bank (m^3)	0	0	0	0	0	51,267	183,500	0	234,767
Bantry Bay (m^3)	3,850	3,850	3,850	5,770	-	6,150	8,460	7,690	43,460

Summary of current licence position and forecasts for future exploitation of marine aggregates

The Department of Communications and Natural Resources is currently assessing four expressions of interest in sites off the east coast as well as the one longstanding application for a site off the south coast (Waterford Harbour). Demand for aggregates is generally high in the country, and regional shortfalls in supplies of finer grades have been highlighted by the industry.

3.9 The Netherlands

Table A3.16. Marine aggregate (sand and gravel) extraction figures for 2002.

DREDGING AREA	AMOUNT in $10^6 m^3$
Euro-/Maas access-channel to Rotterdam	3.9
IJ-access-channel to Amsterdam	1.4
Dutch Continental Shelf	27.0
Total	32.3

T = 0.667 m^3

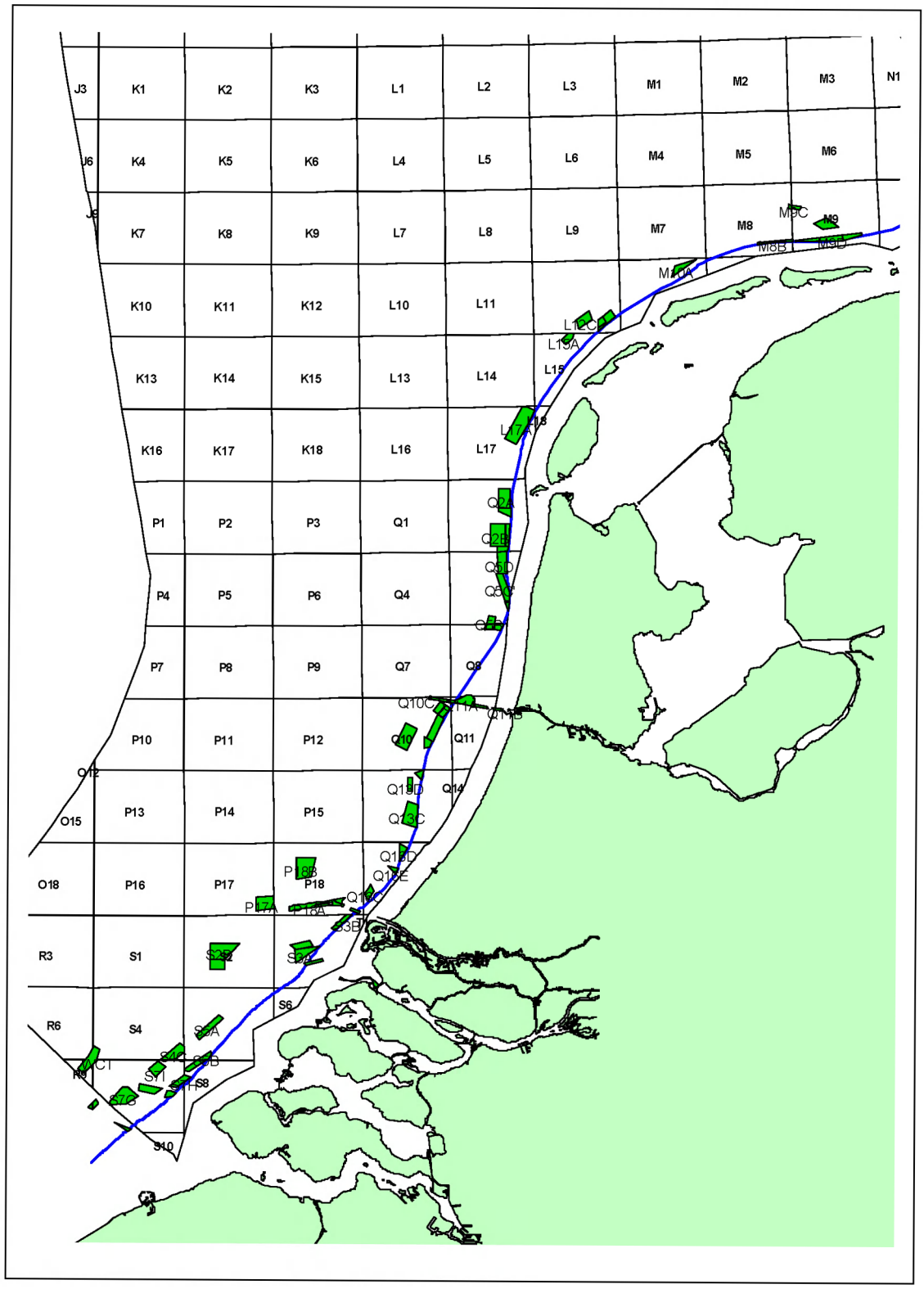


Figure A3.4. Extraction areas in the Netherlands.

Description of aggregate extraction activities in 2002:

16.18 × $10^6 m^3$ of the total quantity has been used for beach replenishment projects.

Table A3.17. Non-aggregate (e.g., shell, maerl, boulders etc) extraction figures for 2002.

DREDGING AREA	MATERIAL	AMOUNT m^3
Wadden Sea	Shells	83,626
Wadden Sea inlets	Shells	82,939
Western Scheldt	Shells	10,945
North Sea	Shells	95,076
Voordelta of the North Sea	Shells	19,640

Description of non-aggregate extraction activities in 2002:

On the basis of the National Policy Note and EIA for shell extraction (15 December 1998) there are maximum permissible amounts defined from 1999 onwards.

These permissible amounts (in m^3) of shells to be extracted from:

- the Wadden Sea is 120,000;
- from the sea inlets between the isles 90,000;
- from the Voordelta of the Wadden Sea 40,000;
- from the Western Scheldt 40,000;
- the rest of the North Sea until a distance of 50 km offshore.

Table A3.18. Exports of marine aggregate in 2002.

DESTINATION/(landing)	AMOUNT in 10^6 m^3
Belgium	approx. 2.32 (exact figures are not known)
Luxembourg	approx. 0.02 (exact figures are not known)

Marine aggregate use in 2002

There is a continuous flow of sand extracted out of the extraction areas in the southern part of the Dutch sector of the North Sea, used for landfill and for concrete and building industries.

Table A3.19. Amount of material extracted for beach replenishment projects in 2002.

DREDGING AREA	MATERIAL	AMOUNT in 10^6 m^3
L 17A (coast of Texel)	sand	5.40
Q5C (coast of Noord-Holland)	sand	1.65
Q5E (coast of Noord-Holland)	sand	0.82
Q10G (coast of Zuid-Holland)	sand	2.11
Q13C (coast of Zuid-Holland)	sand	3.08
Q13D (coast of Zuid-Holland)	sand	0.14
Q13E (coast of Zuid-Holland)	sand	0.73
S3B (coast of Zuid-Holland)	sand	0.35
S5B (coast of Zeeland)	sand	1.30
S8B (coast of Zeeland)	sand	0.60
Total	sand	16.18

Table A3.20. Historic patterns of marine aggregate extraction in 10^6 m^3.

Extraction Area	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	Total 1992–2002
Euro-/Maas channel	6.76	0.35	4.80	7.51	9.97	8.31	5.71	1.36	6.83	10.32	3.90	65.82
IJ-channel	2.67	2.84	4.15	3.30	4.78	4.18	6.33	5.06	4.78	2.31	1.41	41.81
Dutch Continental Shelf	5.36	9.83	4.61	6.02	8.39	10.26	10.46	15.99	13.82	23.81	21.50	130.05
Total extracted	14.80	13.02	13.55	16.83	23.15	22.75	22.51	22.40	25.42	36.45	26.81	237.69

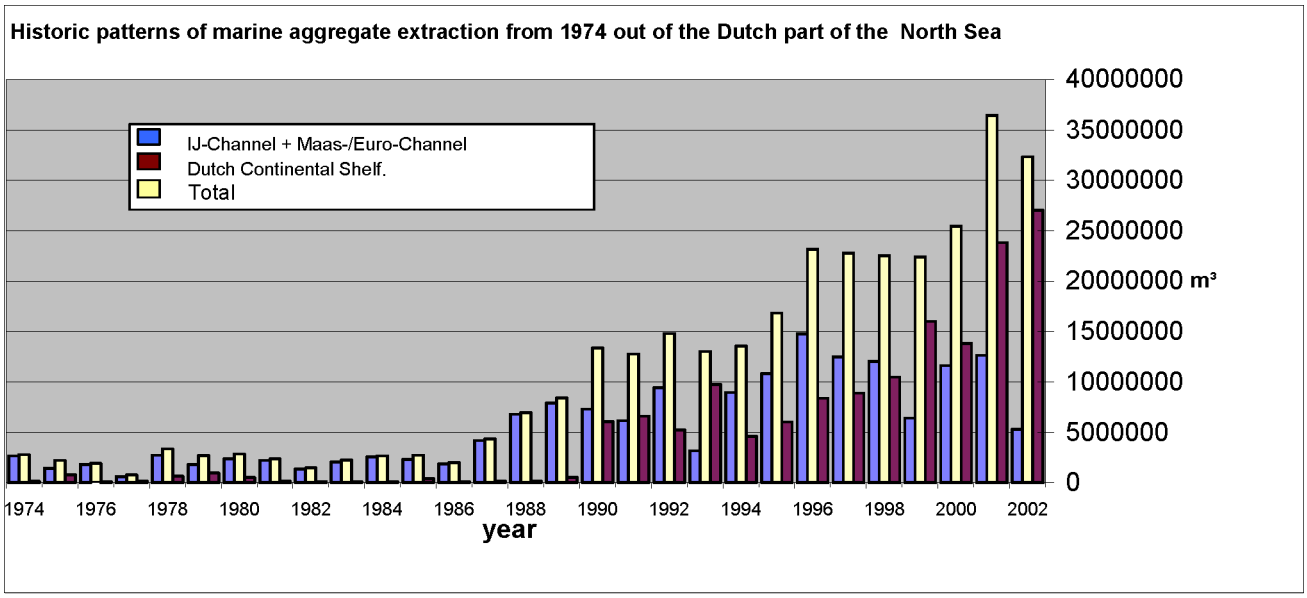


Figure A3.5. Historic patterns of marine aggregate extraction for the Dutch part of the North Sea.

Description of historic extraction activities for 1992–2002

The higher financial contribution of the Ministry of Transport, Public Works and Water management and the choice for beach replenishments by means of sand supplementation in the foreshore instead or on the beach is the cause for the above increase in sand demand. Due to great infrastructure works in the Netherlands as the Betuwe-line a.s.o. there was an extra sand demand in 2001.

Summary of current licence position and forecasts for future exploitation of marine aggregates

Considered and issued licences by Rijkswaterstaat North Sea Directorate for a period of three years:

In the year:	amount
1998	35
1999	30
2000	25
2001	27
2002	42
2003 April	11

Table A3.21. Summary of current licence position.

In April 2003, 56 licences were under charge.

3.10 Poland

Total extraction of marine aggregates in 2002/3 was 532,000 m^3.

Table A3.22. Marine aggregate (sand and gravel) extraction figures for 2002/3.

DREDGING AREA	AMOUNT m^3
Slupsk Bank	167,144

Description of aggregate extraction activities in 2002/2003

- Slupsk Bank — extraction of gravel for export to Germany
- Jastarnia and Rozewie fields (open sea north of Hel Peninsula) — extraction of medium grained sand for beach nourishment

Description of non-aggregate extraction activities in 2002/2003

No activity in Polish EEZ of the Baltic Sea.

Table A3.23. Exports of marine aggregate in 2002/2003.

PORT (landing)	AMOUNT m^3
Rostock, Greifswald	167,144

Marine aggregate exports in 1999/2000

Export of gravel extracted from Slupsk Bank.

Table A3.24. Amount of material extracted for beach replenishment projects in 2002/2003.

DREDGING AREA	MATERIAL	AMOUNT
Jastarnia field II	medium sand	365,000 m^3

Table A3.25. Historic patterns of marine aggregate extraction (m^3).

Extraction Area	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	Total 1990–2002
Slupsk Bank	0	0	54400	0	6400	0	0	3200	0	73000	280000	86500	167144	670644
Kuznica field (open sea)	0	0	0	0	0	0	134000	60000	0	0				194000
Jastarnia field I (open sea)	0	0	42600	246810	0	0	0	187310	88870	375860		100 253		1041703
Jastarnia II field (open sea)	0	0	0	0	0	90200	0	0	0	0	167000		365 000	622200
Rozewie field (open sea)	-	-	-	-	-	-	-	-	-	-	74000			74000
Chalupy pit (Puck Lagoon)	290785	105215	383308	68908	0	0	0	0	0	0				848216
Kuznica II pit (Puck Lagoon)	755573	615535	134852	379200	166290	60580	0	0	0	0				2112030
Jastarnia pit (Puck Bay)	0	45700	256296	279880	85120	129940	0	0	0	0			0	796936
TOTAL	1046358	766450	871456	974798	257810	280720	134000	250510	88870	448860	521000	186753	532144	

3.11 Norway

Extraction quantities are approximately the same as in previous years. This is no sand and gravel extraction and approximately 115,000 m^3 carbonate sand extraction.

3.12 Sweden

3.13 United Kingdom

Table A3.26. Marine aggregate (sand and gravel) extraction figures for 2002.(Includes aggregate and material for beach replenishment and fill contract)

DREDGING AREA	AMOUNT m^3
Humber	1,767,969
East Coast	5,269,780
Thames	963,622.8
South Coast	3,366,458
South West Coast	857,966.1
North West Coast	554,956.1
Rivers and Miscellaneous	45,963.16
TOTAL	12,826,715

Conversion factor = 1.71

Licences especially for fill contracts and beach replenishment were as follows:

- Contract Fill 309,076 m^3
- Beach Replenishment 655,127 m^3

Non-aggregate (e.g., shell, maerl, boulders etc.) extraction figures for 2002

There was no calcareous seaweed extracted from Crown Estate licences during 2002.

Table A3.27. Exports of marine aggregate in 2002.

PORT (landing)	AMOUNT (m^3)
Amsterdam	1088971
Antwerp	339881.3
Brugge	253175.4
Calais	73644.44
Dunkirk	329205.3
Fecamp	22358.48
Flushing	523400.6
Harlingen	164015.2
Honfleur	54419.3
Nieupoort	33910.53
Ostend	342416.4
Roscoff	24463.16
Rotterdam	177149.1
Zeebrugge	193401.8
TOTAL	3620412

Conversion factor=1.71

Table A3.28. Amount of material extracted for beach replenishment projects in 2002.

DREDGING AREA	MATERIAL	AMOUNT (m^3)
Mapplethorpe/Skegness	Sand	208,231
Pevensey Bay	Shingle	209,102
Southend	Sand	237,795
TOTAL		655,127

Conversion factor for sand =1.5

Conversion factor for shingle =1.71

Table A3.29. Historic patterns of marine aggregate extraction (tonnes). (Figures exclude beach replenishment and fill contracts)

Extraction Area	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**Total**
Humber	0	0	1116996	1,045,878	1,113,262	1,374,990	1,576,010	1,660,971	1825778	1715569	1585310.5	13,014,765
East Coast	5738150	5738150	5488222	6,138,802	5,442,643	5,495,734	5,218,457	5,340,065	5338968	5635495	5269779.5	61,103,868
Thames	715315.8	715315.8	1170297	971,535	652,396	658,433	504,581	568,398	499697.7	531661.4	755030.99	7,907,153
South Coast	2550758	2550758	2884428	2,589,682	2,770,995	2,768,319	3,404,504	3,441,715	3282771	3291233	3157356.7	32,945,439
South West Coast	1270512	1270512	1321080	1,336,783	1,180,880	1,197,669	1,103,093	1,005,733	937072.5	906100	857966.08	12,513,466
North West Coast	222418.7	222418.7	170085.4	162,647	167,983	166,373	161,164	207,628	184848	246238.6	282029.24	2,153,158
Rivers & Misc	7398.246	7398.246	8474.269	8,254	12,739	10,870	3,648	3,668	26970.76	42717.54	45963.158	181,228
Yearly Total	10504553	10504553	12159583	12,253,581	11,340,899	11,672,387	11,971,457	12,228,178	12096105	12369015	11,953,436	129,819,078

Summary of current licence position and forecasts for future exploitation of marine aggregates (2003):

- 71 Extraction licences containing approximately 155 million tonnes of marine sand and gravel;
- 51 Production licence applications containing approximately 541 million tonnes of marine sand and gravel;
- 2 Current prospecting licences.

3.14 United States of America

Description of aggregate extraction activities in 2002/2003

Sand is dredged from the outer reaches of the main shipping channel into New York Harbour (the Ambrose Channel) by a trailing suction dredger, washing and mixed with crush stone, if needed, at a shore side facility. Product is used mostly in the New York Metropolitan region for construction.

Marine aggregate (sand and gravel) extraction figures for 2002

DREDGING AREA	**AMOUNT**
New York Harbour	1,100,000 m^3
	Not including beach nourishment sand

Description of beach replenishment schemes in 2002

Table A3.30. Amount of material extracted for beach replenishment projects in 2002/2003.

DREDGING AREA	**MATERIAL**	**AMOUNT**
New Jersey	sand	5,500,000 m3
New York	sand	510,000 m3
Delaware	sand	62,000 m3

Major renourishment projects continue south of New York especially along the New Jersey shoreline. Offshore borrow areas are used or sand is provided from the dredging of inlets.

Table A3.31. Historic patterns of marine aggregate extraction excluding beach nourishment.

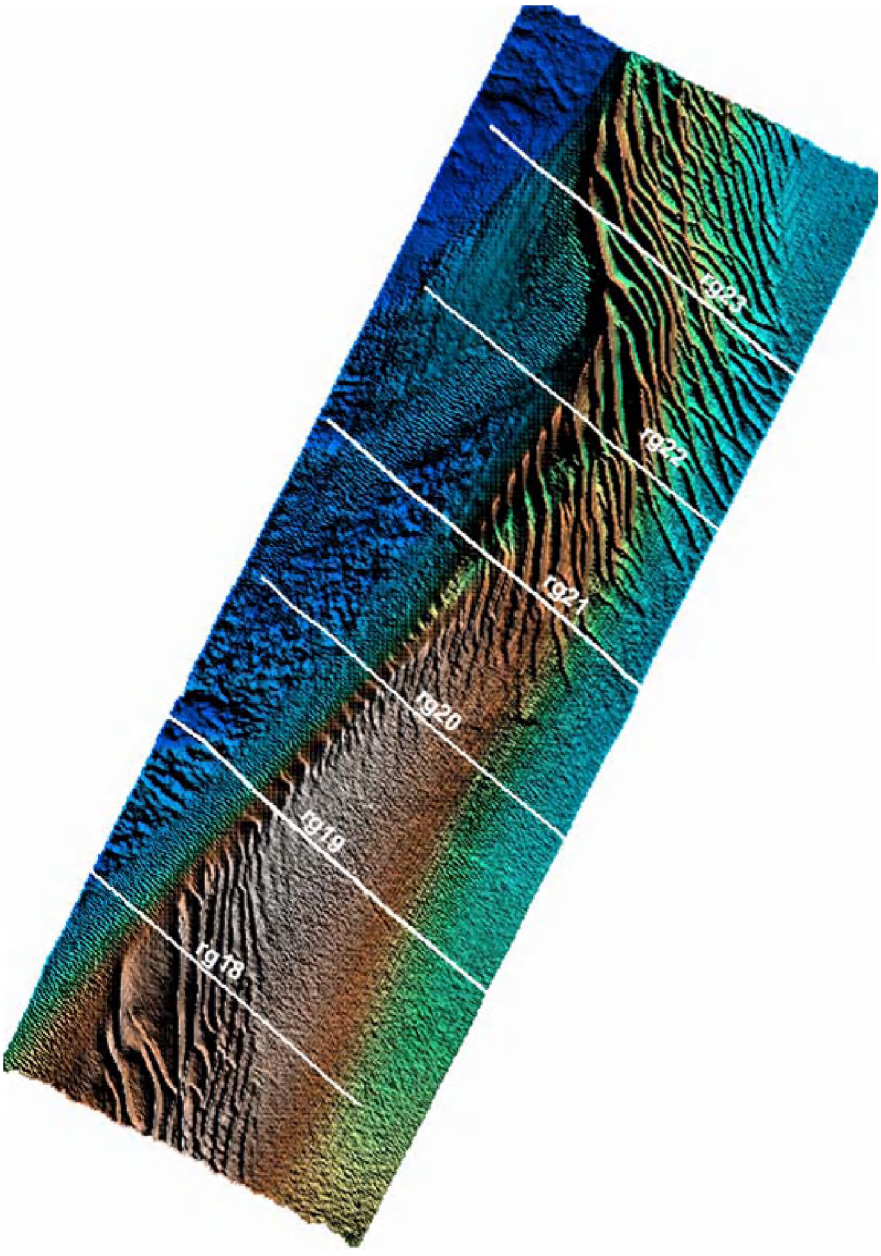
Extrac-tion Area	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**200**	**2001**	**2002**
NE Atl. × $10^6 m^3$	0.2	0.8	0.8	1.5	1.7	1.4	c1.4	c1.4	c1.3	1.3	1.1	1.3	1.1

Annex 4 Review of national seabed resource mapping programmes

4.1 Belgium

The Ministry of Economic Affairs is undertaking mapping of the sandbanks in zone 2 of the Belgian continental shelf (see Section 3.1) by multibeam. The Kwintebank map has been finished and maps of the Buiten Ratel and Oost Dijck are under development.

Figure A4.1. Multibeam Map of the Kwintebank.



4.2 Canada

The Canadian regional systematic multibeam mapping project called "SEAMAP" is still active, but is unfunded at present.

4.3 Denmark

In 2002 the Geological Survey of Denmark and Greenland (GEUS) carried out mapping of sediment transport and resources along the Jutland westcoast.

Published seabed resource maps in 2002/2003

Technical reports including resource maps have been prepared from the North Sea. No published maps.

Future marine resource mapping programmes

No general resource mapping programmes are planned for 2003.

4.4 Finland

A study of marine geology by the Geological Survey of Finland (GTK) concerning late-Quaternary deposits on the seabed is being conducted using acoustic and seismic methods: echo-sounders, single channel seismics and side-scan sonar. Investigations are supplemented with seabed sampling and visual observations. The basic scope of the study is to acquire data on the distribution and thickness of various types of sediments and information on stratigraphy, mineralogy and geochemistry of the deposits. New methods of sounding and sampling as well as data processing and analyses of samples are also developed and tested. The aim of the study is also to increase knowledge of the physical properties and the geochemical variations in seabed sediments induced by both the nature and the human activity. Also the demand of various practical and scientific needs arising in surrounding community should be met. The annual goal of seabed survey is 700 km^2, in year 2002 about 800 km^2 was surveyed. Some information on survey methods and data processing can be found from http://www.gtk.fi/marine.html. Meta-data of samples carried out by GTK are updated in the EU-SEASED meta-database (http://www.eu-seased.net).

4.5 France

IFREMER (Marine Geosciences Department) has undertaken seabed mapping programmes since 2000. The general survey methods employed include side-scan sonar, multibeam bathymetry, echosounder, high resolution seismics, grabs, corers and video techniques.

Published seabed resource maps in 2002/2003

Augris, C., Clabaut, P., Durand, F., Mazé, J-P., and Satra, C. 2003. Les fonds marins du plateau insulaire de la Guadeloupe et de la Martinique. Carte des formations superficielles. Ed. IFREMER - Conseil Général de la Martinique.

More information on seabed mapping programmes can be obtained from the following web address:

http://www.ifremer.fr/drogm/Realisation/Bathy_Carto/Plateau/index.html

Future marine resource mapping programmes will cover areas in the Atlantic and Channel coast

4.6 Ireland

Irish National Seabed Survey

The Irish National Seabed Survey in Zone 2 (50–200 m depths) has been continued under the direction of the Geological Survey of Ireland. This is a full geophysical survey including Multibeam, Gravity, Magnetic and sub-bottom profile data acquisition being undertaken by the Marine Institute and their national research vessel "Celtic Explorer".

- NUI Galway is carrying out a multibeam survey of Clew Bay;

- Irish Lights vessel "Granuaile II" to carry out a multibeam survey of northern Rockall Bank;
- Groundtruthing to be carried out in Porcupine seabight and West Porcupine by TTR13 "Logachev" of Moscow University.

Published seabed resource maps in 2002/2003

- Gravity and Magnetic overview maps of Zone 3 (>200 m depths);
- Bathymetry contours, sun illuminated relief and backscatter maps;
- 1:250,000 gridded at 250 m maps of all EEZ waters with depth greater than 200 m;
- 1:60,000 gridded at 50 m of Donegal Bay deeper than 100 m;
- 1:30,000 gridded at 10 m of Donegal Bay between 50 m and 100 m depth.

These maps are available from the GSI from the websites http://www.gsi.ie and http://www.gsiseabed.ie

Future marine resource mapping programmes

- GSI may carry out survey utilising Tenix LADS (airborne laser) in Zone 1 Donegal Bay this year 2003;
- The Marine Institute is funding a desk study to review inshore mapping activities and to recommend a management strategy to map inshore resources. The steering group for this project comprises representatives of numerous state agencies involved or interested in mapping activities. It is proposed that this steering group will also act as a coordination group for marine mapping activities in Ireland.

Deliverables /Objectives:

- Identify national (including statutory) seabed mapping requirements for inshore resource assessment and development (depth range: 0–50 m);
- Identify existing Irish inshore seabed mapping programmes and relevant digital mapping data holdings;
- Identify and evaluate current inshore resource mapping techniques (to include data collection, processing and map production);
- Identify, by way of international case histories and "best-practice", how other coastal states have addressed their inshore resource mapping requirements;
- Undertake a cost-benefit analysis of existing inshore mapping techniques relevant to the Irish situation;
- Recommend, on the basis of identified national needs, a prioritised and costed inshore mapping strategy for Irish coastal waters.

Background

The sustainable development of the inshore marine resource (0–50 m depth) requires strategic information on bathymetry, currents and living and non-living resources, etc., preferably in map format. To date, while a number of thematic and site specific marine resource mapping programmes have been undertaken, there has been no concerted programme to prepare a comprehensive map of all Irish inshore resources.

There is general agreement that an interactive inshore resource map/database would provide an invaluable tool for resource evaluation, sustainable resource development and would in assist in conflict resolution.

This desk study will identify priority requirements, evaluate mapping techniques and provide a basis for dialogue amongst the relevant national agencies with a view to initiating the establishment of a Large Scale Inshore Resource Mapping Project.

4.7 The Netherlands

In the last year the emphasis on resource mapping in the Dutch North Sea has shifted gradually to dedicated and targeted resource inventories following clear needs on one hand and conceptual prospects on the other hand. This implies that the traditional systematic mapping programmes are slowing down and increasingly depend on the results of specific resource inventories for their advancement. Also, during surveys and studies links between aggregate and ecological inventories are becoming more frequent.

Developments in marine resource mapping

Resource mapping is within the responsibility of the national geological survey. The survey is a component body of the national applied science and technology conglomerate TNO named "Netherlands Institute of Applied Geoscience TNO, - national geological survey".

A review of the progress in the field of seabed resource mapping in 2002/2003 is presented below including corresponding maps that show the advancement of the mapping programmes.

1:250,000 GEOLOGICAL RECONNAISSANCE MAP SERIES

This map series consists amongst others of a surface geology (Seabed Sediments) sheet, which includes a main map in UTM (zone 31, ED 50) on scale 1:250,000 showing the uppermost 10 cm of the seabed following the Folk classification system and various subsidiary maps. These last maps on scale 1:1,000,000 include the seismic line grid, thickness of Holocene sediments, depth to the base of the Holocene sediments, distribution of (older) Holocene formations, mean grain size, biogenic and lithic gravel content and/or carbonate content of sand fraction, geochemistry of surface sediments (Oyster Grounds map only), a key to colours and symbols and a short description. Each mapped area covers 1° latitude and 2° longitude.

The Quaternary map sheet covers the Pleistocene sediments. It also consists of a main map showing the nature of the Pleistocene surface and various subsidiary maps, profiles, a table and short descriptions. This map would cover the nature and extent of subseabed aggregate occurrences, which are becoming increasingly of interest.

All the sheets of the 6 mapped areas are now available in digital format. The Seabed Sediment map of Terschelling Bank (53°–54°N, 4°–6°E) is in an advanced state of preparation. The Quaternary map of the same area is in preparation.

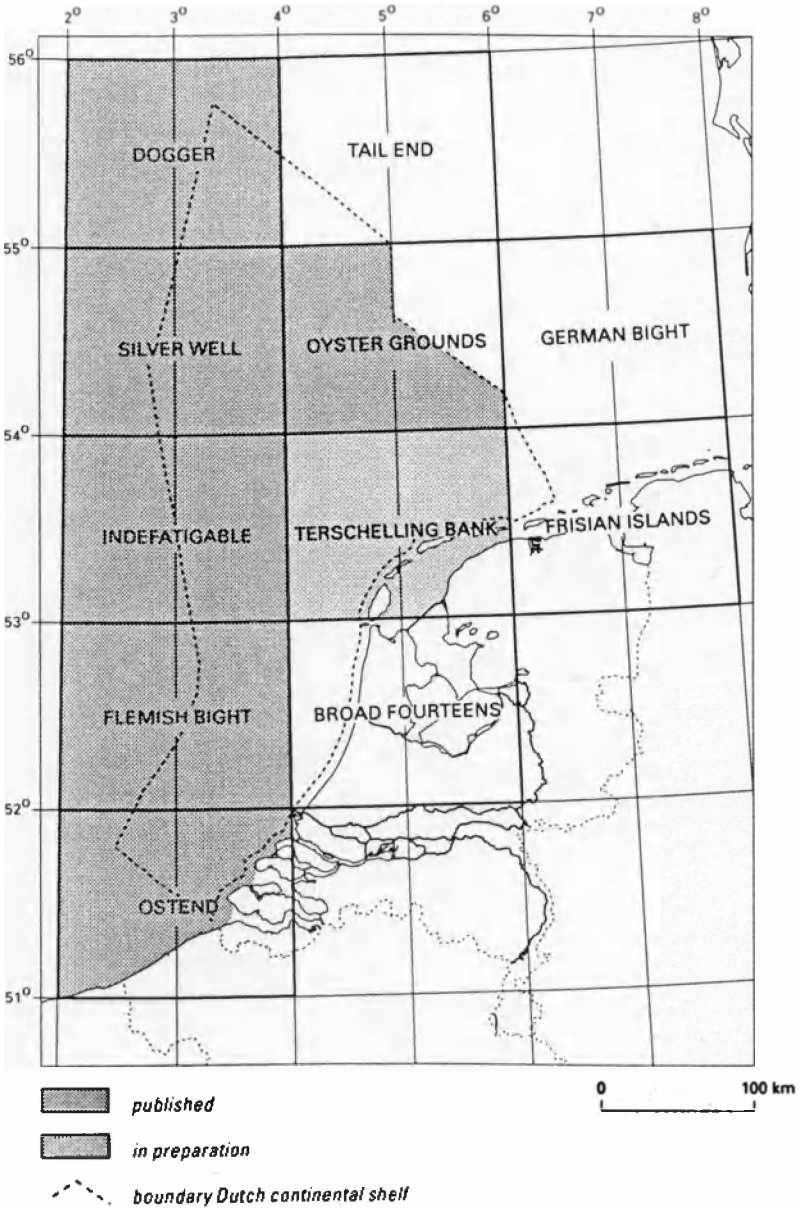


Figure A4.2. Map of the Dutch sector of the North Sea with the 1:250,000 map sheet subdivision and the progress of this mapping programme.

1:100,000 GEOLOGY AND RESOURCE MAP SERIES

This map series consist of digital map sheets with both geological information and resource information.

The geological component of the map includes a fence diagram with the geological structure of the younger layers (1:100,000), a bathymetric map on 1:150,000, 1:250,000 maps on geomorphology, on the occurrence of Holocene formations, on thickness of Holocene and of Pleistocene deposits, a fence diagram of older sediments, nature and depth of the top Pleistocene and of the top Tertiary and a short description of amongst others the stratigraphic units.

The resource component includes a map of the mean grain size and mud content of the uppermost metre on a scale of 1:100,000. It also has a similar map of the metre below on scale 1:150,000 as well as 1:250,000 maps of the carbonate content in the first and the second metre, of lithic and biogenic gravel contents in the first and second metre, and of interfering (clayey) layers in the first and in the second metre below seabed. Furthermore there is a short note on methodology, sediment classification and on the availability of further information. Digital grain-size information is also available from the 2–3 m and 3–4 m below seabed intervals.

The map sheets Rabsbank (51°20'–51°40'N, 3°–3°40'E) and Buitenbanken (51° 40'–-52°N, 3°–3° 40'E) have been printed as well (in 1992 and 1996 respectively). Schouwenbank (51° 40'–52°N, 3° 40'–4° 30'E) was the first sheet to

become available in digital form only. A digital and updated version of the Indusbank (52°–52° 20'N, 3° 50'–4° 30'E) sheet was completed in 2002. The IJmuiden Ground (52° 20'–52° 40'N, 4°–4° 40'E) sheet is being prepared and is in its integration phase. Data acquisition on the next sheets to the north i.e. Egmond Gronden (52° 40'–53° 00'N, 3° 50'–4° 30'E) as well as the offshore part of the adjoining Fransche Bank sheet (52° 40'–53° 00'N, 4° 30'–5° 10'E) is completed, although the inshore part of the latter sheet remains to be done. Both sheets are at present in the interpretation phase. The Keysersplaat sheet (53° 00–53° 20'N, 4° 20'–5° 00'E) survey programme is currently under way. This sheet covers the marine areas around Texel island. A geophysical survey programme has been made for all map sheets immediately north of the Frisian Islands.

The survey equipment employed in the data acquisition phase of the mapping programmes includes sampling and coring devices such as the Hamon grab (for sand and gravel down to 0.2 m), electric and hydraulic vibrocorers (for short cores 1 m and 4–5 m in length respectively), and Geodoff and Roflush counterflush sampling systems (for disturbed subseabed samples down to 12 m and 25 m respectively). Seabed and subseabed information is obtained by conventional echosounders and multibeam (bathymetry), side-scan sonar and multibeam (morphology), various subbottom profilers (the uppermost few tens of metres max.) and sleeve guns (the Quaternary succession reaching thicknesses of many hundreds of metres).

A GIS system to process the survey data and results is under development. It will be used as a tool in the data processing and interpretation phases and to facilitate land-sea correlation.

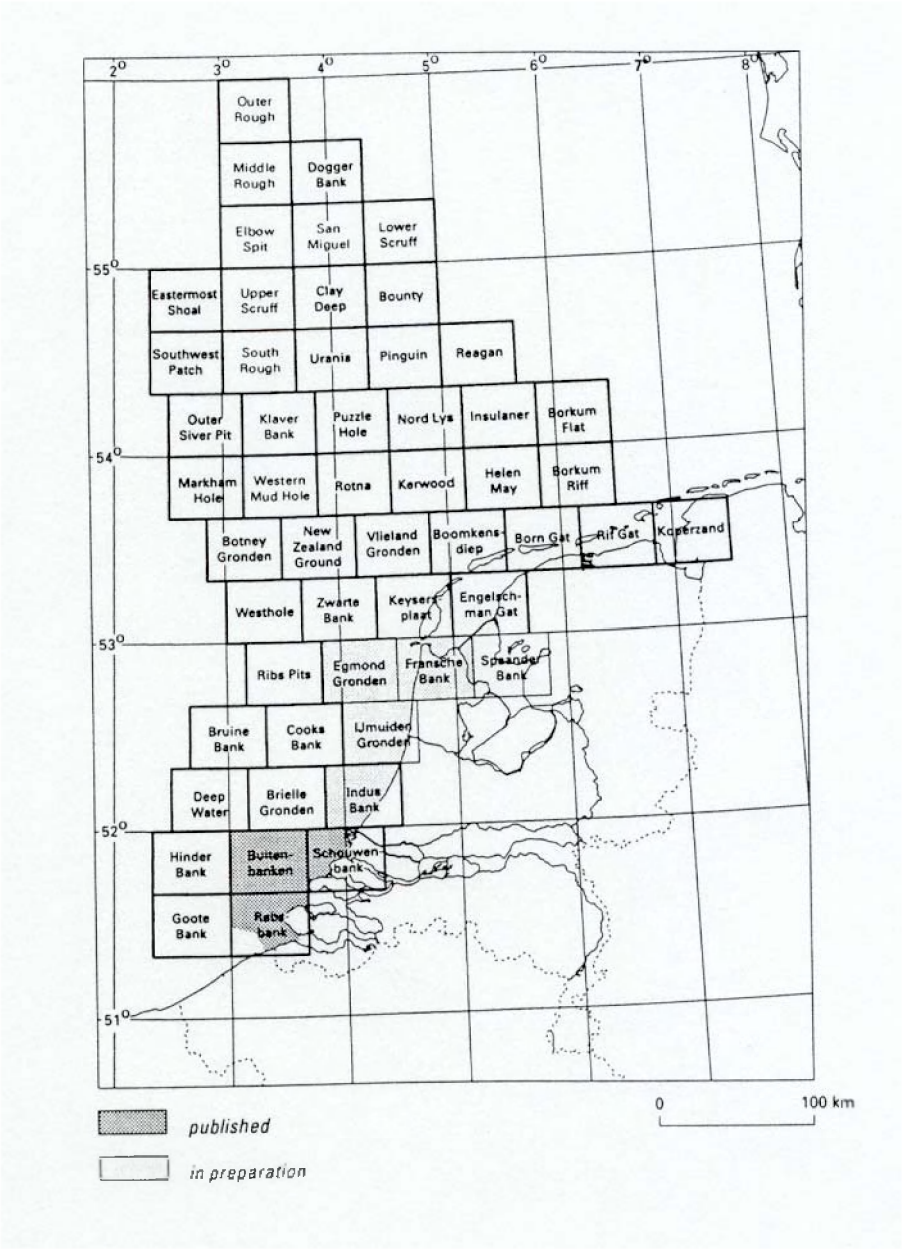


Figure A4.3. Map of the Dutch sector of the North Sea with the 1:100,000 map sheet subdivision.

Published seabed resource maps in 2002/2003

As stated above 6 sheets of the 1:250,000 series have been published from 1984 onwards, a seventh sheet is currently in preparation. Only the first two sheets of the 1:10,000 series have been printed in 1992 and 1996 respectively. These and all further sheets are available in digital format. Based on the institute's digital database a specific map of any part of the (sub) seabed of the Dutch sector can be produced.

Future marine resource mapping programmes

Currently a few research initiatives are being carried out that focus on seabed dynamics and so have a direct relation with survey techniques, resource mapping, extraction policies and environmental monitoring.

Ecomorphodynamics of the North Sea

The project started in 2000 and ended in 2002. To improve management opportunities and use of the North Sea, field management and knowledge of the ecomorphodynamics have to be integrated. The project aims to improve knowledge

on the relationship between different natural processes affecting benthic life. Study areas include a small area on the toe of the shoreface, a small part of a shoreface-connected ridge and a short transect in a sandwave field. Seabed characteristics (morphology, sedimentology), dynamics and benthic life (including benthic fish) are studied using different techniques, including side-scan sonar, multibeam bathymetry and bottom sampling. Results from 2001 and 2002 surveys indicate distinct differences between benthic species composition and morphological features such as sand, wave crests and troughs being independent of area and sampling period. The results are presented in annual reports that are available on request. The project has put forward a proposal for continuation from 2004 onwards.

References

Delft Cluster, Ecomorphodynamics of the seafloor, Baptist *et al.* 2001, Progress Report 2000.

Website: www.delftcluster.nl/index

Applied and other geological investigations in 2002

A number of studies have been carried out in the past year to evaluate potential deep and seabed extraction sites for raw materials especially for industrial sand (concrete and mortar sand) and gravel.

Reports include:

Mesdag, C.S., and Laban, C. 2002. Geologisch onderzoek voorkomen oppervlaktedelfstoffen tot een diepte van 150 m in vier deelgebieden noordelijk deel NCP (GSV/Quicksand). (Geological study of aggregate resource occurrences down to a depth of 150 m in four areas, northern part of Dutch sector (GSV/Quicksand), Rept. NITG 02-047-C, 26 p. + appendices (in Dutch).

Several studies related to the evaluation of industrial sand resources present in the sub-seabed fluvial deposits dating from the last sea-level low-stand. The target last year again was the course of the river Rhine when the North Sea was dry land. Any finer-grained (d50 < 500 μm) seabed sands covering the industrial sand resources could be used as either infill sand or beach recharge material.

Of interest remained the performance of NITGs' Roflush counterflush drilling equipment, which successfully completed 200 more borings down to 20 or more metres below seabed.

Reports include:

Kok, P.T.J. *et al.,* 2002. Onderzoek voorkomen beton- en metselzand Noordzee, Interimrapportage zuidoostelijk deel gebied van onderzoek vierde tranche. (Study of concrete and mortar sand occurrences in the North Sea, Interim Report on the SE part of the study area, 4th part), Rept. NITG 02-056-C, 23 p. + appendices (in Dutch).

Kok, P.T.J. *et al.,* 2002. Onderzoek voorkomen beton- en metselzand Noordzee, Interimrapportage vijfde tranche. (Study of concrete and mortar sand occurrences in the North Sea, Interim Report, 5th part), Rept. NITG 02-149-C, 40 p. + appendices (in Dutch).

Mesdag, C.S. 2002. Onderzoek karakterisatie zeebodemsedimenten met seismische technieken, Deel 1: Data-acquisitie. (Study of seabed sediment characteristics using seismic techniques, Part 1: data acquisition), Rept. NITG 02-195-C, 14 p. + appendices (in Dutch).

Other similar reports are being prepared

In 1999 a 3-year research project started to investigate the grain size variability in relation to crest stability of a particular North Sea sandwave in block S2 in space and time. TNO-NITG and Rijkswaterstaat North Sea Directorate are surveying two times a year to establish the grain size at and near the surface and the nature and evolution of the various bedforms present. The outcome of this study will be useful not only for detailed extraction policies in areas with sandwaves and/or other bedforms but also for (natural) variability of grain size data and reliability of archive data. A report was completed at the end of 2002.

Schüttenhelm, R.T.E. 2002. Grain-size variability and crest stability of a North Sea sand wave in space and time. Rept. NITG 02-219-B, 52 p. + appendices.

The SEDCLAS project (2000–2002) is aimed at seabed sediment classification using sonars. Reports are:

Van Overmeeren, R.A. 2002. Graphical user interfaces voor blinde en gekalibreerde sonar processing t.b.v. sediment classificatie van de zeebodem. (Graphical user interfaces for blind and calibrated sonar processing for seabed sediment classification), Rept. NITG 02-004-B, 20 p. + appendices. (in Dutch).

Van Overmeeren, R.A. 2002. Sediment classificatie van een deel van de Baltische Zeebodem d.m.v. analyse van verticale 33 kHz sonar echo's. (Sediment classification of part of the Baltic seabed by analysis of vertical 33 kHz sonar echos), Rept. NITG 02-210-B, 23 p. + appendices. (in Dutch).

Geochemical distribution graphs of surface sediments, as outlined in an earlier ICES progress report, are now being prepared for the entire Dutch sector. The aim is to have reliable information on natural background values and their variation and so on human-induced changes. In doing so, the thickness of the youngest layer (mobile since the start of the industrial revolution) may be estimated. During 2002 the results of geochemical mapping on the 1:250,000 Terschelling Bank sheet were reported:

Gieske, J.M.J., and van Os, B.J.H. 2002. Geochemical mapping of North Sea sediments: the Terschelling Bank area. Rept. NITG 02-109-A, 40 p. text + 30 p. distribution maps + 16 p. analytical results.

Reported by R.T.E. Schüttenhelm, NITG-TNO, March 26, 2003.

4.7 United Kingdom

The British Geological Survey (BGS) have produced a digital seabed sediment map of the UK Continental Shelf and slope. The digital map is called DigSBS250 and is based on published BGS 1:250,000 sea bed sediment maps. This map will provide a primary tool for regional resource assessments of marine sand and gravel in the UK. Complementary to the DigSBS250 map BGS have also produced, in association with the United Kingdom Hydrographic Office, a vector attributed digital bathymetry of the UK and adjacent Irish waters called DigBath250. This digital bathymetry is currently being extended to include the whole of the North Sea and English Channel. It is hoped that licence agreements can be concluded with all the relevant Hydrographic Authorities from Norway to France and the bathymetry for the whole North Sea and English Channel can be made available by the end of 2003. Both DigSBS250 and DigBath250 are available in standard GIS and CAD formats. Details on specification and coverage can be found on the BGS website at www.bgs.ac.uk/products.

4.8 United States of America

Organisations undertaking seabed-mapping programmes:

- U.S. Geological Survey
- U.S. Minerals Management Service
- U.S. Army Corps of Engineers

Offshore mapping and processing of survey data continue in order to:

- Identify sand resources for beach nourishment
- Identify benthic marine habitats particularly Essential Fish Habitat.

Published seabed resource maps in 2002:

Completed Minerals Management Service Studies: Surveys of Sand Resource Areas Offshore Maryland/Delaware and the Environmental Implications of Sand Removal for Beach Restoration Projects (Site-specific)

Annex 5 Review of developments in national authorisation and administrative framework and procedures

5.1 Belgium

Although the law of 16 June, 1969 was amended by the law of January 20, 1999 and the law of 22 April, 1999, the implementing decrees further to these amendments have not yet come into force. Consequently, the old Royal Decree of 7 October, 1974 regarding procedures for granting licences and that of 16 May, 1977 defining the exploitation zones, are applied.

5.2 Denmark

In January 2003 new legislation entitled "Law on amendment to Law on resources. Law nr. 1055 of 17. December 2002" was implemented by the Ministry of the Environment, Danish Forest and Nature Agency. This translates to a minor change in the Raw Materials Act that makes it possible to extract other materials than sand and gravel in international protected areas and on water depths less than 6 m.

The amendment will include extraction of other resources e.g., shells in the same administrative framework as extraction of sand and gravel. The administration of extraction in international protected areas and in water depths less than 6 m is very restrictive and will only be permitted when a valuable resource can be extracted without deterioration of the local environment.

5.3 France

Since 1997, calcareous and siliceous aggregates have been under the same legal regulation by the Ministry of Industry.

New regulation has now been proposed, the principles of this are as follows.

Today, several applications are required to obtain a mining permit, a state permission and finally an authorisation to commence mining works.

Investigation procedures are made complex by the succession of consultations and public inquiries at different phases of the same project, which leads to the investigations lasting several years.

A project to clarify the statutory directives, proposes to review the arrangements applicable to extraction of marine aggregates from the public seabed and from the continental shelf into a single "autoporteur" decree.

It is proposed that there will be only one application to obtain the mining permit, the state permission and the authorisation to begin the mining works. This application will include an impact study completed at the beginning of the investigation. The required preliminary studies and monitoring measures will be detailed within the new decree.

A joint and coordinated assessment of the consolidated application will take place. This will include a single consultation of the administrative services concerned. This consultation will cover all aspects of the applications and occur only once during the assessment period. There will also be only one public inquiry, instead of two successive inquiries regarding the different applications.

Local dialogue commissions including all services and concerned parties have been set up. These will include representatives from the different marine user groups, especially fishermen. A monitoring committee will also be set up by the prefect.

Specific mining regulations are to be adapted to the maritime nature of the extractions.

New ways of evaluating the state taxes will be developed, taking into account the future exploitation's interest, the volume and quality of extracted materials.

To encourage new extraction areas to be identified, state authorisation will be delivered for free for exclusive research licences and preliminary prospecting authorisations, if the volume of materials removed is less than 10,000 m^3.

Consultations to evaluate environmental impacts in a transboundary context should occur in order to fit in with the international conventions' recommendations.

Conclusion

These proposals have been provided to meet demands earnestly expressed by the Council of State and the Mining General Council. They aim to reorganise the administrative and adapt monitoring and policing techniques to enable State decisions to become more transparent and easy to understand.

5.4 GERMANY

In Germany the Mining Act and the decree about environmental impact assessment for mining projects are not changed. In April 2002 the Federal Act of Nature Conservation (BNatSchG) was changed by giving the Ministry of Environment and the Federal Agency for Nature Conservation the responsibility to identify and implement Nature 2000 sites in the German EEZ of the North Sea and the Baltic Sea. Legal implications for extraction sites which are already authorised or will be in the future in areas also identified by the habitat or bird directive (e.g., sandbanks) are not satisfactorily clarified at the moment.

5.5 IRELAND

There is no new legislation affecting the regulation of marine aggregate extraction. The Department of Communications Marine and Natural Resources envisage that policy development may be completed within three to four years, giving time to include findings from inshore habitat mapping programmes.

5.6 The Netherlands

There is a new approach to setting a threshold for EIA involving the volume of material extracted. Until now all extractions exceeding an area of 500 hectares require an EIA. An additional criterion of 10 million cubic metres for extraction has been added. Therefore from 2003 onwards an EIA has to be made when a licence application for extraction fulfil any of the following criteria.

- the extraction exceeds an area of 500 ha
- the extraction exceeds a volume of 10 million cubic metres.

Due to an evaluation of the amended 1997 Sediment Extraction Act, over the last five years there are other changes foreseen. However, most of these changes will be related to terrestrial extraction. Another point of interest is the foreseen amendments to the Act regarding procedures. It is intended that the procedure for granting licences in the North Sea remains as brief as possible.

5.7 United Kingdom

The preparation of draft Regulations to bring marine aggregate extraction under statutory control in the England, Wales and Northern Ireland continues. The Regulations will be consistent with the requirements of the EIA and Habitats Directives, and will be compatible with Human Rights legislation. Guidance on the procedures for applying for an authorisation to dredge (a Dredging Permission) in English waters is being prepared by the Office of the Deputy Prime Minister. Separate guidance may be issued for dredging in Welsh and Northern Irish waters. Scotland is producing its own Regulations.

Annex 6 Review of approaches to environmental impact assessment and related environmental research

6.1 Belgium

As the decrees implementing the amendments to the 1969 law (see Section 5.1) are still not in force, EIAs cannot be requested for new applications.

6.2 Canada

The research projects on essential fish habitat are continuing. However, the NRCan initiative mentioned in last year's report has been discontinued.

6.3 Denmark

See Annex 11.

6.4 Estonia

Environmental Impact Assessment of Sand extraction in the Gulf of Finland

According to Estonian legislation the possible impacts of the above project on the marine ecosystem should be estimated. This includes the impacts on benthic communities, fish, fisheries, seabirds and seals. Coastal impacts and impacts on seabed morphology will also be determined. In this project the hydrodynamic modelling of currents and waves was provided in order to estimate the movement of the suspended sediments. The impact assessment will also detail the monitoring programmes needed during and after the extraction takes place. Sediment analysis will be carried out within the proposed extraction areas. This will include the determination of concentrations of oil products, Cd, Cu, Hg, Zn, Pb within these sediments.

The sand extraction being assessed in this project is in the Gulf of Finland close to Island Prangli in the Estonian EEZ. Approximately 1,300,000m^3 sand will be extracted for use in building a new berth in the Port of Muuga.

The Environmental Impact Assessment is being undertaken by the Geological Survey of Estonia and the Estonian Marine Institute at the University of Tartu. It began in February 2003 and is expected to last two months. The work is being funded by the Port of Tallinn.

6.5 France

Sedimentological Transport and Morphodynamic Modelling

Sand mining in coastal regions is subjected to different regulation throughout the world. While a minimum water depth is commonly used as a restrictive criterion for providing mining licences in numerous countries, no such limit is used in France. As a result, extractions may be carried out in shallow areas where wave propagation might be altered by the sand pit. In an erosional context of sandy coasts, such practices are often held responsible for beach recession.

One of IFREMER's roles is to assess the validity of environmental impact studies carried out by industrial companies when submitting their permit applications. In order to improve its expertise (and possibly refine the requirements of the environmental impact assessment), IFREMER has initiated a research programme aiming at better understanding the impact of sandpits on bottom morphology in shallow water areas. While monitoring of extraction sites is now required and can help us understand how the morphology of sand pits evolves depending on the local physical processes (waves, currents, geometric characteristics of the pit, bottom slope, sediment size etc.), we need to be able to predict long- term effects in order to reduce negative impacts due to poor coastal management.

After several physical models have studied the effects of sandpits in a wave tank (e.g., Migniot and Viguier, 1983), numerical models are now available to understand quantitatively, at a lower cost and for a variety of configurations, how the different physical parameters interact in long-term morphological evolutions. So-called morphodynamic models include a hydrodynamic module (to compute tidal currents coupled with waves), and a sediment transport module, and they update the bottom in time. However, long-term simulations still require to choose representative conditions for the wave climate and the tidal regime, since high computational times do not allow us to actually simulate a realistic suc-

cession of tides superimposed with a random occurrence of waves for several years. Depending on the cases, the results of the simulations might be highly dependent on this input schematisation, as well as on the transport formula.

In order to tackle one problem at a time, we have decided to first test the ability of a state-of-the-art morphodynamic model to reproduce morphological evolutions monitored in a wave tank (Migniot and Viguier's experiments, 1983). Simultaneously, we will apply the model to a real site for which morphological evolutions have been monitored over 15 years, in order to compare observed evolutions with modelled hind-cast predictions.

It is probably beyond the scope of an environmental impact study to routinely run such models. The ultimate goal of our study would therefore be to establish a methodological guide based on simulations run on different environments (different wave climates, sediment types, bottom slopes etc.) in order to define a number of indicators to be investigated within an environmental impact study, along with accepted values for these indicators.

This 5-year project began in 2001 and is being carried out and funded by IFREMER.

REBENT Study

A study named REBENT (for "Réseau Benthos") was conceived in 2001 over coastal waters of Brittany as a pilot-area. It concerns a new survey network of the macrobenthos in relation to oil pollution and long-term climate change.

The main partners undertaking the research project are IFREMER and the European University Institute of the Sea (Brest). The Project is being funded by the Territorial Assemblies of Brittany, DIREN and other scientific organisations.

The first step will be targeted towards intertidal areas and inshore waters (maximum depth 30 metres) in relation to the EC Water Directive. This work will use maps to synthesise information about morphosedimentology, the main habitats, algal cover, etc., providing a zonal approach of the seabed in relation to the main abiotic factors.

Two others aims will be developed:

1) spatial evolution of some local and characterised habitats and populations;
2) long-term survey of reference stations selected according to their representative features, interest and sensitivity.

This new benthic survey will be described in the frame of the 2002 WG Marine Habitat Mapping report, but it is also relevant for WG EXT because such a study will have to be developed for the Eastern Channel using similar methodology. This will improve scientific capacity for assessment of the effects of dredging on benthos and the seabed.

Dieppe Case Study: Monitoring of impact since 1980

See Annex 15.

Impact of Marine Aggregate Extraction

The project began in 2002 and is expected to continue until 2006.

A description of the main topics of this project was given in the 2001 report; objectives for 2003 are the following :

- fortnightly monitoring of fish (identification, counting, biomass and biometry) in the extraction site and the surrounding areas (intensive deposit area, recolonisation and reference ones) ;
- trophic relationships between benthic and demersal fish species and benthic preys through analysis of stomach contents ;
- continuation of the restoration process of the former extraction site (cessation of activity in 1995) ;
- video "ground-truthing" survey of the different areas (underwater video records with divers and sledge).

The organisation undertaking the research is a scientific interest group, the funding bodies include The Ministry of Research, Region Haute-Normandie and dredging companies, with the collaboration of IFREMER and Universities (Rouen, Le Havre).

6.6 GERMANY

(German Länder: Schleswig-Holstein, Mecklenburg-Vorpommern) Baltic Sea

Until 2001 in Germany (Baltic Sea) no EIA was conducted before dredging for new dredging activities in the already licenced fields. Also in Germany the "Decree about Environmental Impact Assessment for Mining Projects" is obligatory in requiring an EIA if the extraction exceeds 10 ha or when the daily exploitation is more than 3,000 tonnes, but the reported marine extractions could take place without EIA because they were permitted before 1990 and therefore were granted by "old law".

Description of research project

In 2002 two research projects were finalised, however published results are not available at the moment, but will be in the near future.

- Regeneration of sediment extraction fields in the North Sea and the Baltic Sea. This research project was conducted by the German Federal Agency for Seashipping and Hydrography (BSH) and had analysed the processes of refilling of two sediment extraction sites in the North Sea and two in the Baltic Sea.
- The effects of sediment extraction on sensitive macrobenthic species in the southern Baltic Sea. The thesis was conducted at the University of Rostock. A brief summary was published in the Annual Report of WGEXT in 2002 by Krause *et al.*

In 2002 more than ten research projects were started to analyse and map distribution and abundance of habitats and species according to the habitat (92/43/EEC) and bird (79/409/EEC) directives. First results summarising recent data and reviewed literature data will be soon available on the web-page of the German Federal Agency for Nature Conservation. A translation of these German web-pages into English is intended.

Capital Dredging in the outer Elbe Estuary

The Elbe estuary was deepened in 1999 in order to allow larger ships to reach the port of Hamburg. Now a depth of 14.5 m minimum is guaranteed. In the frame of this project, an EIA had to be made and in the following legal procedure, a monitoring programme was set up. This shall prove the prognoses made in advance of the capital dredging. More information about the Project and the investigations can be seen on the internet

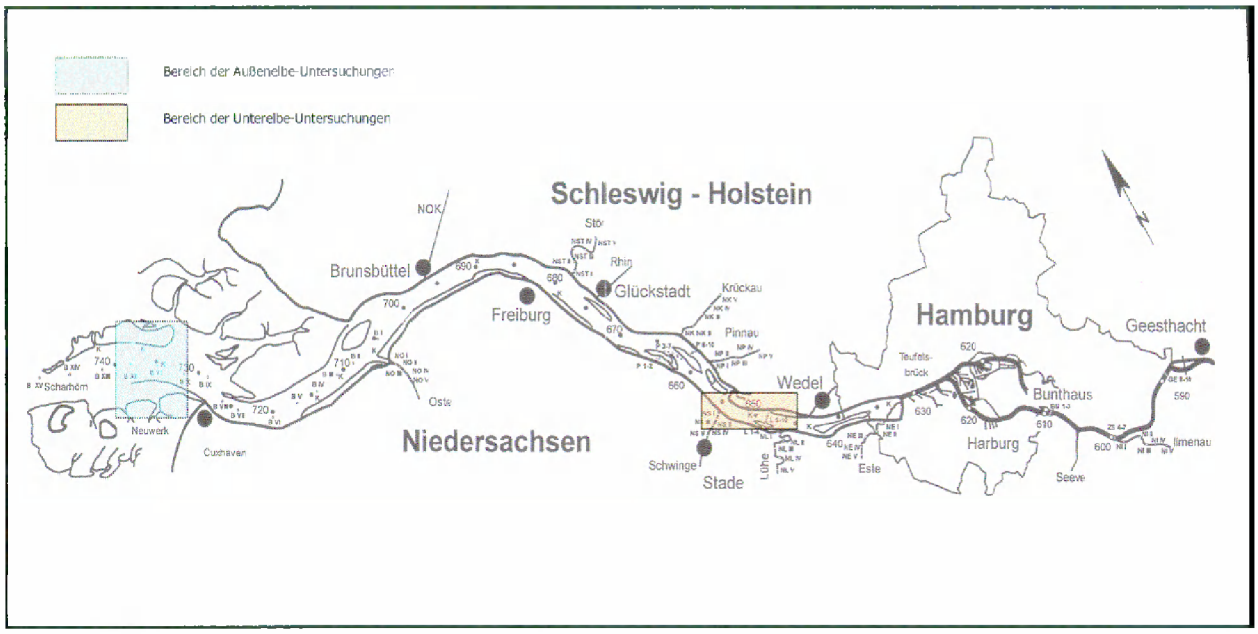
- (http://www.cux.wsd-nord.de/htm/zustimm.asp).

One part of the monitoring programme is the investigation of the effects of dredging on the macrozoobenthos in a limnic and a marine area. The investigation started preceding the capital dredging and was undertaken annually afterwards. The reference in time, the preceding investigation, and in space, the reference area are necessary to be able to detect possible changes in macrozoobenthic biocoenosis within the highly dynamic estuary.

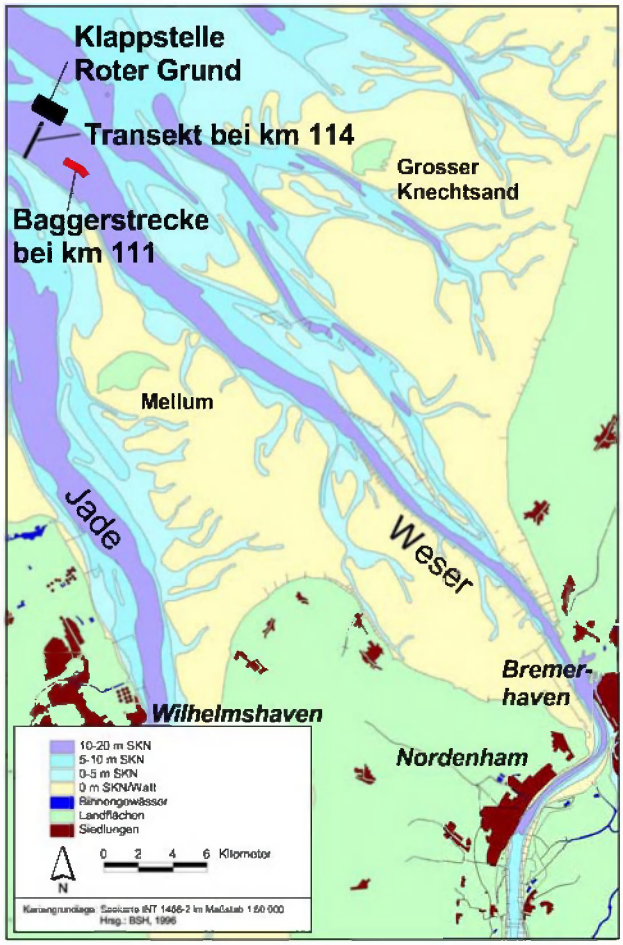
The investigation started in April 1999 and was continued after the capital dredging in May 2001 and 2002. 15 stations with 6 replicates each have been investigated. Analysed parameters are age structure and dominance in addition to species composition and number of individuals.

The results available at present show that impacts in dredging areas are hardly detectable. It was registered a higher variability in the dredging area than in the reference area.

It is planned to finalise the investigations including the dumping areas in 2004. This project is being undertaken by Bioconsult, Bremen and funded by the Federal Water and Shipping Authority, Hamburg.



Figures A6.1 and A6.2. Map with the investigated area in the Elbe estuary. The marine area is blue, the limnic area is yellow.



6.7 IRELAND

There are currently no new approaches to environmental impact assessment procedures to report.

6.8 The Netherlands

EIA for the extraction of aggregate sand from the North Sea. A study of the effects in the area off the coast of South-Holland.

The starting document for this project was produced in September 1998. The organisations undertaking the research were The Netherlands' Ministry of Transport, Public Works and Water Management, Directorate North Sea and The National Institute for Coastal and Marine Management (RIKZ). The funding body is The Netherlands' Ministry of Transport, Public Works and Water Management, Directorate North Sea.

This study has been terminated because the EIA Commission rejected the EIA because of its structure and knowledge gaps. The results of the public consultation and the comments from the EIA commission will be included in a new policy document on marine sand and gravel extraction.

EIA for the extraction of aggregate sand and gravel from the Cleaverbank Area

The starting document was produced in July 2001, the guideline EIA in October 2001.

The organisations undertaking the research are The Netherlands Ministry of Transport (Initiator), Public Works and Water Management, Directorate North Sea Initiator and Royal Haskoning, Haskoning Nederland b.v. (Drafter). The funding bodies consist of The Netherlands Ministry of Transport, Public Works and Water Management, Directorate of the North Sea

The study is focussed on the environmental impact of the extraction of an amount of about 10 million cubic metres of aggregate sand and gravel from the Cleaverbank Area (Netherlands Continental Shelf, blocks D15, 18, E13, 14, 16, 17, J3, 6, K1, 2, 4, 5). Due to the coarse sediments on the seabed the benthic fauna in this area is special compared to the other parts of the Dutch Continental Shelf. The EIA is aimed at defining locations for the extraction and extraction methods in such a way that recovery of the benthic fauna is possible. Extraction in the Cleaverbank Area is compared with extraction in the area off the coast of South-Holland

The EIA was initiated by the Dutch government, however, recently the government has decided that the industry should be responsible for their actions and that the government should concentrate on legislation and licensing procedures. Therefore the EIA procedure has been stopped and the study will be published as a research report.

EIA for the extraction of sand for the Westerschelde Container Terminal in the southern part of the North Sea

The starting document for this project was produced in October 2001, the guideline EIA in February 2002. The first public draft was published in March 2003. The project is expected to run until July 2003.

The research was commissioned by Zeeland Seaports and prepared by DHV Milieu en Infrastructuur BV. The funding bodies consist of Zeeland Seaports.

The study is focussed on the environmental impact of the extraction of an amount of about 20 million cubic metres of fill sand in the area off the coast of Zeeland from the 20 m depth contour (Dutch Level) to a distance of 40 km from the coast.

Alternatives are given by location and by shallow (<2 m below the seabed) versus deep (> 2 m) extraction.

PUTMOR

The organisations undertaking the research are The National Institute for Coastal and Marine Management (RIKZ), the Netherlands' Ministry of Transport, Public Works and Water Management and the Directorate of the North Sea. The funding bodies consist of the Netherlands' Ministry of Transport, Public Works and Water Management and the Directorate of the North Sea.

Field measurements were carried out in and outside a large extraction pit some 10 km off the Dutch coast near Hoek van Holland. The dimensions of the pit are 500 m × 1300 m, with a depth of 10 m relative to the seabed. The water depth is 22–24 metres. After the measurement period the pit was filled in with harbour mud. The aim of the study is to determine changes in physical parameters due to the presence of an extraction pit. The physical parameters are important to qualify and to quantify the morphological and ecological effects of sand extraction pits. The field study can be used for validation of models on hydrodynamics and morphology. The study shows that the influence of the sand pit on the flow velocities is generally small. The flow velocities in the pit are sufficient to renew the water each tide even in the lower parts. Therefore there is no increase of stratification. There is no indication that the pit acts as a trap for water with high density. Occasionally the oxygen content is measured. These measurements show only a slight difference (< 0.2 mg/l) between a location at the bottom of the pit and at the seabed near the pit. The morphological development of the sandpit during the observation period is less than the accuracy of the bathymetric surveys. The measurements comprise bathymetry, flow velocities, water levels, temperature, conductivity, turbidity, oxygen content and analysis of seabed sediments. The final report, together with the validated data will be available in December 2003.

The following reports have been published:

Hoogewoning, S. 2000. PUTMOR-field measurements. A six-months measuring campaign at a lowered dumping pit near Hoek van Holland (The Netherlands). Work document RIKZ/OS-2000.132x. National Institute for Coastal and Marine Management (RIKZ), Den Haag, 27 pp.

Svasek. 2001. PUTMOR field measurements at a temporary sandpit, part 1: processing and validation. Kust2005 Report, National Institute for Coastal and Marine Management (RIKZ), Den Haag / Svasek, Rotterdam.

Svasek. 2001. PUTMOR field measurements at a temporary sandpit, part 2: data analysis. Kust2005 Report, National Institute for Coastal and Marine Management (RIKZ), Den Haag / Svasek, Rotterdam.

Svasek. 2001. PUTMOR field measurements at a temporary sand pit, part 3: final report. Kust2005 Report, National Institute for Coastal and Marine Management (RIKZ), Den Haag / Svasek, Rotterdam.

Map of archaeological and cultural heritage values on the Netherlands Continental Shelf

The research is being undertaken by The Netherlands' Institute for Maritime and Underwater Archaeology. The funding bodies consist of the Netherlands' Ministry of Transport, Public Works and Water Management and The Directorate of the North Sea.

As a result of the framework of the Malta Treaty and the UNESCO Convention of Underwater Cultural Heritage the importance of archaeological and cultural heritage values in planning extraction activities is increasing. Therefore an archaeological expectation map has been made that gives an indication of the areas with a high chance of finding archaeological and cultural heritage values in the seabed. This map is based on the geomorphological behaviour of the seabed.

Another map has been made that gives the location of archaeological remains, mainly wrecks.

The two maps will be combined to produce one map of archaeological and cultural heritage values on the Netherlands Continental Shelf. This project was initiated in 1999 and a map is expected to be produced in 2003.

Map of geomorphological and geological values on the Netherlands Continental Shelf

The research is being undertaken by The Bureau Buitenwerk, Deventer and is being funded by the Netherlands' Ministry of Transport, Public Works and Water Management and The Directorate North Sea.

Geomorphological and geological values are more and more taken into account the decisions about the location of extraction sites. In EIAs they must be described. Therefore a map has been made of areas with geomorphological and geological values on the Netherlands Continental Shelf. This map is based on the notion that it is worthwhile to preserve good examples of geomorphological or geological features from each period of the Quaternary. Both important features on the seabed as well as boreholes or areas of seismic lines with unique stratigaphic information are mapped. This project was initiated in 1999 and a map is expected to be produced in 2003.

Kust*2005 Zeebodem

The research is being undertaken by The National Institute for Coastal and Marine Management (RIKZ) and Den Haag. The project is being funded by The Netherlands' Ministry of Transport, Public Works and Water Management and The Directorate of the North Sea (among others).

The project is focused on the effects of (large-scale) extraction of sand in relation to the licence conditions.

The end products will be:

- interpretation of the PUTMOR Project
- physical effects of large-scale sand extraction
- effects of sand extraction on sand banks

The project commenced in 2001 and is expected to be completed in 2004.

BEAST

The project started in 2001 and aims to integrate present knowledge and site-specific information in order to understand and predict the possible environmental impacts of different human activities. Ecotope maps will be produced on a scale that is applicable for detailed EIA studies. Using GIS, a tool is to be developed to support the management of different human activities on the Dutch Continental Shelf that might affect the seabed.

The Flyland-project

In 1999 the Dutch government decided that the possibility of the construction of an airport on an island in the sea could not be excluded for the future. Therefore funds were made available for a research programme which began in 2000 and was due to end in 2004. Within the research theme "marine ecology and morphology" information was gathered on water movement, mud transport, (phyto) plankton, the benthos community, beach and dune ecosystems, fish fauna, birds and seals.

However, due to political and financial reasons, the funding authorities decided to end the project on 1 February 2003. Only part of the research was completed and reported on.

6.9 United Kingdom

C1172 - Guidelines for the conduct of benthic studies at aggregate dredging sites (completed June 2002).

The Centre for Environment, Fisheries and Aquaculture Science (CEFAS) has published guidelines on the conduct of benthic surveys at commercial aggregate extraction sites. They have been written by scientists at CEFAS on behalf of the UK Office of the Deputy Prime Minister (ODPM). The guidelines have been produced to facilitate consistency of approaches amongst consultants employed by the industry when carrying out baseline and monitoring surveys and to foster compatibility between ongoing regulatory monitoring activity and related R&D.

The report begins with an account of the rationale for environmental appraisals at aggregate extraction sites, presents a strategy for their planning and design and then documents current and developing methodologies for the conduct of seabed surveys in support of Environmental Statements. This is followed by a general review of the range of equipment available for sampling the marine benthic fauna from coarse substrata and the approaches for processing faunal samples both in the field and the laboratory. Recognising the role of remote acoustic techniques in complementing conventional approaches, the report describes a number of devices for use in elucidating attributes of the physical habitat. A range of techniques for characterising the wave and current climate and for the collection and analysis of sediments is also described. Throughout the report, good practice in terms of Quality Assurance (QA) is presented within each of the sections describing methodological approaches and this is supplemented by generic guidance on QA matters at the end of the report.

Copies of the report are available from ODPM Free literature, PO BOX 236, Wetherby, West Yorkshire, United Kingdom LS23 7NB and at www.planning.odpm.gov.uk/benthic/index.htm

C1103 – Assessment of the re-habilitation of the sea-bed following marine aggregate dredging

CEFAS, HR Wallingford and the British Geological Survey are undertaking this 4-year research project between April 2000 and May 2004, on behalf of ODPM, The Crown Estate and The Department of the Environment, Food and Rural Affairs (DEFRA). The principal aim of the project is to provide a better understanding of the processes leading to the physical and biological recovery of the seabed following marine aggregate extraction. In addition, it aims to identify dredging practices that minimise environmental harm at licensed sites and promote rehabilitation on cessation. Pilot

field surveys have been conducted at seven sites, spanning 5 geographical areas around the English coastline. A range of sampling methods was employed at each of these sites in order to direct field sampling programmes in years 2–4 of the project. More comprehensive surveys have been conducted at 4 sites: Area 408 (Humber), Area 222 (Thames) and Hastings Areas X and Y (English Channel). An account detailing the preliminary observations at Area 222, a relinquished extraction off Harwich (Area 222) is due to be published shortly in Estuarine Coastal and Shelf Science (Boyd *et al., in press*).

Hydrodynamic conditions at ten locations around the south and east coasts of England have also been derived from a combination of computational flow and wave models by HR Wallingford. The data have been analysed in a systematic manner enabling relative comparisons from one site to another to be made. Furthermore, a "mobility" index has been produced to classify these locations based on the local hydrodynamic conditions and the nature of the sediments.

Reference

Boyd, S.E., Limpenny, D.S., Rees, H.L., Cooper, K.M., and Campbell, S. (*in press*). Preliminary observations of the effects of dredging intensity on the recolonisation of dredged sediments off the south-east coast of England (Area 222). Estuarine, Coastal and Shelf Science.

AE0903 – Cumulative environmental impacts of marine aggregate extraction.

This was a 4-year research project carried out by CEFAS on behalf of DEFRA and the Crown Estate between April 1998 and March 2002. The main aim of this research project was to investigate the potential for cumulative environmental effects arising from marine aggregate extraction. Research on cumulative effects represents a major departure from conventional "once off" evaluations of the impact of dredging in that, it aims to evaluate the interaction of events separated in time and in space and therefore calls for a more holistic approach to assessments.

In an initial assessment of the scope for such cumulative effects, a review of historical data was undertaken, focussing on the dredging intensity and extent, and the performance of local fisheries in two regions: East of the Isle of Wight, in the English Channel and in the vicinity of the Cross Sands extraction licences, in the Southern North Sea. However, the results of these investigations were not considered representative of the current situation in terms of the distribution and performance of local fishing effort. Therefore, interviews were also conducted with key fishermen, operating within the East of the Isle of Wight region. It was also necessary to conduct new carefully targeted benthic sampling to cover appropriate spatial scales. Sampling regimes were designed to provide a regional perspective on macrofaunal community patterns in the two regions. A sub-set of stations was also selected from the large-scale grid surveys and these are intended to contribute to a time-series of information for assessing the persistence of effects in relation to changes in dredging intensity and natural variations in populations.

Surveys were also designed to examine the nature of impacts on the macrobenthos arising from marine aggregate extraction. The first of these surveys was conducted in 1999 to investigate the effect of different levels of dredging intensity on macrofaunal assemblages within extraction licences located East of the Isle of Wight. Further studies conducted in 2000 were designed to investigate the nature and footprint of biological effects arising from both trailer and static suction hopper dredging. The outcome from these latter surveys will be published shortly in Estuarine Coastal and Shelf Science (Boyd and Rees, *in press*).

A technical report describing the findings from the entire research project is also being prepared and will be published later in the year.

Reference

Boyd, S.E., and Rees, H.L. (*in press*). An examination of the spatial scale of impact on the marine benthos arising from marine aggregate extraction in the Central English Channel. Estuarine, Coastal and Shelf Science.

AE1033 - Role of seabed mapping techniques in environmental monitoring and management

This is a 4-year project being conducted by CEFAS, Newcastle University and BGS on behalf of DEFRA between April 2001 and March 2005. The main aims of this project are to evaluate the utility of seabed mapping techniques for determining the significance of several types of anthropogenic disturbances at the seabed and to develop a strategy for the investigation of seabed conditions over different spatial scales.

Experience of techniques developed in an earlier research project on coarse substrates (see Brown *et al.*, 2001) has been extended in this project by undertaking further surveys covering both a broader range of substrates and anthropogenic impacts (dredged material disposal, aggregate extraction and demersal fishing). Typically, an acoustic survey combining side-scan sonar and acoustic ground discrimination system techniques (AGDS) is conducted over a study site to identify acoustically distinct areas of the seabed which are then ground-truthed, using grabs and underwater photography, to determine their physical and biological characteristics. BGS is also currently describing seabed facies at study sites in the eastern English Channel. The Hastings area which includes a number of current extraction licences has been used as a template to develop a methodology for mapping seabed facies in a GIS format based on seismic reflection, sidescan sonar and sediment sample data. CEFAS in conjunction with Newcastle University have also been investigating the characteristics of three AGDS systems (RoxAnn™, EchoPlus™ and QTC™) at a dredged material disposal site during simultaneous and multi-frequency deployments.

Reference

Brown, C.J., Hewer, A.J., Meadows, W.J., Limpenny, D.S., Cooper, K.M., Rees, H.L., and Vivian, C.M.G. 2001. Mapping of gravel biotopes and an examination of the factors controlling the distribution, type and diversity of their biological communities. Sci. Ser. Tech. Rep., CEFAS Lowestoft, 114: 43 pp.

A Development Plan for Marine Aggregate Dredging - A scoping study

(Posford Haskoning together with CEFAS, H R Wallingford and David Tyldesley Associates)

This study, commissioned by the Office of the Deputy Prime Minister (ODPM) in October 2001, assesses whether a development plan approach (i.e., spatial planning) could provide a suitable and sustainable framework for identifying and allocating future areas of the English seabed for marine aggregate dredging.

The research included a review of :

- markets for marine aggregates;
- key environmental, social and economic issues;
- the extent to which approaches used in the preparation of existing plans, such as Mineral Local Plans, Shoreline Management Plans etc., are potentially transferable to the marine setting;
- the current regulatory framework for marine aggregate dredging;
- other approaches to development control.

An assessment of the data required for a development plan or alternative approach has been undertaken, together with an evaluation of the availability of such data and the resources required to fill identified key gaps.

Recognising that a future marine aggregates development plan, if taken forward, might require a Strategic Environmental Assessment (SEA) in accordance with Directive 2001/42/EC, the study also considered what this might entail.

A draft final report is being considered by ODPM, and it is anticipated that it will be published later in 2003.

Seabed characterisation and the effects of soil structure on the benthos and on benthos recolonisation caused by marine aggregate extraction

(Andrews Survey)

The objective of this study is to examine the microclimate of the water column/seabed interface to determine the characteristics of the seabed, its relation to benthic populations and changes caused by marine aggregate dredging. The study will make use of:

- seabed mounted acoustic Doppler current profilers and silt meters;
- sediment penetration camera, towed camera and video sledge;
- cone penetration testing of the seabed; and
- sediment and benthic sampling.

Comparison will be made between dredged and non-dredged areas to assess the relationship between soil characterisation and the biological benthic population and to identify the implications for post-dredging recovery.

Completion by 31 March 2001.

Impacts of overboard screening on the seabed and associated benthic biological community structure in relation to marine aggregate extraction

(Marine Ecological Surveys Limited with Andrews Survey)

The objective of this study is to establish the fate and distribution of material rejected by on-board screening, and the extent to which this is associated with changes in biological community composition in space and time outside the boundaries of aggregate dredging sites in different coastal areas.

The study will complement ongoing research by CEFAS on the recovery of the seabed following aggregate dredging and on the nature and scale of cumulative impacts between adjacent licensed areas.

Completion by 31 March 2004.

Best practice guide to assessing the impacts of aggregates dredging

(Posford Haskoning Ltd)

The objective is to produce a best-practice guidance document on the assessment of the impacts of aggregate extraction on the marine environment.

A desk study of available information will be used to identify best practice on data collection, collation, assessment, mitigation and management for each of the key environmental parameters, including the physical environment, benthic biological resource, fish resources and the fishery, navigation, recreation and marine archaeology.

To be completed 31 March 2004.

Seabed pre-history: gauging the effects of marine aggregate extraction

(Wessex Archaeology)

The aim of this study is to provide a clearer understanding of seabed deposits of prehistoric interest, and to develop new methodologies for their assessment and evaluation as part of an Environmental Impact Assessment.

The study will involve:

- preparation of a digital metadata catalogue of existing non-archaeological surveys by dredging companies;
- consideration of the potential for archaeological [re-]interpretation of existing survey results;
- a sub-bottom survey of an area of seabed known to comprise deposits of prehistoric interest in the vicinity of aggregate deposits. The resulting deposit model will be interpreted with a view to better understanding the extent and character of prehistoric seabed deposits, and to identify survey methodologies suitable for adoption by industry;
- a programme of seabed sampling using vibrocores and grabs/trawls. The results will be interpreted with respect to the extent and character of prehistoric deposits in conjunction with the results of sub-bottom survey, and with a view to arriving at methodological recommendations.
- palaeo-environmental assessment, analysis and scientific dating of sub-samples obtained from the vibrocores and grab/trawl surveys. The results will be interpreted in conjunction with the other studies to address the extent and character of prehistoric seabed deposits in the area surveyed, as well as their likely extent and character more broadly in the region and nationally.

To be completed 31 March 2004.

Eastern English Channel – Regional Environmental Assessment

Six aggregate dredging companies have been investigating significant new reserves of marine sand and gravel located in the Eastern English Channel, some 30 km south of the Sussex coast. This has resulted in ten applications being submitted to English Government over a period of four years.

Site-specific environmental assessments and associated technical reports (coastal processes, benthic survey, archaeology etc.) are required for individual applications under English Government licensing procedures. However, the scale, extent and timing of the individual applications in the region meant that assessment of potential cumulative and in-combination effects was incomplete.

In 2001 the applicant companies formed the East Channel Association (ECA) in order to jointly and voluntarily fund a Regional Environmental Assessment (REA). The objective of this study was to address the potential cumulative and in-combination issues associated with the development as a whole. Although having no legal status in the formal application process, a regional assessment was considered to offer significant benefit to industry, regulators and stakeholders, when considering the implications of the proposed development as a whole – and particularly the potential for cumulative and in-combination impacts.

The REA was undertaken by an independent team of consultants and experts and covered regional scale (as opposed to site-specific) issues, including a description of the existing regional environment, physical impacts (waves, tides, sediments), plume effects, marine biology, fish resources, fishing activity, shipping and navigation, and marine archaeology, in addition to potential trans-boundary effects. As well as drawing upon existing information presented in site-specific EIA studies, a significant amount of new research was commissioned.

To permit a consistent approach to the regional assessment process, a series of assumptions were defined for annual extraction levels (tonnes/year), dredger occupancy (hours on site) and the seabed area dredged (area disturbed/year). These parameters were then used to inform impact assumptions throughout the regional assessment.

The regional assessment concluded with a series of management, mitigation and management recommendations, as well as identifying areas where further research will be necessary.

The completed REA document was published in February 2003, and further information is available from www.eastchannel.info.

6.10 United States of America

Regional Sediment Management

The New York District of the U.S. Army Corps of Engineers is one of the demonstration programmes for the concept of regional sediment management. The programme is ultimately intended to coordinate dredging activity in the coastal zone "for the purposes of retaining sand in the littoral system in order to foster more balanced natural system processes and reduce project costs". This project is funded by the U.S. Army Corps of Engineers; it commenced in 1994 and will go on indefinitely

For further information:

Regional Sediment Management: Background and Overview of Initial Implementation: U. S. Army Corps of Engineers, Institute for Water Resources Policy Studies Program, IWR Report 02-PS-2, Lynn R. Martin, 2002.

Biological monitoring for the Atlantic Coast of New Jersey, Sea Bight to Manasquan Inlet, Beach Erosion Project

This project is being undertaken and funded by the U.S. Army Corps of Engineers. It commenced in 1998 and is intended to reach completion in 2003.

For further details: www.nan.usace.mil/business/prjlinks/coastal/asbury/index.htm.

Evaluation of the effects of fishing gear on local benthic habitats

Experts in the fields of benthic ecology, fishery ecology, geology, fishing gear technology and operations evaluated the effects of fishing gear on local benthic habitats and identified potential management measures. The panel expressed greatest overall concern about impacts from otter trawls and scallop dredges to structure-forming organisms. Gravel habitat was considered to be most at risk from gear impacts, followed by sand and mud habitats. In some circumstances, the extent of impact in each habitat varied based on the environment's energy level (high vs. low energy). In general, bottom tending mobile gear was of greater concern than fixed gear. Clam dredges were rated as having the least effect of the mobile gears because of the limited geographic area and the rapid recovery rates of the high energy sand environment in which they are fished. Scallop dredges were rated as having large effects in the gravel and sand habitats in which they are fished. Panellists had the greatest difficulty reaching consensus on the impacts of otter trawls due to their widespread use over a large variety of habitat types as well as the numerous gear configurations employed. The three primary management measures proposed to reduce fishing gear impacts included effort reductions, spatial closures, and gear modifications. This report can be found at the following website:

- www.nefsc.nmfs.gov/nefsc/publications/crd/crd0201/.

This project was funded by National Marine Fisheries Service and undertaken by Northeast region essential fish habitat steering committee. The project duration was 1- year and was completed in 2002.

Minerals Management Service Studies

Various studies have been undertaken and funded by the U.S. Minerals Management Service, for the purposes of beach nourishment along the Northeast Atlantic Coast. See:http://www.mms.gov/intermar/environmentalstudiespage.htm

- Environmental Surveys of OCS Sand Resources Offshore New Jersey (Site-specific)
- Study of the Cumulative Effects of Marine Aggregate Dredging (Generic)
- Design of a Monitoring Protocol/Plan for Environmentally Sound Management and Development of Federal Offshore Sand Borrow Areas Along the United States East and Gulf of Mexico Coasts (Generic)
- A Numerical Modelling Examination of the Cumulative Physical Effects of Offshore Sand Dredging for Beach Nourishment (Generic)

Ongoing Minerals Management Service Studies which are expected to be completed in 2003:

- Integrated Study of the Biological and Physical Effects of Marine Aggregate Dredging (Generic; Final report will be expected in 2003)
- Environmental Surveys of Potential Borrow Areas Offshore Northern New Jersey and Southern New York and the Environmental Implications of Sand Removal for Coastal and Beach Restoration (Site-specific; Draft report due mid-February 2003; Final report due mid-April 2003)
- Model Development or Modification for Analysis of Benthic and Surface Plume Generation and Extent During Offshore Dredging Operations (Generic; Final products due February 2003)
- Environmental Investigation of the Use of Shoals Offshore Delaware and Maryland by Mobile Benthos and Finfish A Species (Site-specific/Generic; Final Report due January 2005)
- World-wide Analysis of Shipwreck Damage Caused by Offshore Dredging: Recommendations for Proportional surveys/mitigation During Dredging to Avoid Adverse Impacts (Generic) (Final report due November 2003)

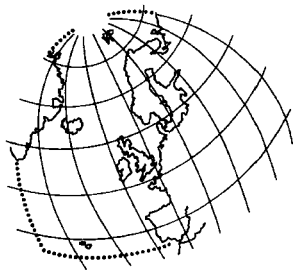
Annex 7 Draft Agreement on Sand and Gravel Extraction

OSPAR Commission

for the Protection of the Marine Environment of the North-East Atlantic

Commission OSPAR

pour la protection du milieu marin de l'Atlantique du Nord-Est



25 March 2003

To the chairman and heads of delegation to the Biodiversity Committee

Dear Colleagues,

DRAFT AGREEMENT ON SAND & GRAVEL EXTRACTION
This letter seeks your agreement to a proposal for submission to OSPAR 2003 on the regulation of marine sand and gravel extraction. **A deadline of 11 April is set for comments.**

Background
2. You will remember that BDC 2003 agreed the Secretariat will circulate a draft OSPAR agreement for approval by BDC heads of delegation in a written procedure and final adoption by OSPAR 2003, recommending Contracting Parties to take into account the ICES Guidelines for the Management of Marine Sediment Extraction within their procedures for licensing the extraction of marine sediments (BDC Summary Record §4.1)

Draft agreement
3. I accordingly attach a draft agreement. The following comments may help you in considering it.

4. The OSPAR Convention makes provision for decisions, recommendations and "other agreements". In contrast to decisions and recommendations, which are drafted as formal, free-standing instruments, "other agreements" are usually part of the summary record of the meeting which adopts them. This approach has been adopted in the draft.

5. BDC spoke variously about "licences" and "permits". In general, OSPAR instruments have tended to use the general word "authorise", in order to avoid any implication about the particular nature of any instrument. This approach has been followed here.

6. Since it is difficult to carry out a strategic environmental assessment of an activity in the abstract (see the way in which the EU SEA Directive is drafted), the recommendation on this point has been turned into a recommendation to develop, when and where appropriate, national programmes and to subject these to SEA.

7. Since the EC Habitats directive does not apply to EEA states, the element relating to this has been confined to EU Member States, and a parallel provision has been drafted to cover the others. In practice the reference to the Habitats Directive is concerned with paragraph 4 of Article 6, since the other procedures covered are already effectively covered by the reference in paragraph 1.2(d)(i) to environmental impact assessment (EIA). The proposed provision relating to non-EU states is therefore designed to provide a parallel commitment to Article 6(4). Since non-EU states do not participate in the NATURA 2000 network, in place of the reference to maintaining that network, reference is made to maintaining the functioning of the ecosystem of which the site forms part.

Timetable
8. BDC agreed to a written procedure, but did not set a timetable. We therefore propose to work on the basis that, if you make no comment by 11 April, you are content for the draft to go to OSPAR 2003 without change. If you have

comments, could you please let us have them as soon as possible before then, so that we can try to find a solution and circulate a revised version. The aim is to circulate a final draft (if need be with footnotes on problems that have not been resolved) by 25 April, in good time before the meeting of OSPAR HOD on 13 May.

Yours sincerely,

ALAN SIMCOCK

Executive Secretary

Draft OSPAR Agreement on Sand and Gravel Extraction

1.1 OSPAR noted the information presented to SEABED 2002 by Denmark and ICES and the conclusions of BDC that:

a. the ICES Cooperative Research Report on "Effects of extraction of marine sediments on the marine ecosystem" was sufficient to cover OSPAR's requirements for an overview assessment of environmental effects of sand and gravel extraction;

b. OSPAR should make use of ICES' data on sand and gravel extraction in its future assessments, and should not initiate a separate system for collecting similar data;

c. Denmark should invite ICES to consider ways to expand the coverage of the data to all OSPAR Contracting Parties and ensure consistency between data sets submitted by different Contracting Parties;

d. SEABED 2003 should review ICES' arrangements for reporting data on sand and gravel extraction activities to determine whether it will remain sufficient for OSPAR's needs;

e. in general, the ICES Guidelines for the Management of Marine Sediment Extraction set out adequate guidance in this field.

1.2 OSPAR therefore agreed that

a. Contracting Parties which are coastal states of the maritime area should take the ICES Guidelines for the Management of Marine Sediment Extraction into account within their procedures for authorising the extraction of marine sediments (including sand and gravel);

b. the procedures of such Contracting Parties for authorising the extraction of marine sediments should also take into account the ecosystem-based approach to management of human activities;

c. when and where appropriate, such Contracting Parties should develop general plans covering the extraction of marine sediments in areas of the maritime under their jurisdiction, in order to provide a framework for the procedures on individual applications, and should carry out strategic environmental assessment (SEA) of those plans;

d. authorisations for the extraction of marine sediments from any ecologically sensitive site (such as a nature reserve, a national park, a NATURA 2000 site, a Ramsar site etc), should only be granted after:

   i. careful consideration of a comprehensive and thorough environmental impact assessment (EIA) of the effects of the extraction proposed at that site, in accordance with the ICES Guidelines, and

ii. in the case of such Contracting Parties as are EU Member States, where the site is designated under the EC Habitats Directives[1], the proposal for the extraction of marine sediments has been subject to the procedures laid down in Article 6 of that Directive;

iii. in the case of other such Contracting Parties, where a site is subject to protective measures, but over-riding public interests require the extraction of marine sediments with a consequential significant adverse impact on the site, all necessary steps are taken to avoid adverse impacts on the functioning of the ecosystem of which it forms part and, where the site has been designated as an OSPAR marine protected area, on the coherence of the OSPAR network of marine protected areas.

(Draft of 25 March 2003)

1 Council Directive of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (92/43/EEC)

Annex 8 OSPAR SEABED AGENDA ITEM 3: Assessment of Human Activities in the context of Annex V (Extract from the 2002 meeting of the OSPAR Working Group on the Use of and Impact on the Seabed (SEABED)

SEABED 02/3/1-SEABED 02/3/3; SEABED 02/3/3 Add.1; SEABED 02/3/4; SEABED 02/3/Info.1-SEABEB 02/3/Info.7

Sand and gravel Extraction

3.1 SEABED recalled that Denmark, as lead country in OSPAR for work on sand and gravel extraction, had agreed to prepare, on the basis of ICES work, proposals for:

a. an overview assessment of environmental effects of sand and gravel extraction;

b. a proposal for reporting data and information on sand and gravel extraction activities;

c. draft OSPAR Guidelines on sand and gravel extraction.

3.2 SEABED examined Section 12 (Effects of extraction of marine sand and gravel on marine ecosystems) of the report of the 2002 meeting of the ICES Advisory Committee on the Marine Environment (ACME) (SEABED 02/3/2). The document reported on the development of ICES Guidelines for the management of marine sediment extraction, current marine extraction activities and results of assessment of their environmental effects, and methods to assess localised impacts from aggregate extraction on fisheries. SEABED took this information into account in its discussions on the proposals put forward by Denmark.

Overview assessment of environmental effects of sand and gravel extraction

3.3 On the basis of a proposal from Denmark, SEABED 2001 had considered how to prepare an OSPAR overview assessment of the environmental effects of sand and gravel extraction. Denmark had proposed that, subject to further scrutiny by Contracting Parties, the ICES Cooperative Research Report (CRR) on "Effects of extraction of marine sediments on the marine ecosystem" could fulfil OSPAR's needs in this respect.

3.4 Denmark had therefore sought the views of Contracting Parties on whether the ICES CRR covered all of the issues that should be addressed by an OSPAR overview assessment of the environmental effects of sand and gravel extraction; whether there were any aspects not covered, or not covered in sufficient detail, and whether there was a need for any further work on an overview assessment of the environmental effects of sand and gravel extraction for OSPAR. Denmark had only received a response from the UK who commented that the CRR made no reference to the ecosystem approach to the management of the marine environment, or to the important issue of cumulative impacts (SEABED 02/3/1). Denmark also informed SEABED that ICES planned to update the CRR in 2005, taking into account any new research findings, and could at that time also take the comments made by the UK into account.

3.5 Following discussion, SEABED agreed:

a. to recommend to BDC that the ICES Cooperative Research Report on "Effects of extraction of marine sediments on the marine ecosystem" was sufficient to cover OSPAR's requirements for an overview assessment of environmental effects of sand and gravel extraction;

b. to invite **Denmark to draw to the attention of ICES to the comments made at the present meeting and to invite ICES to consider taking account in its updated assessment in 2005, the ecosystem approach to the management of the marine environment, and cumulative impacts, as well as any new research findings**.

Guidelines on sand and gravel extraction

3.6 Denmark presented Guidelines on sand and gravel extraction which had been prepared by the ICES Working Group on the Effects of Extraction of Marine Sediments on the Marine Ecosystem (WGEXT) and subsequently adopted by the ICES Advisory Committee on the Marine Environment (see SEABED 02/3/2). The Guidelines had been finalised in the light of comments made by OSPAR Contracting Parties on an earlier draft. Denmark recommended that OSPAR Contracting Parties should follow these guidelines.

3.7 Following discussion, SEABED concluded that there was a need for Guidelines that OSPAR Contracting Parties could follow when dealing with the management of marine sediment extraction activities, and that the ICES Guidelines could serve this purpose without further amendment. Therefore, SEABED agreed to recommend to BDC that the ICES Guidelines for the Management of Marine Sediment Extraction should be taken into account by OSPAR Contracting Parties within their procedures for licensing the extraction of marine sediments.

Reporting data and information on sand and gravel extraction activities

3.8 Denmark informed SEABED that, following the agreements of SEABED 2001, comments had been sought from Contracting Parties on a proposed reporting schedule for data and information on sand and gravel extraction activities (SEABED 02/3/1). On the basis of the comments received from only three Contracting Parties (France, Germany and the UK), and an evaluation of the data that ICES is able to collect and report, Denmark had concluded that the data collected by ICES would be sufficient for OSPAR's needs for information on sand and gravel extraction activities.

3.9 In discussion, the following comments were made:

a. it was not clear how ICES obtained the data, how complete the data reported by each country was, why there were gaps in the data, and why data was not available for some OSPAR Contracting Parties. Such issues would need clarification before the ICES data could be used by OSPAR in a meaningful assessment;

b. many Contracting Parties possessed information on actual areas dredged which would be valuable information for use in assessments, particularly in relation to the environmental impact of dredging and it would be useful to collect this information as well. However, it was recognised that determining the actual area dredged was not a simple process and that this information would not be readily available from all Contracting Parties;

c. for some countries the data reported by ICES included sea areas other than the OSPAR maritime area. If data for these countries was to be used by OSPAR the data relating to different regional seas would need to be reported separately.

3.10 On the basis of the discussion, SEABED concluded:

a. that there was no desire on the part of Contracting Parties to initiate a specific OSPAR exercise to collect data on sand and gravel extraction activities, and that any future assessment work should make use of the data collected and made available by ICES;

b. that the data on sand and gravel extraction activities currently collected and made available by ICES was lacking in a number of aspects regarding OSPAR's requirements, and that adjustments to what ICES collected could be of significant benefit to OSPAR.

3.11 Taking into account the above conclusions, SEABED agreed:

a. to recommend to BDC that OSPAR should make use of ICES' data on sand and gravel extraction in its future assessments, and should not initiate a separate system for collecting similar data;

b. **Denmark should inform ICES of the conclusions of the present meeting on the use of information from ICES on sand and gravel extraction activities for future OSPAR assessments, and to invite ICES to**:

(i) continue to collect and report data on sand and gravel extraction activities;

(ii) consider whether, in addition to area licenced for dredging, it would be possible to calculate or collect information on the actual areas dredged, and if feasible to report that information in future;

(iii) consider ways to expand the coverage of the data to all OSPAR Contracting Parties and ensure consistency between datasets submitted by different Contracting Parties;

(iv) **consider presenting data for the OSPAR maritime area separately from that for other regional seas;**

c. **Contracting Parties should submit to the Secretariat with a copy to Denmark by 1 January 2003 contact details for their national authorities responsible for data on sand and gravel extraction, for onward transmission to ICES to assist in identifying the relevant OSPAR sources of data on sand and gravel extraction activities**;

d. the next meeting of SEABED should review ICES' arrangements for reporting data on sand and gravel extraction activities to determine whether it is, or would become, sufficient for OSPAR's needs, or whether alternative arrangements would be required.

3.12 SEABED noted a report from the UK on a review of current state of knowledge of the impacts of marine sand and gravel extraction (SEABED 02/3/Info.1) which showed that the recovery period for extracted areas could be in some cases longer than initially estimated. The UK also presented guidelines for the conduct of benthic studies at aggregate dredging sites (SEABED 02/3/Info.6) that aimed at helping to reach a consistent approach to dredging when implementing the EU Directive on Environmental Impact Assessment.

3.13 SEABED also noted a copy of a self explanatory article on marine stewardship and dredging for aggregates submitted by UEPG (SEABED 02/3/Info 7).

Annex 9 Agenda Item 4 – Assessment of Human Activities

In the context of the OSPAR Convention Annex V and Appendix 3 (Extract from the report of the January 2003 meeting of the OSPAR Biodiversity Committee (BDC))

Sand and gravel extraction

4.1 On the basis of information presented by Denmark and ICES to SEABED 2002 with regard to (a) an overview assessment of environmental effects of sand and gravel extraction; (b) reporting data and information on sand and gravel extraction activities and (c) draft guidelines on sand and gravel extraction, BDC noted arrangements for further work made by SEABED 2002 and endorsing its recommendations, agreed that:

a. the ICES Cooperative Research Report on "Effects of extraction of marine sediments on the marine ecosystem" was sufficient to cover OSPAR's requirements for an overview assessment of environmental effects of sand and gravel extraction;

b. OSPAR should make use of ICES' data on sand and gravel extraction in its future assessments, and should not initiate a separate system for collecting similar data. However **Denmark should invite ICES to consider ways to expand the coverage of the data to all OSPAR Contracting Parties and ensure consistency between datasets submitted by different Contracting Parties**. SEABED 2003 should review ICES' arrangements for reporting data on sand and gravel extraction activities to determine whether it will remain sufficient for OSPAR's needs;

c. the **Secretariat will circulate a *draft OSPAR agreement* for approval by BDC heads of delegation in a written procedure and final adoption by OSPAR 2003, recommending Contracting Parties to take into account the ICES Guidelines for the Management of Marine Sediment Extraction within their procedures for licensing the extraction of marine sediments**. This agreement should emphasise that:

   (i) extraction permits should be granted and extraction activities should be conducted, by taking into consideration the ecosystem approach to management of human activities;

   (ii) **Contracting Parties should, where and when appropriate, carry out strategic environmental assessments (SEA) of this activity**;

   (iii) that permits for marine sediment extraction in ecologically sensitive sites such as nature reserves, national parks, NATURA 2000 sites, Ramsar sites etc. should only be granted after:

   - careful consideration of a comprehensive and thorough EIA according to the ICES Guidelines, and
   - where the sites are designated under the Habitats directive, they have been subject to the procedures laid down in Article 6 of the EU Habitats Directive;

   (iv) **Contracting Parties should report back periodically to the appropriate OSPAR working group on their experiences with the implementation of the ICES Guidelines**.

   Denmark should invite ICES to take these points into account when reviewing their guidelines for the management of marine sediment extraction.

Environmental Effects of Dredging Operations and Dumping/Disposal of Dredged Material

4.2. BDC endorsed the arrangements made at SEABED 2002 (BDC 03/4/1) for further work on dredging and dumping activities, and in particular for the preparation of a further developed draft background document assessing the need for additional OSPAR measures aimed at controlling the environmental effects of *dredging activities* on marine species and habitats for consideration by SEABED 2003, under the leadership of Germany and the Netherlands.

4.3 BDC noted that the relocation of dredged material generated by *hydrodynamic and sidecast* dredging and the issues related to the impact of *dumping* of dredged material on species and habitats will be dealt with when revising the OSPAR Guidelines for the Management of Dredged Material.

Exploration for solid materials

4.4 HOB 2001 and BDC 2001 had agreed that, since the work related to exploration for solid minerals (see art 2.2.iii of the OSPAR Biodiversity Strategy) was likely to be very largely confined to exploration for sand and gravel, it was appropriate for SEABED to consider how to take forward this work. The Chairman of SEABED explained that the techniques used for the exploration for solid minerals are predominantly acoustic survey methods (such as side scan sonar and shallow seismic methods) and physical sampling methods (such as grabs, cores and vibrocores).

4.5 Following the outcome of HOB 2001 and SEABED 2002's recommendation, BDC agreed to include the preparation of a preliminary assessment on the exploration for solid minerals as a product in its Work Programme for 2003/2004 and endorsed the arrangements made by SEABED 2002 (BDC 03/4/1) for future work under the lead of the UK.

Annex 10 ICES Guidelines for the management of marine sediment extraction[3]

Introduction

In many countries sand and gravel[4] dredged from the seabed makes an important contribution to the national demand for aggregates, directly replacing materials extracted from land-based sources. This reduces the pressure to work land of agricultural importance or environmental and hydrological value, and where materials can be landed close to the point of use, there can be additional benefits of avoiding long distance over-land transport. Marine dredged sand and gravel is also increasingly used in flood and coastal defence, fill and land reclamation schemes. For beach replenishment, marine materials are usually preferred from an amenity point of view, and are generally considered to be the most appropriate economically, technically and environmentally.

However, these benefits need to be balanced against the potential negative impacts of aggregate dredging. Aggregate dredging activity, if not carefully controlled, can cause significant damage to the seabed and its associated biota, to commercial fisheries and to the adjacent coastlines, as well as creating conflict with other users of the sea. In addition, current knowledge of the resource indicates that while there are extensive supplies of some types of marine sand, there appear to be more limited resources of gravel suitable, for example, to meet current concrete specifications and for beach nourishment.

Against the background of utilising a finite resource, with the associated environmental impacts, it is recommended that regulators develop and work within a strategic framework which provides a system for examining and reconciling the conflicting claims on land and at sea. Decisions on individual applications can then be made within the context of the strategic framework.

General principles for the sustainable management of all mineral resources overall include:

- conserving minerals as far as possible, whilst ensuring that there are adequate supplies to meet the demands of society;
- encouraging their efficient use (and where appropriate re-use), minimising wastage and avoiding the use of higher quality materials where lower grade materials would suffice;
- ensuring that methods of extraction minimise the adverse effects on the environment, and preserve the overall quality of the environment once extraction has ceased;
- the encouragement of an ecosystem approach to the management of extraction activities and identification of areas suitable for extraction;
- protecting sensitive areas and important habitats (such as marine conservation areas) and industries (including fisheries) and the interests of other legitimate uses of the sea;
- preventing unnecessary sterilisation of mineral resources by other forms of development.

The implementation of these principles requires a knowledge of the resource, and an understanding of the potential impacts of its extraction and of the extent to which rehabilitation of the seabed is likely to take place. The production of an Environmental Statement, developed along the lines suggested below, should provide a basis for determining the potential effects and identifying possible mitigating measures. There will be cases where the environment is too sensitive to disturbance to justify the extraction of aggregate, and unless the environmental and coastal issues can be satisfactorily resolved, extraction should not normally be allowed.

It should also be recognised that improvements in technology may enable exploitation of marine sediments from areas of the seabed which are not currently commercially viable, while development of technical specifications for concrete, etc., may in the future enable lower quality materials to be used for a wider range of applications. In the shorter term, continuation of programmes of resource mapping may also identify additional sources of coarser aggregates.

Scope

It is recognised that sand and gravel extraction, if undertaken in an inappropriate way, may cause significant harm to the marine and coastal environment. There are a number of international and regional initiatives that should be taken into

1 These guidelines do not relate to navigational dredging (i.e., maintenance or capital dredging)
2 It is recognized that other materials are also extracted from the seabed, such as stone shell and maerl, and similar considerations should apply to them.

account when developing national frameworks and guidelines. These include the Convention on Biological Diversity (CBD), EU Directives (particularly those on birds, habitats, Environmental Impact Assessment (EIA), and Strategic Environmental Assessment (SEA)—once implemented) and other regional conventions/agreements, in particular the OSPAR and Helsinki Conventions, and initiatives pursued under them. This subject, for example, has recently been included in the Action Plan for Annex V to the 1992 OSPAR Convention on the Protection and Conservation of the Ecosystems and Biological Diversity of the Maritime Area as a human activity requiring assessment. It is also recognised that certain ecologically sensitive areas may not be designated under international, European, or national rules but nonetheless require particular consideration within the assessment procedures described in these Guidelines.

Administrative framework

It is recommended that countries have an appropriate framework for the management of sand and gravel extraction and that they define and implement their own administrative framework with due regard to these guidelines. There should be a designated regulatory authority to:

- issue authorisation having fully considered the potential environmental effects;
- be responsible for compliance monitoring;
- develop the framework for monitoring;
- enforce conditions.

Environmental impact assessment

The extraction of sand and gravel from the seabed can have significant physical and biological effects on the marine and coastal environment. The significance and extent of the environmental effects will depend upon a range of factors including the location of the extraction area, the nature of the surface and underlying sediment, coastal processes, the design, method, rate, amount and intensity of extraction, and the sensitivity of habitats and assorted biodiversity, fisheries and other uses in the locality. These factors are considered in more detail below. Particular consideration should be given to sites designated under international, European, national and local legislation, in order to avoid unacceptable disturbance or deterioration of these areas for the habitats, species, and other designated features.

To enable the organisation(s) responsible for authorising extraction to evaluate the nature and scale of the effects and to decide whether a proposal can proceed, it is necessary that an adequate assessment of the environmental effects be carried out. It is important, for example, to determine whether the application is likely to have an effect on the coastline, or have potential impact on fisheries and the marine environment.

The Baltic Marine Environment Protection Commission (Helsinki Commission) adopted HELCOM Recommendation 19/1 on 26 March 1998. This recommends to the Governments of Contracting Parties that an EIA should be undertaken in all cases before an extraction is authorised. For EU member states, the extraction of minerals from the seabed falls within Annex II of the "Directive on the Assessment of the Effects of Certain Public and Private Projects on the Environment" (85/337/EEC) As an Annex II activity, an EIA is required if the Member State takes the view that one is necessary. It is at the discretion of the individual Member States to define the criteria and/or threshold values that need to be met to require an EIA. The Directive was amended in March 1997 by Directive 97/11/EC. Member States are obliged to transpose the requirements of the Directive into national legislation by March 1999.

It is recommended that the approach adopted within the EU be followed. Member States should therefore set their own thresholds for deciding whether and when an EIA is required, but it is recommended that an EIA always be undertaken where extraction is proposed in areas designated under international, European, or national rules and in other ecologically sensitive areas. For NATURA 2000 sites, Article 6 of the Habitats Directive contains special requirements in this respect.

Where an EIA is considered appropriate, the level of detail required to identify the potential impacts on the environment should be carefully considered and identified on a site-specific basis. An EIA should normally be prepared for each extraction area, but in cases where multiple operations in the same area are proposed, a single impact assessment for the whole area may be more appropriate, which takes account of the potential for any cumulative impacts. In such cases, consideration should be given to the need for a strategic environmental assessment.

Consultation is central to the EIA process. The framework for the content of the EIA should be established by early consultation with the regulatory authority, statutory consultees, and other interested parties. Where there are potential

transboundary issues, it will be important to undertake consultation with the other countries likely to be affected, and the relevant Competent Authorities are encouraged to establish procedures for effective communication.

As a general guide, it is likely that the following topics considered below will need to be addressed.

Description of the physical setting

The proposed extraction area should be identified by geographical location, and described in terms of:

- the bathymetry and topography of the general area;
- the distance from the nearest coastlines;
- the geological history of the deposit;
- the source of the material;
- type of material;
- sediment particle size distribution;
- extent and volume of the deposit;
- the stability and/or natural mobility of the deposit;
- thickness of the deposit and evenness over the proposed extraction area;
- the nature of the underlying deposit, and any overburden;
- local hydrography including tidal and residual water movements;
- wind and wave characteristics;
- average number of storm days per year;
- estimate of bed-load sediment transport (quantity, grain size, direction);
- topography of the seabed, including occurrence of bedforms;
- existence of contaminated sediments and their chemical characteristics;
- natural (background) suspended sediment load under both tidal currents and wave action.

Description of the biological setting

The biological setting of the proposed extraction site and adjacent areas should be described in terms of:

- the flora and fauna within the area likely to be affected by aggregate dredging (e.g., pelagic and benthic community structure), taking into account temporal and spatial variability;
- information on the fishery and shellfishery resources including spawning areas, with particular regard to benthic spawning fish, nursery areas, over-wintering grounds for ovigerous crustaceans, and known routes of migration;
- trophic relationships (e.g., between the benthos and demersal fish populations by stomach content investigations);
- presence of any areas of special scientific or biological interest in or adjacent to the proposed extraction area, such as sites designated under local, national or international regulations (e.g., Ramsar sites, the UNEP "Man and the Biosphere" Reserves, World Heritage sites, Marine Protected Areas (MPAs) Marine Nature Reserves, Special Protection Areas (Birds Directive), or the Special Areas of Conservation (Habitats Directive)).

Description of the proposed aggregate dredging activity

The assessment should include, where appropriate, information on:

- the total volume to be extracted;
- proposed maximum annual extraction rates and dredging intensity;
- expected lifetime of the resource and proposed duration of aggregate dredging;
- aggregate dredging equipment to be used;
- spatial design and configuration of aggregate dredging (i.e., the maximum depth of deposit removal, the shape and area of resulting depression);

- substrate composition on cessation of aggregate dredging;
- proposals to phase (zone) operations;
- whether on-board screening (i.e., rejection of fine or coarse fractions) will be carried out;
- number of dredgers operating at a time;
- routes to be taken by aggregate dredgers to and from the proposed extraction area;
- time required for aggregate dredgers to complete loading;
- number of days per year on which aggregate dredging will occur;
- whether aggregate dredging will be restricted to particular times of the year or parts of the tidal cycle;
- direction of aggregate dredging (e.g., with or across tide).

It may be appropriate, when known also to include details of the following:

- energy consumption and gaseous emissions;
- ports for landing materials;
- servicing ports;
- on-shore processing and onward movement;
- project-related employment.

Information required for physical impact assessment

To assess the physical impacts, the following should be considered:

- implications of extraction for coastal and offshore processes, including possible effects on beach draw down, changes to sediment supply and transport pathways, changes to wave and tidal climate;
- changes to the seabed topography and sediment type;
- exposure of different substrates;
- changes to the behaviour of bedforms within the extraction and adjacent areas;
- potential risk of release of contaminants by aggregate dredging, and exposure of potentially toxic natural substances;
- transport and settlement of fine sediment disturbed by the aggregate dredging equipment on the seabed, and from hopper overflow or on-board processing and its impact on normal and maximum suspended load;
- the effects on water quality mainly through increases in the amount of fine material in suspension;
- implications for local water circulation resulting from removal or creation of topographic features on the seabed;
- the time scale for potential physical "recovery" of the seabed.

Information required for biological impact assessment

To assess the biological impact, the following information should be considered:

- changes to the benthic community structure, and to any ecologically sensitive species or habitats that may be particularly vulnerable to extraction operations;
- effects of aggregate dredging on pelagic biota;
- effects on the fishery and shellfishery resources including spawning areas, with particular regard to benthic spawning fish, nursery areas, over-wintering grounds for ovigerous crustaceans, and known routes of migration;
- effects on trophic relationships (e.g., between the benthos and demersal fish populations);
- effects on sites designated under local, national or international regulations (see above);
- predicted rate and mode of recolonisation, taking into account initial community structure, natural temporal changes, local hydrodynamics, and any predicted change of sediment type;
- effects on marine flora and fauna including seabirds and mammals;

- effects on the ecology of boulder fields/stone reefs.

Interference with other legitimate uses of the sea

The assessment should consider the following in relation to the proposed programme of extraction:

- commercial fisheries;
- shipping and navigation lanes;
- military exclusion zones;
- offshore oil and gas activities;
- engineering uses of the seabed (e.g., adjacent extraction activities, undersea cables and pipelines including associated safety and exclusion zones);
- areas designated for the disposal of dredged or other materials;
- location in relation to existing or proposed aggregate extraction areas;
- location of wrecks and war-graves in the area and general vicinity;
- wind farms;
- areas of heritage, nature conservation, archaeological and geological importance;
- recreational uses;
- general planning policies for the area (international, national, and local);
- any other legitimate use of the sea.

Evaluation of impacts

When evaluating the overall impact, it is necessary to identify and quantify the marine and coastal environmental consequences of the proposal. The EIA should evaluate the extent to which the proposed extraction operation is likely to affect other interests of acknowledged importance. Consideration should also be given to the assessment of the potential for cumulative impacts on the marine environment. In this context, cumulative impacts might occur as a result of aggregate dredging at a single site over time, from multiple sites in close proximity, or in combination with effects from other human activities (e.g., fishing and disposal of harbour dredgings).

It is recommended that a risk assessment be undertaken. This should include consideration of worst-case scenarios, and indicate uncertainties and assumptions used in their evaluation.

The environmental consequences should be summarised as an impact hypothesis. The assessment of some of the potential impacts requires predictive techniques, and it will be necessary to use appropriate mathematical models. Where such models are used, there should be sufficient explanation of the nature of the model, including its data requirements, its limitations and any assumptions made in the calculations, to enable assessment of its suitability for the particular modelling exercise.

Mitigation measures

The impact hypothesis should include consideration of the steps that might be taken to mitigate the effects of extraction activities. These may include:

- the selection of aggregate dredging equipment and timing of aggregate dredging operations to limit impact upon the biota (such as birds, benthic communities, any particularly sensitive species and habitats, and fish resources);
- modification of the depth and design of aggregate dredging operations to limit changes to hydrodynamics and sediment transport and to minimise the effects on fishing;
- spatial and temporal zoning of the area to be authorised for extraction or scheduling extraction to protect sensitive fisheries or to respect access to traditional fisheries;
- preventing on-board screening or minimising material passing through spillways when outside the dredging area to reduce the spread of the sediment plume;
- agreeing exclusion areas to provide refuges for important habitats or species, or other sensitive areas.

Evaluation of the potential impacts of the aggregate dredging proposal, taking into account any mitigating measures, should enable a decision to be taken on whether or not the application should proceed. In some cases it will be appropriate to monitor certain effects as the aggregate dredging proceeds. The EIA should form the basis for the monitoring plan.

Authorisation issue

When an aggregate extraction operation is approved, then an authorisation should be issued in advance (which may take the form of a permit, licence or other form of regulatory approval). In granting an authorisation, the immediate impact of aggregate extraction occurring within the boundaries of the extraction site, such as alterations to the local physical and biological environment, is accepted by the regulatory authority. Notwithstanding these consequences, the conditions under which an authorisation for aggregate extraction is issued should be such that environmental change beyond the boundaries of the extraction site are as far below the limits of allowable environmental change as practicable. The operation should be authorised subject to conditions which further ensure that environmental disturbance and detriment are minimised.

The authorisation is an important tool for managing aggregate extraction and will contain the terms and conditions under which aggregate extraction may take place, as well as provide a framework for assessing and ensuring compliance.

Authorisation conditions should be drafted in plain and unambiguous language and will be designed to ensure that:

a) the material is only extracted from within the selected extraction site;
b) any mitigation requirements are complied with; and
c) any monitoring requirements are fulfilled and the results reported to the regulatory authority.

Monitoring compliance with conditions attached to the authorisation

An essential requirement for the effective control of marine aggregate extraction is the monitoring of dredging activities to ensure conformity with the authorisation requirements. This has been achieved in several ways, e.g., an Electronic Monitoring System or Black Box. The information provided will allow the regulatory authority to monitor the activities of aggregate dredging vessels to ensure compliance with particular conditions in the authorisation.

The information collected and stored will depend on the requirements of the individual authorities and the regulatory regime under which the permission is granted, e.g., EIA, Habitats, Birds Directives of the EU.

The minimum requirements for the monitoring system should include:

- an automatic record of the date, time and position of all aggregate dredging activity;
- position to be recorded to within a minimum of 100 metres in latitude and longitude or other agreed coordinates using a satellite-based navigation system;
- there should be an appropriate level of security;
- the frequency of recording of position should be appropriate to the status of the vessel, i.e., less frequent records when the vessel is in harbour or in transit to the aggregate dredging area e.g., every 30 minutes, and more frequently when dredging, e.g., every 30 seconds;

The above are considered to be reasonable minimum requirements to enable the regulatory authority to monitor the operation of the authorisation in accordance with any conditions attached. Individual countries may require additional information for compliance monitoring at their own discretion.

The records can also be used by the aggregate dredging company to improve utilisation of the resources. The information is also an essential input into the design and development of appropriate environmental monitoring programmes and research into the physical and biological effects of aggregate dredging, including combined/cumulative impacts (see section above)

Environmental monitoring

Sand and gravel extraction inevitably disturbs the marine environment. The extent of the disturbance and its environmental significance will depend on a number of factors. In many cases, it will not be possible to predict, in full, the environmental effects at the outset, and a programme of monitoring may be needed to demonstrate the validity of the

EIA's predictions, the effectiveness of any conditions imposed on the authorisation, and therefore the absence of unacceptable impacts on the marine environment.

The level of monitoring should depend on the relative importance and sensitivity of the surrounding area. Monitoring requirements should be site-specific, and should be based, wherever possible, on the findings of the EIA. To be cost-effective, monitoring programmes should have clearly defined objectives derived from the impact hypothesis developed during the EIA process. The results should be reviewed at regular intervals against the stated objectives, and the monitoring exercise should then be continued, revised, or even terminated.

It is also important that the baseline and subsequent monitoring surveys take account of natural variability. This can be achieved by comparing the physical and biological status of the areas of interest with suitable reference sites located away from the influence of the aggregate dredging effects, and of other anthropogenic disturbance. Suitable locations should be identified as part of the EIA's impact hypothesis.

A monitoring programme may include assessment of a number of effects. When developing the programme, a number of questions should be addressed, including:

- What are the environmental concerns that the monitoring programme seeks to address?
- What measurements are necessary to identify the significance of a particular effect?
- What are the most appropriate locations at which to take samples or observations for assessment?
- How many measurements are required to produce a statistically sound programme?
- What is the appropriate frequency and duration of monitoring?

The regulatory authority is encouraged to take account of relevant research information in the design and modification of monitoring programmes.

The spatial extent of sampling should take account of the area designated for extraction and areas outside which may be affected. In some cases, it may be appropriate to monitor more distant locations where there is some question about a predicted nil effect. The frequency and duration of monitoring may depend upon the scale of the extraction activities and the anticipated period of consequential environmental changes, which may extend beyond the cessation of extraction activities.

Information gained from field monitoring (or related research studies) should be used to amend or revoke the authorisation, or refine the basis on which the aggregate extraction operation is assessed and managed. As information on the effects of marine aggregate dredging becomes more available and a better understanding of impacts is gained, it may be possible to revise the monitoring necessary. It is therefore in the interest of all concerned that monitoring data are made widely available. Reports should detail the measurements made, results obtained, their interpretation, and how these data relate to the monitoring objectives.

Reporting Framework

It is recommended that the national statistics on aggregate dredging activity continue to be collated annually by the ICES Working Group on the Effects of Extraction of Marine Sediments on the Marine Ecosystem (WGEXT).

Definitions

In these Guideline, "marine sediment extraction" is intended to refer to the extraction of marine sands and gravels (or "aggregates") from the seabed for use in the construction industry (where they often directly replace materials extracted from land-based sources), and for use in flood and coastal defence, beach replenishment, fill and land reclamation projects. It is recognised that other materials are also extracted from the seabed, such as stone, shell materials, and maerl, and similar considerations to those set out in the Guidelines should also apply to them. The Guidelines do not apply to navigational dredging (e.g., maintenance or capital dredging operations).

In these Guidelines, the term "authorisation" is used in preference to "permit" or "license" and is intended to replace both terms. The legal regime under which marine extraction operations are authorized and regulated differs from country to country, and the terms permit and license may have a specific connotation within national legal regimes, and also under rules of international law. The term "authorisation" is thus used to mean any use of permits, licenses, or other forms of regulatory approval.

The ecosystem approach will be elaborated by further work in both OSPAR and ICES. The following definition has been used elsewhere "the comprehensive integrated management of human activities based on best available scientific knowledge about the ecosystem and its dynamics, in order to identify and take action on influences which are critical to the health of marine ecosystems, thereby achieving sustainable use of ecosystem goods and services and maintenance of ecosystem integrity."

Revision of Guidelines

WGEXT will continue to review any new information, conclusions, and understandings from scientific research projects, any reports from countries on their experiences with the implementation of the Guidelines and, where appropriate, will revise the Guidelines accordingly.

Annex 11 Review of marine aggregate extraction in Denmark

Ministry of Environment
Danish Forest and Nature Agency
Denmark

26 March 2003
Poul E. Nielsen

REVIEW OF MARINE AGGREGATE EXTRACTION IN DENMARK

Legislation and administration.

The Forest and Nature Agency is, according to the Raw Materials Act, responsible for the administration of marine aggregate extraction in territorial waters and on the continental shelf.

A new Raw Materials Act has entered into force on 1 January 1997 (Consolidated Act No. 569 of June 30, 1997). From this date all dredging activities take place in permitted areas (Fig. A11.1). A 10-year transitional period is allowed for dredging in 117 temporary areas.

New dredging areas are subjected to a Government View procedure including public and private involvement. The applicant is requested to provide sufficient documentation about volume and quality of the resources in the area and to carry out an environmental impact assessment, Executive Order No. 1167 of 16 December 1996. Permits will be granted for a period of up to 10 years.

Besides permits for dredging in specific areas dredgers must have an authorisation to dredge in Danish Waters. In order to maintain a sustainable and environmentally justifiable dredging activity the total tonnage of the dredging fleet will be held on the present level.

Extraction activities, which can be assumed to have a significant impact on the environment, may be granted only on the basis of an assessment of the environmental consequences in accordance with the EC-directive 85/337. The procedure is laid down in Executive Order No. 126 of 4 March 1999. Dredging of more than 1×10^6 m^3 a year or 5×10^6 m^3 in total for a specific project or in a single area will always be subjected to this procedure.

The Danish Government has implemented The Århus Convention of 1998 on Access to Information, Public Participation in Environmental Decision-making and Access to Justice in Environmental Matters in the administration of marine extraction, Executive Order No. 835 of 4 September 2000. The Executive Order widens the public access to complain about decisions made by the authorities in accordance to the Raw Materials Act.

On January 2003 a minor change in the Raw Materials Act has been amended, that makes it possible to extract other materials than sand and gravel in international protected areas and on water depths less than 6 m.

The amendment will include extraction of other resources e.g., shells in the same administrative framework as extraction of sand and gravel. The administration of extraction in international protected areas and in water depths less than 6 m is very restrictive and will only be permitted if a valuable resource can be extracted without deterioration of the local environment.

The process of converting the temporary dredging area from 1997 in accordance with the new act started in 2002. The first permissions will be given in 2003. It is expected that up to 80 areas will be evaluated and receive a permission before 2007.

A number of permissions for dredging in international protected areas will expire in 2005. It is expected that only one or two permissions will be renewed.

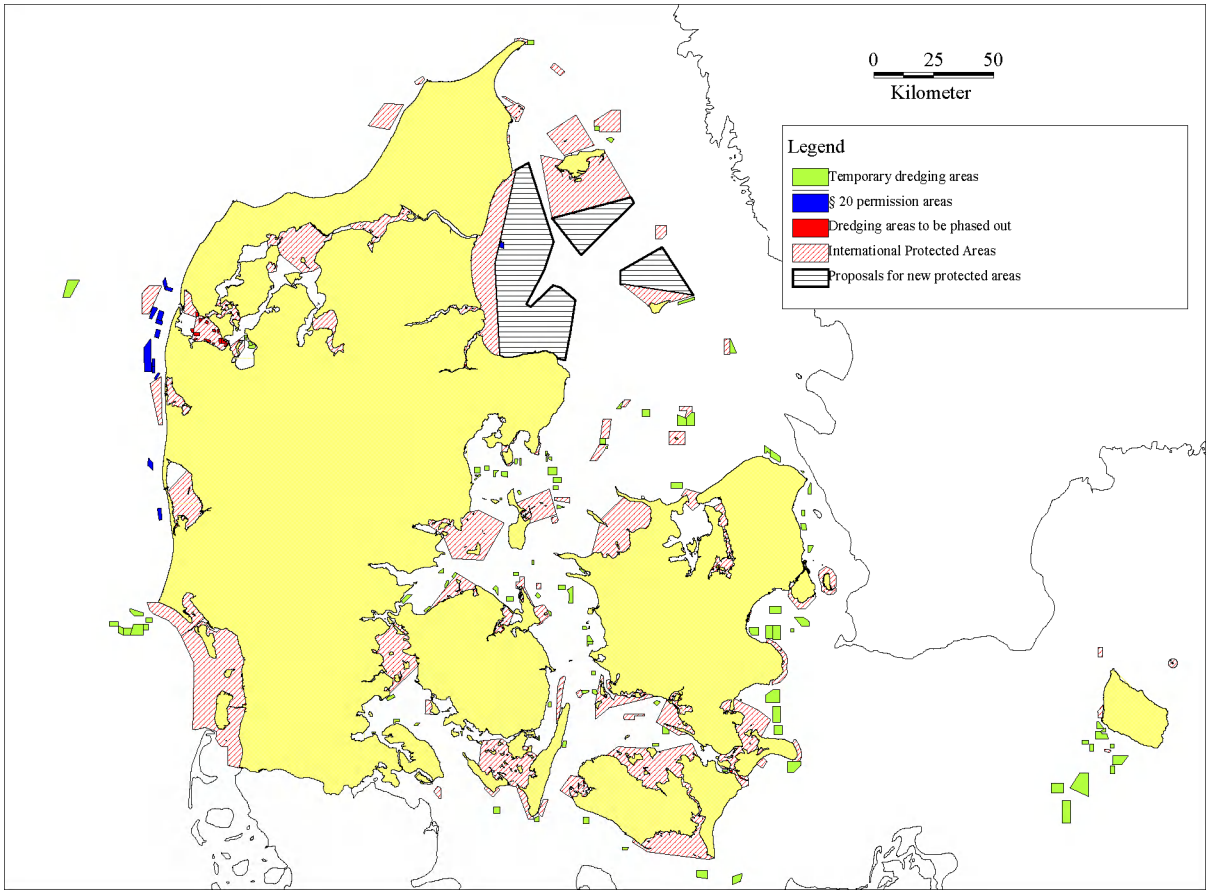


Figure A11.1. Dredging areas in Danish Waters, January 2003.

Production of sand and gravel in Denmark

The extraction of marine sand and gravel represents 10–20 % of the total production of materials for construction and reclamation.

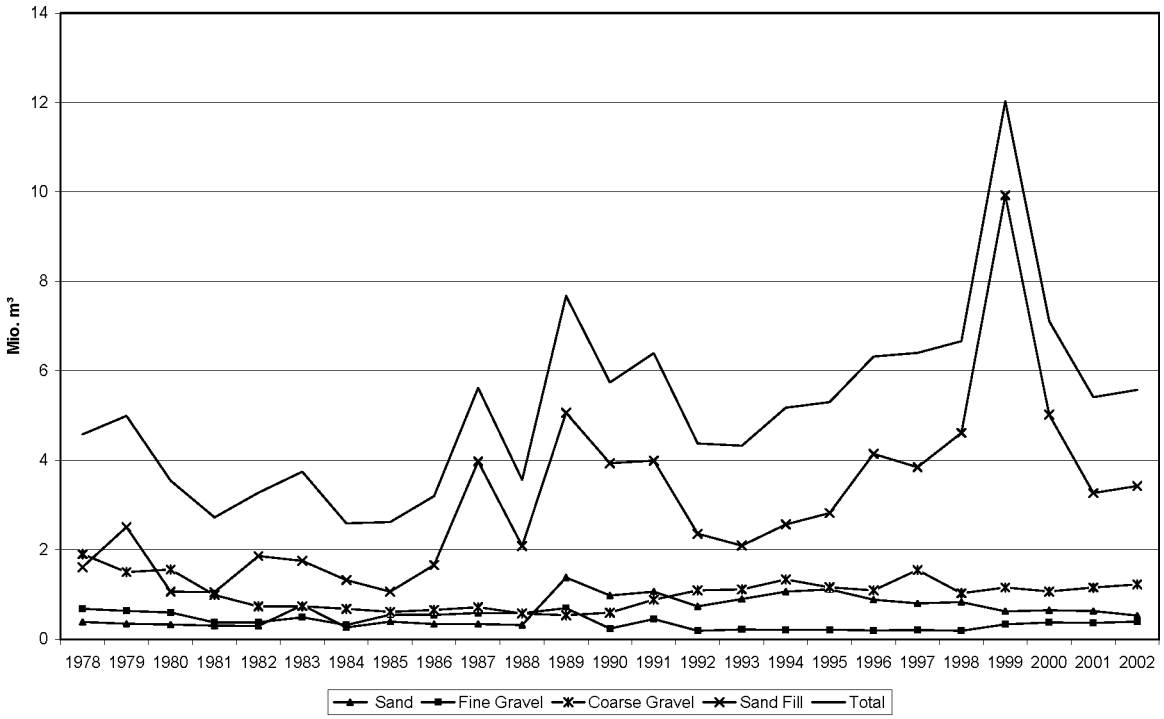


Figure A11. 2. Production of sand and gravel 1978–2002.

The production of construction aggregates has remained stable in the last 5 years. However, the production of coarse aggregates has been very slightly increasing since 2000.

The dredging of sand fill for land reclamation has varied markedly during the last 15 years caused by several large construction works in coastal areas (Figures A11.1 and A11.2).

Only a few reclamation projects have been carried out in 2002. App. 70,000 m^3 of sand fill has been exported to Germany in 2002.

The consumption of sand for beach nourishment at the West Coast of Jutland has shown a pronounced increase from 40,000 m^3 in 1980 to more than 3.5×10^6 m^3 in 1998 (Figure A11.2). The consumption in 2002 was 2.8×10^6 m^3.

Beneficial use of sand from maintenance and capital dredging represents an important contribution to the supply of materials for coastal protection and construction. Between 10% and 15 % of the total marine extraction of sand comes from these sources. In 2002 about 400,000 m^3 from maintenance and capital dredging was reused.

From 1989 to 1993 more than 9×10^6 m^3 of sand fill and till was dredged for the construction of the Great Belt Bridge and tunnel project.

During the construction of the fixed link between Denmark and Sweden 1.3×10^6 m^3 of sand was dredged with a spill of only 2.8 %. In the same period $7 \times 10^6 m^3$ dredged materials of glacial till and limestone has been reused for reclamation and as hydraulic fill in ramps for the bridge and tunnel.

A major enlargement of the harbour of Århus has required more than 8×10^6 m^3 of sand fill. The construction works started in the autumn of 1998 and was completed in 2000. A total of 8×10^6 m^3 has been dredged from 2 areas in Århus Bight. The spill from the dredging operations has been 3.7 %.

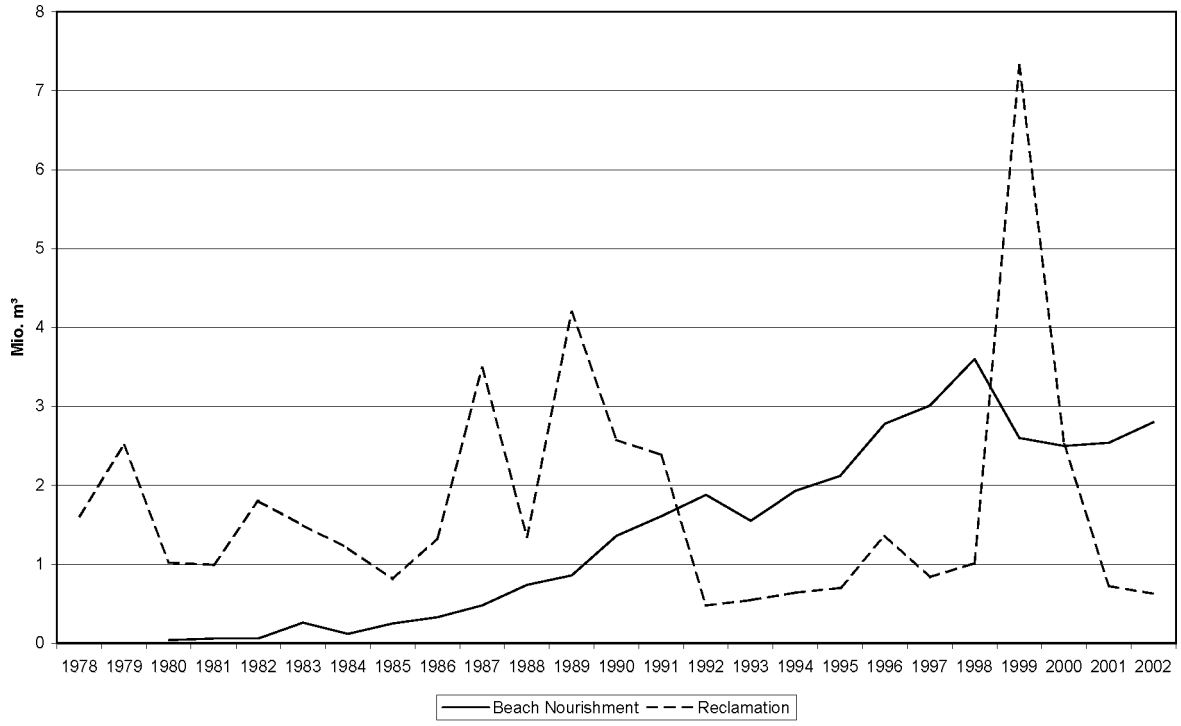


Figure A11.3. Production of sand for beach nourishment and reclamation.

No detailed forecast for the future extraction has been prepared. In general, it can be noted that the extraction varies in line with the development of the national economy.

Several major construction works have increased the demand for sand fill considerably since 1995. These projects have been finished during 2000 and the demand has decreased considerably.

A project for construction of a major depot for contaminated earth combined with a container terminal near Stigsnæs, southern Sjælland, is under preparation. The project will require 1–3 × 10^6 m^3 of sand fill from resource areas in the vicinity of the construction area and is expected to start in 2003–2004.

The construction of artificial islands and beaches for the Amager Beach Resort near Copenhagen is expected to start in the spring 2003. App. 1 × 10^6 m^3 sand will be needed for the beaches.

It is expected, that the total marine extraction of construction aggregates will remain on the current level in the next 5 years.

Overview of seabed sediment mapping programmes in Denmark

Mapping of the seabed is an integrated part of the systematic reconnaissance resource mapping programme in Danish Waters.

The mapping programme continues and is concentrated in The North Sea, Kattegat and The Baltic. Since 1991 mapping programmes have been carried out on Jutland Bank and Horns Reef in The North Sea and in Femer Belt, Adler Ground, Rønne Banke and Kriegers Flak in The Baltic. Maps in scale 1:100.000 of surface sediments, Quaternary geology and sand and gravel resources have been prepared. At present, between 80 % and 90 % of potential resource areas in the Inner Danish Waters have been mapped (Figures A11.4 and A11.5).

In 1999 and 2000 reconnaissance mapping has been carried out on greater water depths in the central part of Kattegat and in the North Sea. The preliminary results indicate the presence of interesting resources in the deeper parts of the Kattegat area and in the North Sea.

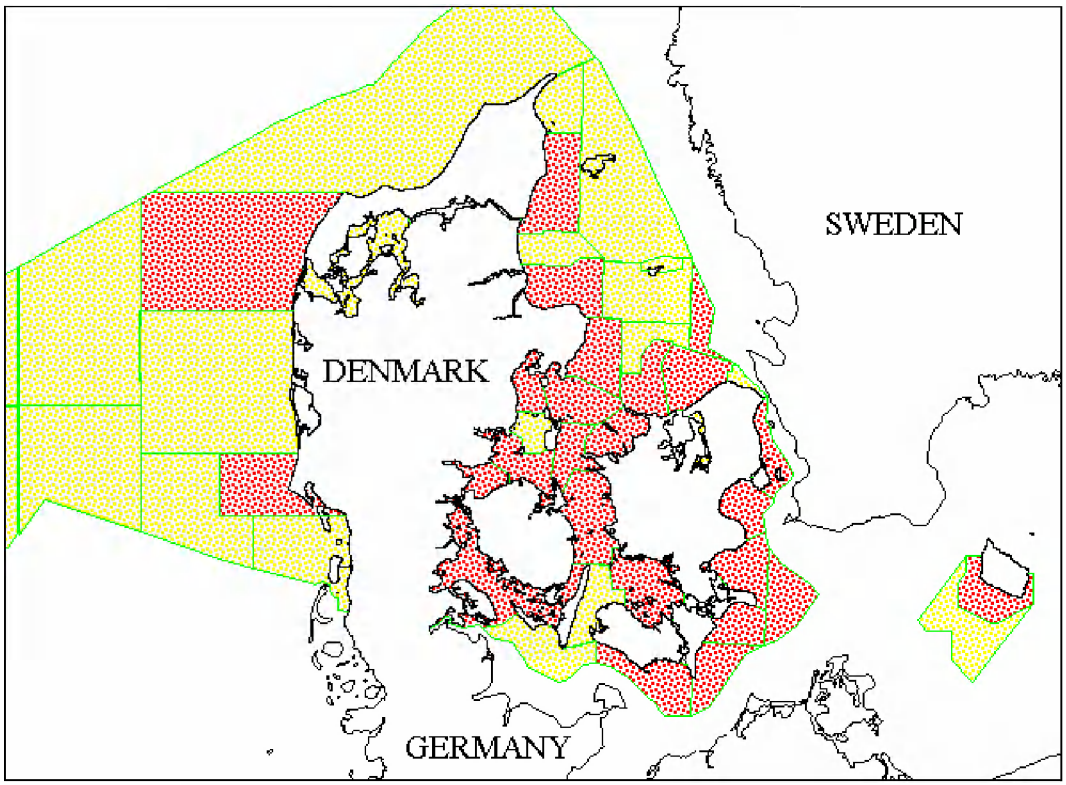


Figure A11.4. Mapping programme in Danish Waters. Dark shaded areas indicate where surface sediment maps have been prepared during the reconnaissance mapping programme and other technical and scientific programmes (unpublished and published data).

Detailed resource mapping programmes have been carried out in some regional extraction areas with materials of high quality and in areas licensed for beach nourishment and for bridge and tunnel projects.

In 1997 detailed seabed mapping was carried out for a possible fixed link between Germany and Denmark in the Femer Belt between Putgarten and Rødby.

Surface sediment map from Jutland Bank, North Sea will be published in 2002.

In 2000 detailed seabed mapping programmes were carried out in relation to applications for dredging permits, e.g., in the Bay of Århus, Kattegat, Great Belt and North Sea.

Along the Jutland west coast GEUS has completed a major mapping project commissioned by the Danish Coastal Authority (DCA). The study is based on seismic surveys, samplings and corings (Leth *et al.* 2001).

Results from the projects will be published in the near future, e.g., Anthony and Leth 2002.

On Horns Rev west of Jutland GEUS has completed a major sediment transport study also commissioned by the Danish Coastal Authority (DCA).

The existing map "Bottom Sediments around Denmark and the Western Sweden" has been updated with results from the recent mapping projects and has been published on a CD-ROM. The CD-ROM is available from GEUS.

Figure A11. 5. Seismic surveys in the North Sea and the Baltic, January 2003. The figure shows the coverage with seismic data collected during resource mapping and scientific projects. Recent data from the Skagerrak have not been processed.

Environmental impact assessment in relation to marine aggregate dredging in Denmark

In Denmark the Danish Forest and Nature Agency is responsible for administration of marine aggregate dredging. All new licensed areas are subjected to a Government View Procedure including public and private involvement.

Recent environmental impact studies

The Harbour of Århus

A major enlargement of the harbour of Århus has required dredging of 8 million. m³ of sand fill. Based on a prospecting carried out by the Harbour two areas in Århus Bight were selected for dredging. Due to the size of the project the Harbour was requested to carry out an environmental impact assessment in accordance with the EC Directive 85/337 as part of the application. Based on the assessments acceptable spill limits were set to 6 % and 7 % respectively. The spill should be measured for every tenth cargo. Besides that the Harbour has set up a monitoring programme to document that the environmental impact is within the limits stated in the permission.

Results from monitoring of the bottom fauna after dredging of app. 8×10^6 m^3 of sand show that the changes outside the dredging areas are very small and of the same magnitude as in the reference area. The results in both the impact area and the reference area document a significant and parallel increase in the number and abundance of species (Århus Havn, 2000).

The Harbour of Århus is preparing a new EIA for dredging of up to 7×10^6 m^3 of sand fill for a further enlargement of the harbour. The sand fill will be dredged from three areas in the Bay of Århus. Two of the areas have been used in the first part of the project. The EIA was published during 2001.

Stigsnæs

An Environmental Impact Assessment in accordance with the EC Directive 85/337 was carried out in 2000 for a proposal to construct a Container Terminal Hub near Stigsnæs, Western Sealand. The project includes dredging of 5.6 mio. m³ of sand fill in a very environmentally sensitive area. To fulfil the environmental requirements, direct pumping from the dredging site and use of sedimentation basins is expected to be necessary (The Baltic Gate Terminal A/S, 2000). It is expected that permission will be given during 2001.

North Sea

The Danish Coastal Authority (DCA) has applied for 4 new dredging areas in the North Sea to be used for dredging of sand for beach nourishment in the next 10 years. The application covers dredging of up to 30 × 10^6 m^3. The application is based on an Environmental Impact Assessment in accordance with the EC Directive 85/337 (Kystinspektoratet, 2000).

In 2001 DCA has published an Environmental Impact Assessment for onshore and nearshore nourishment in two areas along the Jutland west coast.

Marine Wind Mill Parks

Environmental Impact Assessments for dredging operations necessary for construction of marine wind mill parks have been carried out for parks on Horns Rev in the North Sea, south of the island of Læsø and near Rødsand in Femer Belt. The Parks on Horns Rev and near Rødsand are under construction.

Research projects

Physical impact from dredging in Danish Waters

The direct physical impact on the seabed from dredging of construction aggregates has been investigated by grid cell analyses of all dredging areas. All dredging operations have been analysed from the last five years within grid cells of 50 m by 50 m.

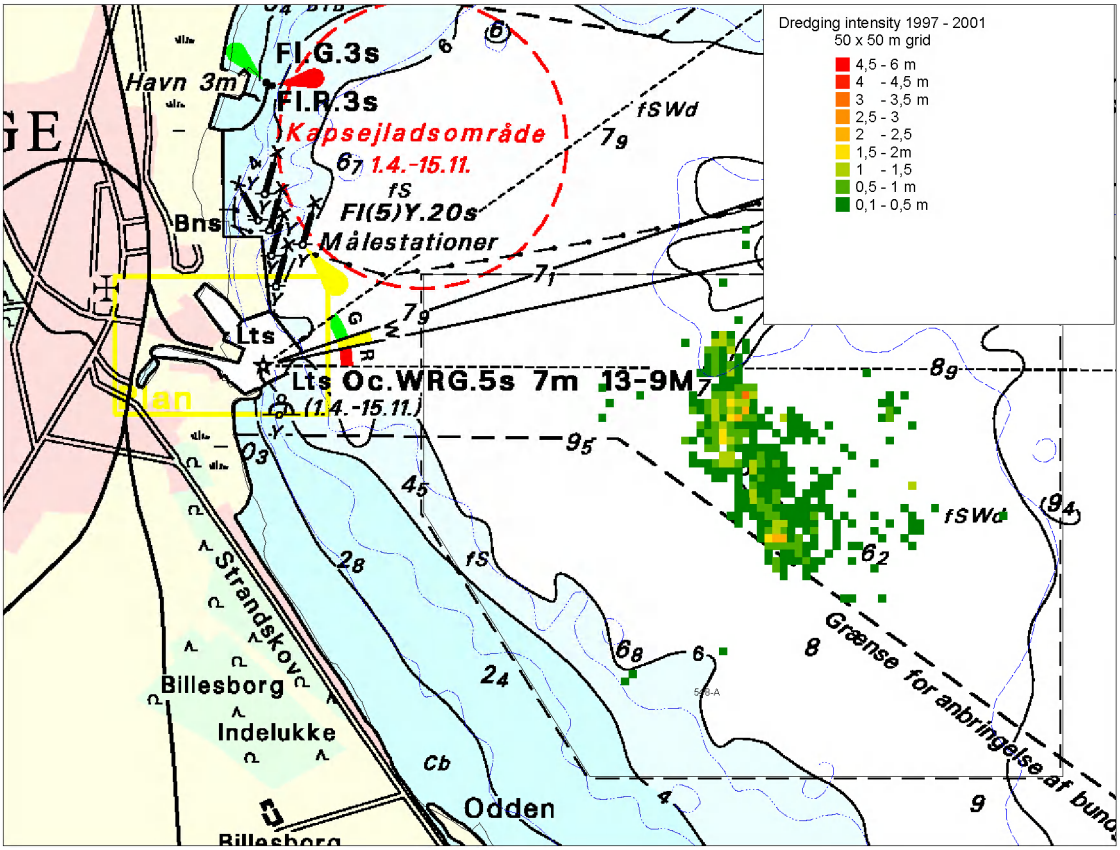


Figure A11.6. Dredging intensity in a dredging area in Køge Bugt.

In Køge Bugt, the size of the permitted dredging area is 13 km^2. Figure A11.6 shows how much has been removed in the period 1997–2001. The active dredge area is 0.8 km^2. In average the area was dredged five times a week during 2001 and the active dredge area was less than 0.5 km^2. The area is one of the most intensely dredged areas in Denmark.

Because stationary dredging is the most common dredging method in Denmark it is possible to gain direct information on the yearly and total volumes dredged within the individual 50 m by 50 m cells. The total area that has been impacted can be calculated by adding all cells where at least one dredging has taken place in the period. The total volume dredged in each cell is calculated. Based on the calculated volumes, an average dredging depth in the cell can be estimated.

The total area permitted for dredging of construction aggregates is about 800 km^2 corresponding to 0.5 % of the Danish EEZ. The analyses show that during the last 5 years only 3 % of the permitted areas has actually been dredged. On a yearly basis the impact is considerably smaller. In 2001 the active dredge area was less than 6 km^2.

The disturbance on birds and marine mammals from the presence of the dredger can be evaluated based on the number and duration of dredging operations. The analyses show that more than 75 % of the areas are dredged less than once a week. Only 4 areas are dredged more then once a day in average (Nielsen, 2003 in prep).

Impact from dredge spill on benthos

Studies on the effects of exploitation of marine resources on epifauna suspension-feeders have recently been published (Lisberg *et al.*, 2002).

Development of new methods for low cost screening of biological interests in potential dredging areas

Danish Forest and Nature Agency (DFNA) has commissioned Hedeselskabet to investigate different methods for screening of biological interests in proposed dredging areas.

The purpose of the study has been to evaluate different seismic and diver techniques in order to develop reliable low cost screening methods for identification of the most important benthic flora and fauna communities.

The study (DFNA, 2002) shows that paravane diving may be a cost efficient method to identify and demarcate benthic flora and fauna communities. The result of the screening will be the basis for decisions on the scope of investigations to be carried out in connection with an application for dredging permission. In a number of cases the screening will be a sufficient background for an impact assessment.

Emissions from Dredgers

A study (in Danish) of the energy consumption and emissions from dredging and transport of marine and land-based resources has been finished in 2000.

Statistics

Danish Forest and Nature Agency has completed a study on the use of statistical analyses in environmental monitoring of dredging spill. The study describes the theoretical background and gives a number of examples of the use of statistics for setting up administrative requirements and for evaluation of the necessary number of measurements for obtaining a specified uncertainty/variation of the considered parameter (Skov- og Naturstyrelsen, 1999).

Environmental effects of dredging in the North Sea

The Forest and Nature Agency and the Coastal Protection Agency have initiated a monitoring programme off the West Coast of Jutland to study the effects of dredging of sand for beach protection.

The study is based on a comparison with simultaneous changes in a reference area. The post-nourish temporal development is analysed using the BACI concept (B(efore) A(fter) C(omparison) I(impact)). A complete quantitative recovery including the number of species, the abundance and the biomass of the bottom has occurred in less than one year after the sand extraction. However, the predominance of a supposed opportunistic species of polychaete (*Spio filicornis*) in the borrow area may indicate a pioneer recolonization. The impact of sand extraction on the predator populations is limited due to a patchy exploitation pattern leaving plenty of foods in 70 % of the (undisturbed) bottom and a recovery of the benthic biomass in less than one year.

The environmental effects of three new sand dredging areas (permissions issued 2001) in the North Sea for beach protection will be monitored during the permission period using multibeam and benthos sampling.

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Annex 12 Grain-size variability and crest stability of a North Sea sand wave in space and time

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Abstract

Most data from literature suggest that due to higher current velocities and higher wave activity somewhat coarser grain sizes may be found on a sand wave crest compared to a sand wave trough. However, the magnitude of the differences and their variability is a largely uncharted field as are the effects of moving bedforms of different size and nature, and of possible seasonal variations.

Therefore an 1825 m × 600 m section around a main sand wave crest was surveyed biannually, once at the end of the stormy winter season (around April) and once at the end of the quiet summer season (around September) for 3 years. 3D bathymetry, short cores and side scan records were studied. The study area in Dutch offshore block S2 comprises bundles of sinuous and seemingly bifurcating sand waves. The help of RWS-North Sea Directorate is gratefully acknowledged.

Results of the present study include the finding that the shape of the same sand wave may change from symmetric to asymmetric or the other way round within short spatial and time scales. As to sand wave migration, differential bathymetric maps show a net northerly shift of sandy material around sand waves but to a variable extent. Migration of the sand wave itself shows mixed results ranging from zero displacement in the WNW end to a 9 m displacement to NNE at the ESE end, probably the effect of the large and low underlying Buiten Banken longitudinal ridge that may give rise to round-going sand movements *sensu* Houbolt (1968). Overall, also the crestal displacement tends to increase from WNW (crestal oscillation only) to ESE (net displacement), while results of individual surveys may not conform to this trend.

The sand wave height drops from WNW, from 7.5 m to 4.5 m but with bumps and hollows in between. Height measurements over 5 surveys combined result in apparent nodal points (<0.4 m) and maximum amplitudes (>1 m). Height differences may be explained by migrating megaripple-like bedforms but also by local lateral accretion of the crestal area. Crestal height measurements showed that the crest has become slightly shallower after 2 years. Sand wave height here is not always lower at the end of the stormy winter season compared to the quiet summer season as reported in literature.

Long bed waves *sensu* Knaapen *et al.* (2001) are present as low waves with a different nature, spacing, orientation and behaviour compared to conventional sand waves. They show a more steady displacement of material to ENE. The prevailing westerly storms could be an important agent in their formation and development.

Megaripples are almost omnipresent. They make a distinct angle with the sinuous sand wave crests and appear to migrate towards the crest. Megaripples towards the crest are progressively higher and farther apart, while those in the troughs are lower and occur in denser patterns. Crestal megaripples are somewhat higher at the end of summer. An apparent eastward displacement of (near) crestal megaripple sections, especially on the southern sand wave flanks was observed.

The top layer, consisting of loosely packed, highly uniform material, equals in our opinion the height of the megaripples that migrate over the seabed. The thickness of this active layer is higher on the crest than in sand wave trough areas and is on the crest also higher at the end of the summer season than at the end of the winter season. Active layer material interspersed with shell debris laminae and lags, was found mainly on the crest and the flanks and was considered to be the result of high energy events and/or buried or stranded basal parts of earlier megaripples. It was also found as lateral accretion fill of higher parts of the sand wave crest.

These findings underline the essential role that megaripples are playing in sedimentary processes and so in grain size and bedform evolution around sand waves.

Smaller ripples, 1–1.5 m apart, probably related to the tidal currents as they are forced over the sand wave, have been observed on and parallel to the sand wave crest.

As to the relation between sand waves and grain size, the shallower parts of the sand wave have on average coarser grain sizes. Samples from the crestal area have on average a 68 mu coarser D50 than samples from sand wave trough areas. Seasonal effects in here do not seem to be persistent. Grain size is persistently coarser, also at depth, where (sand) wave crests are near to each other implying that the entire sand wave et al. pattern has migrated as a whole.

Grain size variability at the seabed and at 0.8–0.85 metre on the sand wave crest and flanks with time may be considerable (with averages for D50 variability of 87 and 107 for all crestal positions and 77 and 119 mu for all flank positions) and larger than in and around sand wave trough areas (with averages of 58 and 77 mu respectively). For exposed parts of the seabed like bedform crests a single grain-size analysis looks to be inadequate to characterise the grain size of the site.

Overall, sorting on the sand wave crest seems better than in trough and sand wave flank positions, seasonal effects do not seem to be apparent.

The help of Rijkswaterstaat, North Sea Directorate staff, (including messrs. P. Pronk, T. Krijthe, S. Bicknese and R. Lambij amongst others) and Rudo Koster (UU/FG) as regards surveying and data processing is gratefully acknowledged. A formal publication is under preparation.

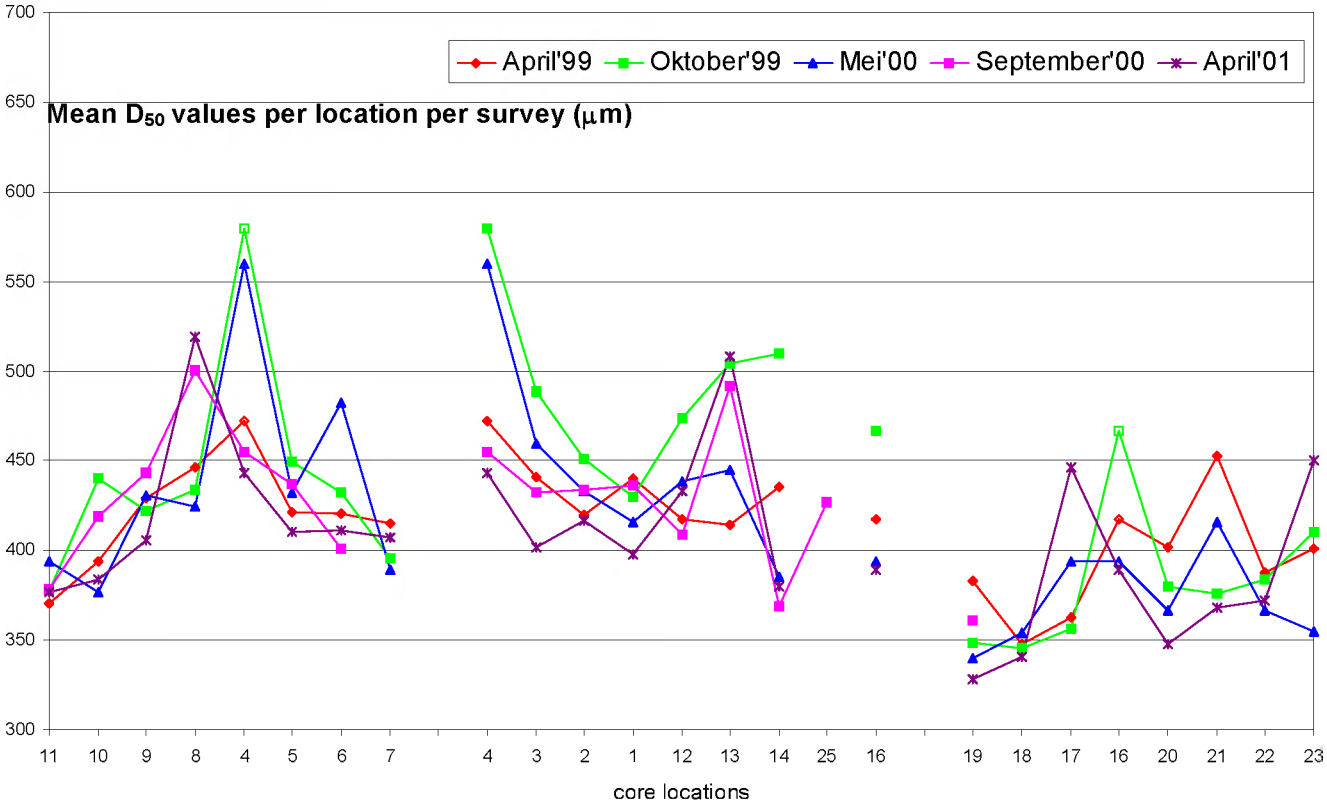

Figure A12.1. Mean D50 values from each coring location per survey. Data from 5 surveys.

Annex 13 Impact of marine aggregate dredging and overboard screening on benthic biological resources in the central North Sea

Prepared for the British Marine Aggregate Producers Association by Marine Ecological Surveys Ltd

During July and August 2000, a total of 194 samples were collected from production licence area 408 (Coal Pit), located in the central North Sea some 100 km east of the Humber Estuary.

The objective of this study was to investigate the impacts of trailer dredging within an existing marine aggregate production licence area, and to assess the impacts arising from the discharge of sediments rejected overboard during the screening process. The licence area is isolated from other marine aggregate activity, and the operator, Hanson Aggregates Marine Ltd, was able to provide a comprehensive dredge history for the site as dredging only commenced in 1996.

Sample stations were selected to allow a detailed examination of the species variety (**S**), population density (**N**), biomass (**B**) and a variety of indices of population structure within both actively and previously dredged areas of the licence area. In addition, stations were located along the predicted dispersion axis of sediment released during the screening process.

An associated study of the morphology of the seabed, based on high resolution side-scan sonar data and seabed sediment samples, suggests that net seabed sediment transport is to the southeast. Results further suggest that the dredging process and associated overboard screening of sand may be associated with the deposition of well-sorted fine sands, and their subsequent transport for at least 2000 m to the southeast of the areas actually being dredged.

The biological community comprises a typical species variety and abundance of benthic macrofauna. In all, a total of as many as 246 taxa were recorded, comprising a mean of 38.9 species, 475 individuals and a biomass of as much as 2.0 g ash free dry weight expressed per 0.2 m^2 of seabed. The community as a whole is dominated by large numbers of small Polychaete worms, and by Crustacea, although many other groups contribute to the assemblage. The community comprises typically small mobile "opportunistic" species that have a high rate of recolonisation and growth, which enhances their ability to recolonise deposits rapidly after episodic disturbance under natural conditions.

Multi-variate analysis of the benthic community composition, based on the species variety and population density of the macrobenthos, shows little evidence of an impact of dredging within the actively dredged area or an impact, from increased sedimentation or sediment transport resulting from the screening process, on biological community composition based on species variety or population density.

There is some evidence of a change in the relative dominance of some components of the macrofauna community both within the boundaries of actively dredged sites, and in seabed sediments likely to have been affected by transport of sediments outside the boundaries of the actively dredged site. One species (*Ophelia borealis*) is more common within the sediments of dredged areas than in the deposits elsewhere in the survey area. Other impacts include an absence of the polychaete *Nephtys caeca* from the actively dredged site and the presence of juveniles of this genus in deposits where dredging had ceased in 1999. This implies that a process of recolonisation and restoration of community composition had occurred in the dredged deposits within the 12-month period since dredging ceased.

Analysis suggests that at the levels of aggregate production recorded for Area 408 up to the time of the survey, the rates of recolonisation by larvae and juveniles from the surrounding deposits were sufficiently high to allow restoration of the species variety and numbers of individuals even within actively dredged areas.

In contrast to the relatively minor impact of dredging and associated return of screened material on species variety and population density of benthic invertebrates, dredging has had a major impact on both biomass and the body size of fauna. In actively dredged areas, this has resulted in biomass being suppressed by as much as 82%, while in adjacent non-dredged areas potentially affected by re-mobilised sediment introduced by the screening process this falls to 34.4%.

The zone of impact on benthic biomass extends for up to 500 m to the northwest of the actively dredged area, and for as much as 2–4000 m to the southeast. This corresponds well with the net southeast dispersion of sediment from the licence area established from tide and bedform evidence in the survey area.

Beyond the zone of suppression of biomass to the northwest of the actively dredged site, biomass values are over 10-fold that reached close to abandoned sites. This enhancement of biomass remains at distances of up to 2000 m to the northwest of the actively dredged site and is consistent with enrichment by organic matter released either from the settlement of material from the screening process or by transport of organic matter in a benthic boundary layer plume.

The results show that restoration of the biomass within the boundaries of this particular dredged area is accomplished within 12 months of cessation of dredging and that thereafter the benthic communities are indistinguishable from those in the surrounding deposits. This appears to coincide with the approximate time taken for trailer tracks to be partially infilled by the natural sediment transport processes in the study area.

A full version of both the biological survey report and the associated seabed sediment report is available to be downloaded from WWW.BMAPA.ORG.

Annex 14 Trends in the spatial distribution of macrobenthos along the Belgian coast

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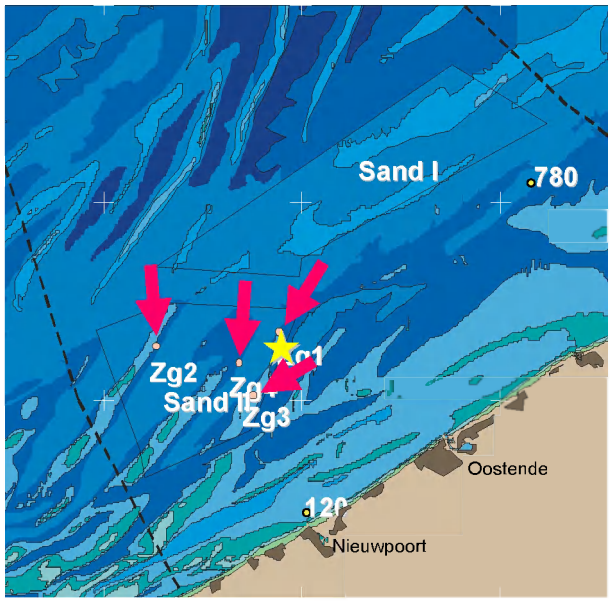
Twice a year, samples are taken on board the A962 "Belgica".
Macrobenthos, epibenthos and demersal fish are routinely sampled. Due to its limited mobility, macrobenthos is an ideal indicator for monitoring temporal trends. From the early 1980s onwards, macrobenthos has been sampled on the sand extraction zone II. Since June 1996 every sand hopper has to have a black-box by law, which registers every ship's movements and operations (Royal decree van 03/03/1996). Because we now knew the exact location of extraction, it was opportune to add 4 new stations to the program, which reflect those exact positions. The original stations didn't show any temporal trends. Therefore this presentation deals with the 4 new stations only, from 1996 to 2001, including 2 reference points namely Westdiep (station 120) and station 780, to the east of the Goote Bank.
All samples were taken with a modified Van Veen grab, equipped with an extra 50 kg weight and a sampling surface of 0.1 m².
A cluster analysis was performed on all sampling points.



Distance: Relatief Sørensen (Kulcyn-
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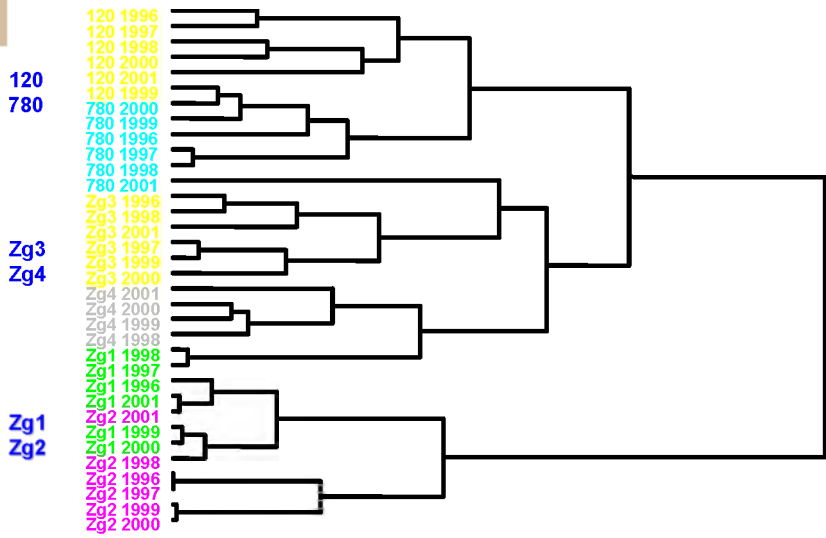
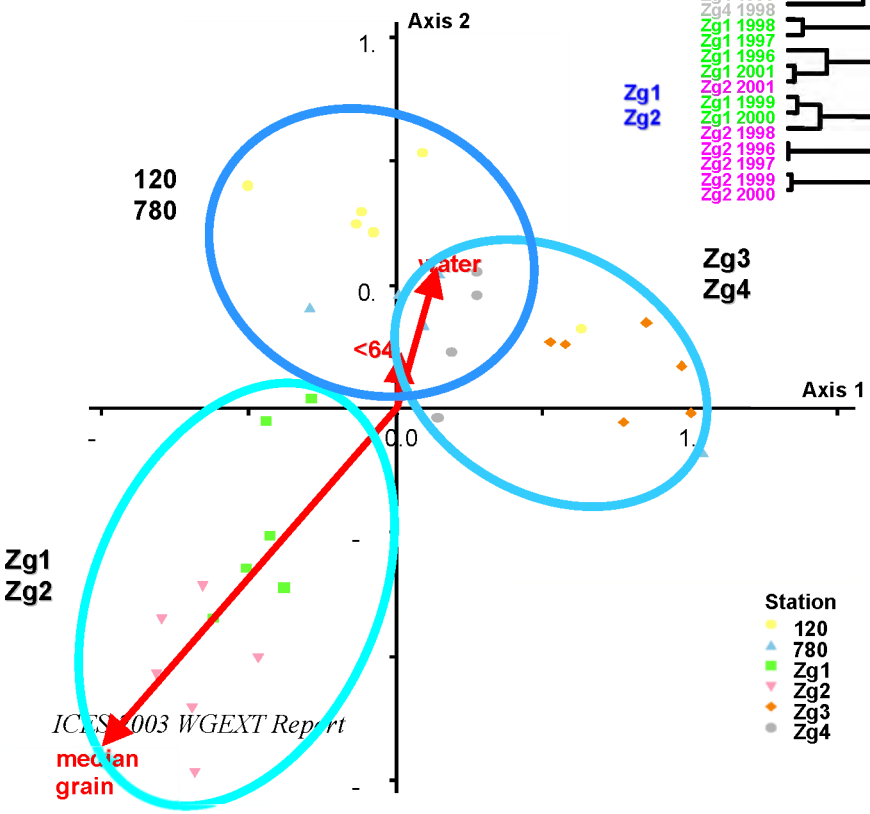
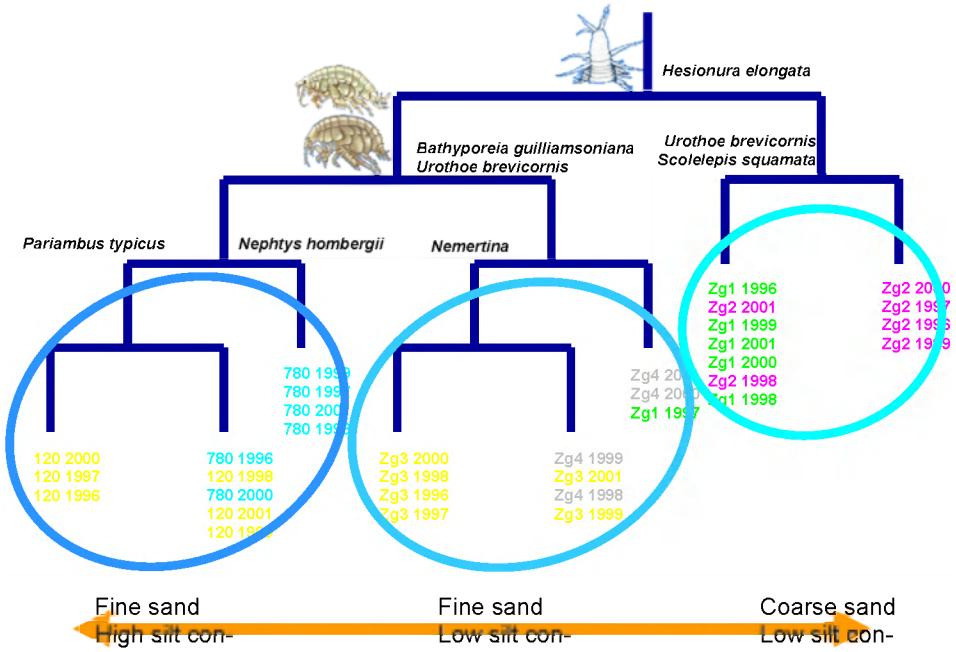


This indicated that differences between the stations are larger than those between the years. We can distinguish three distinct groups: the reference points (yellow and blue), the stations Zg3 and Zg4 (red and grey) and the stations Zg1 and Zg2 (green and purple).
Next, a non-metric multidimensional scaling was applied as an ordination technique.
Once again we find the three same groups.



This technique takes environmental parameters into account. Here, the parameters consist of median grain size, the amount of interstitial water and the granulometric fraction <64µm.
The influence of the different parameters is visualised by vectors. One notices that the median grain size is the largest discriminating factor: the stations Zg1 and Zg2 clearly separate from the other four points. Analysis showed them to have a coarser sediment.

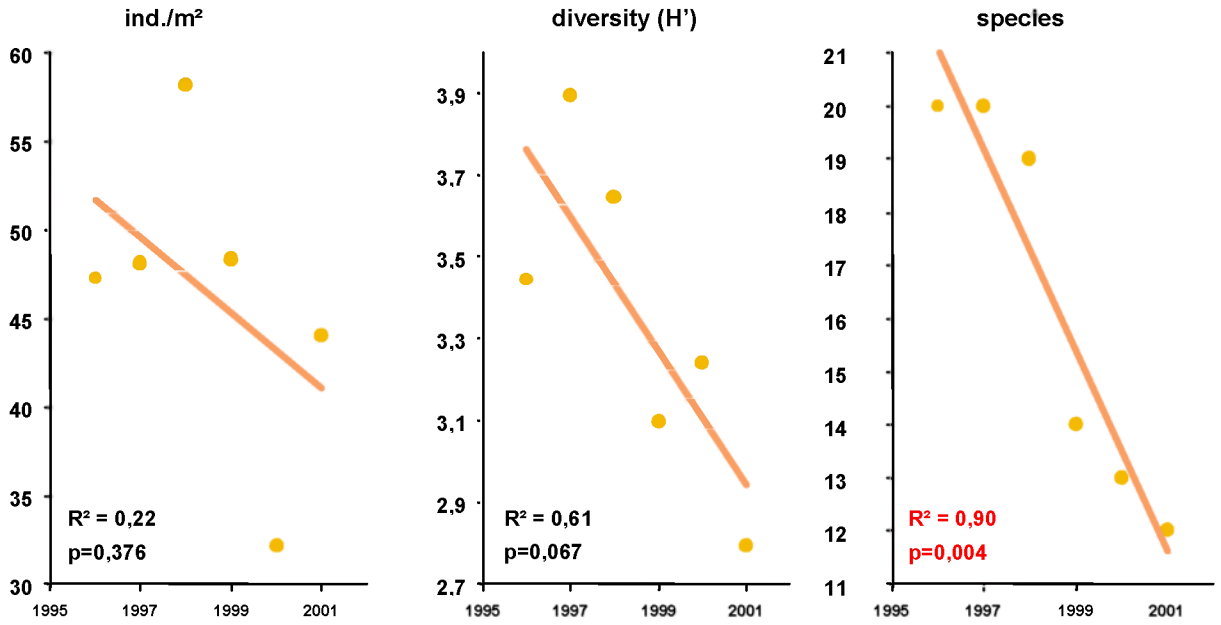
The other four stations, in their turn, break apart again in two groups in response of the <64 µm fraction and closely correlated, the amount of interstitial water: on the one hand, we get a group with Zg3 and Zg4, the two remaining sand stations; on the other hand, we have the Westdiep and station 780.
Twinspan, a two way indicator species analysis, is a splicing cluster analysis. The data set is divided in consecutive smaller units according to the indicator species.
The first division is characterised by *Hesionura elongata*. This is a small interstitial polychaete living in coarse sands.
The next division is set apart by the amphipods *Bathyporeia guilliamsoniana* and *Urothoe brevicornis*. Stations with a higher silt content (3 % to 10 %) are separated from the more sandy locations (1 % to 3 % silt content).
Again we find our 3 groups based on a gradient from coarse sand with low silt content to fine sand with a high silt con-



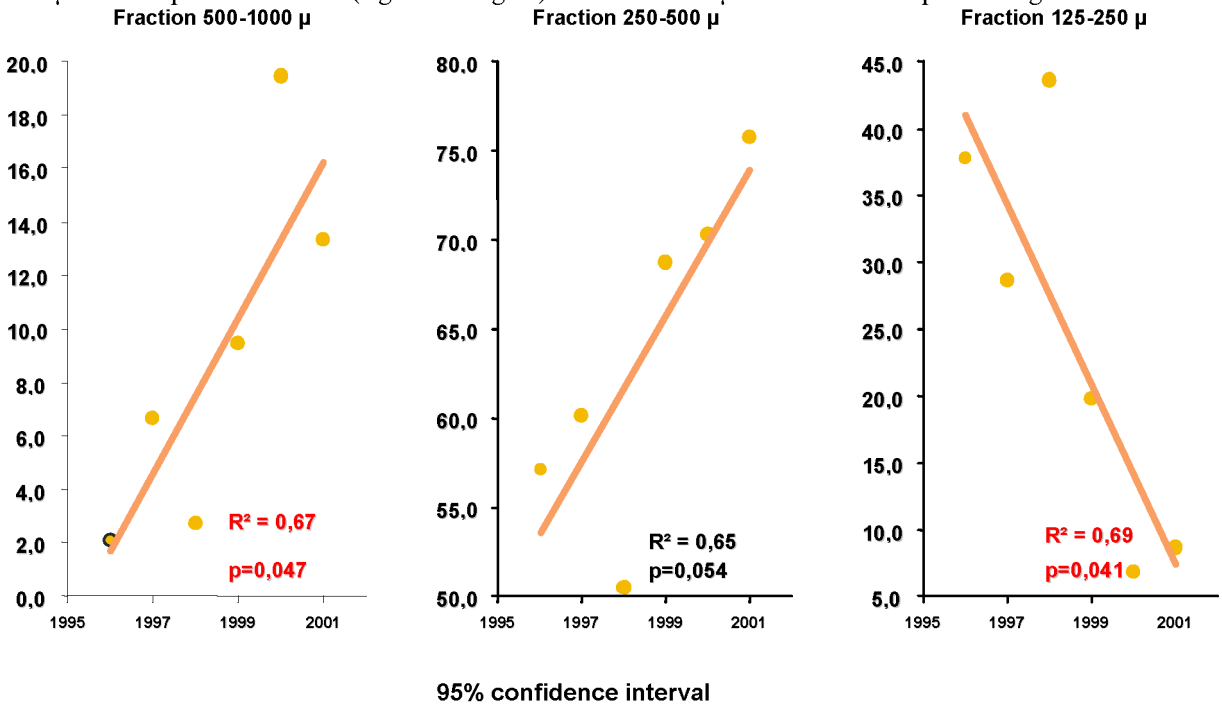
tent. This gradient validates the habitat model developed at the University of Ghent, Section Marine Biology.
The number of individuals/m² is at its lowest on Zg2 (where the aggregate extraction is negligible) followed by Zg1.
The reference stations and the points Zg3 and Zg4, located on the Kwintebank, have a higher number of individuals/m² (up to 3500 ind/m²).
The coarsest sands have the lowest number of species: 2 to 13 for Zg2 and 12 to 20 for Zg1. On other locations more then 40 different species are found.
The diversity on coarse sediments is generally lower than on fine sands with silt.

The final part of the study focuses on station Zg1, which is situated closest to the northeastern part of the Kwintebank. Looking at the highest taxonomical levels, we see no temporal trends in the constitution of the macrobenthos. Polychaetes (bristle worms) and Crustaceans (mainly amphipods), are the most abundant groups. Echinoderms (heart urchins and brittle stars) (click) and the bivalve *Tellimya ferruginosa*, living in the holes of the heart urchin (*Echinocardium condatum*), are found on a regular basis. Just once, Nemertinea (ribbon worms) and the lophophorate *Phoronis pallida* were found.

Between 1996 and 2001, a significant decrease in number of species was found on Zg1, located closest to the major extraction site (northern edge of the Kwintebank). The decrease in number of individuals/m² and the Shannon-Wiener diversity do not prove to be significant at a 95% confidence interval.



A plausible explanation can be found when looking at the granulometric analysis.
We observe a significant increase in the fraction 500–1000 µm and a near-to-significant increase in the fraction 250–500 µm. An important decrease (significant again) in the 125–250 µm fraction is complementing these trends.



The conclusion may well be that there is a coarsening of the sediment, probably due to the intense, nearby, aggregate extraction. And, as shown by the TWINSPAN analysis previously, a coarser sediment carries a lower number of species. The non-significance of the diversity trend may be due to the absence of opportunistic, highly dominant organisms.
As mentioned before there is a richer benthic fauna on fine and more silty sediments. Station Zg1 apparently evolves into a sediment similar to the one found on station Zg2: a larger median grain size with a smaller amount of more specialised species.
No significant trends were observed during the period 1996–2001 at the other stations.
Concluding we can state that median grain size, interstitial water and silt content are respectively the most important gradients to type the stations.
The observed species form associations in accordance to the results of other studies (Habitat-model). Highest densities and diversities are found on fine sands with silt, lowest on pure coarse sands.

Only station Zg1 showed significant trends due to a coarsening of the sand resulting in a decrease in the number of species. These effects are presumably driven by the intense, nearby aggregate extraction.

Annex 15 Biological impact of overflowing sands around a marine aggregates extraction site: Dieppe (French Eastern English Channel)

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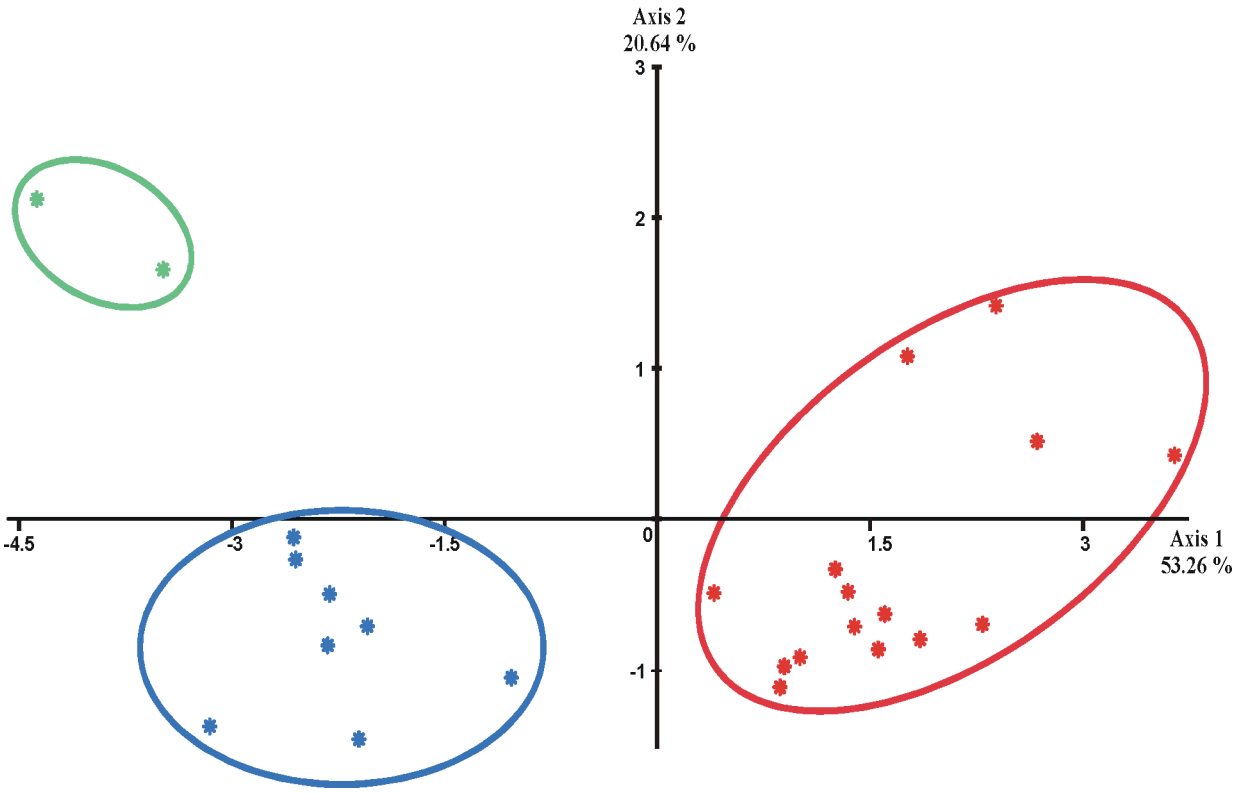
From 1995 to 2001, samples were collected around the extraction area of Dieppe to assess the potential impact associated with deposition of sediments from dredging activities. Sediment and associated benthic macrofauna were sampled at 25 stations mostly located in the direction of residual tidal currents (ENE) and in two western reference stations, outside any likely impact of dredging activity.

A principal component analysis characterised these stations according to their biotic (density and biomass percentage and number of species) and abiotic (composition of sediment in percentage) characteristics.

The first two axis of this analysis, gathering 74 % of inertia, discriminate three groups of stations. The correlation circle shows on the first axis (53 %) a biological gradient from lowest values on the right to maximal values on the left (Figure A15.1), while sediment is evolving from highest percentages of fine sands to maximal ones of coarse sands and gravels. The second axis of the analysis (20 %) discriminates two stations characterised by a higher percentage of fine particles.



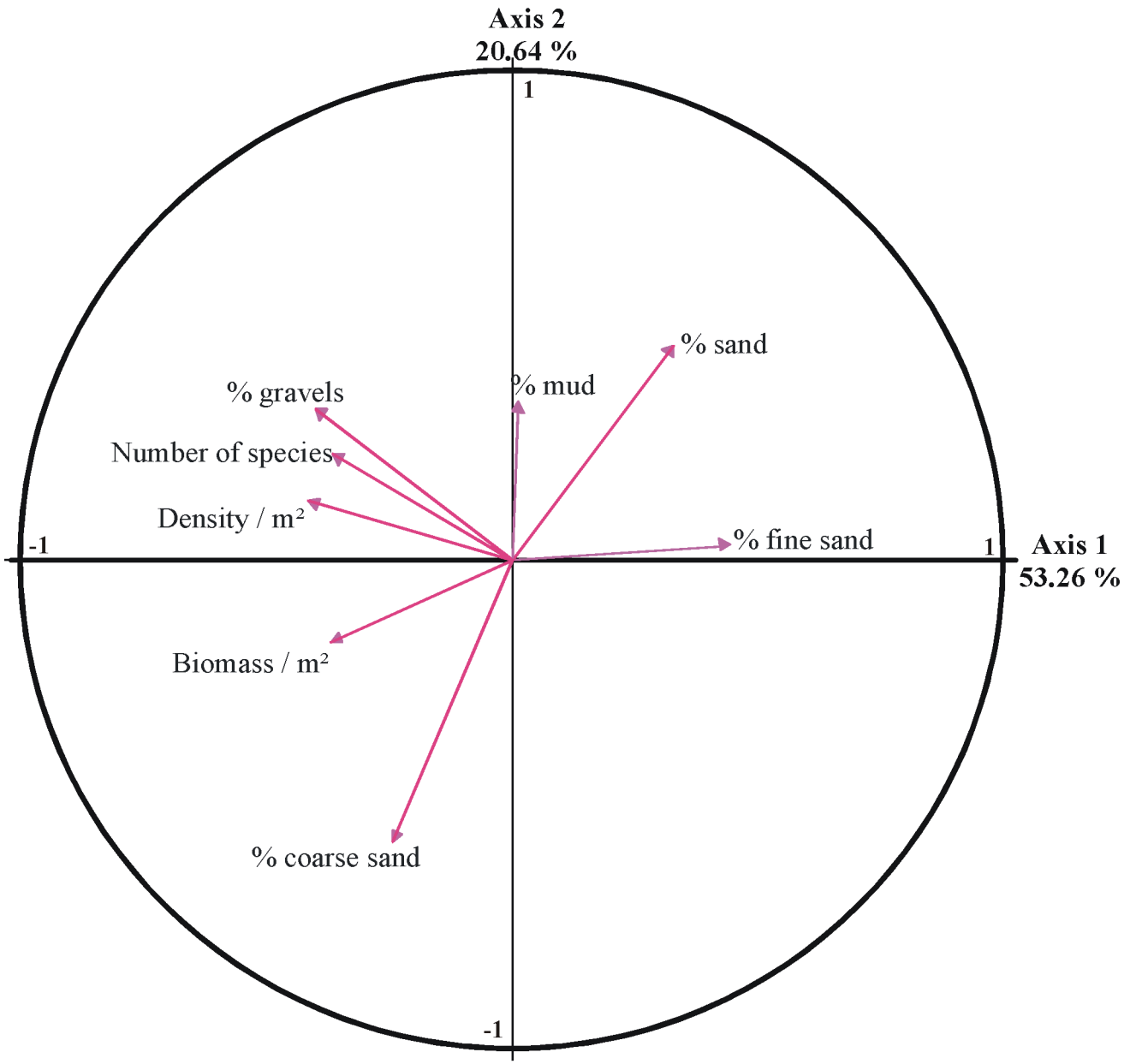


Figure A15.1. First two axis of the Principal Component Analysis showing the 3 groups of stations; correlation circle indicating the relationship between sedimentological and main population parameters.

Two main habitats were identified (Table A15.1):

- coarse sediments are dominated either by sands (in the western reference stations) or by gravels (in the northern and western surrounding stations); the latter are biologically richer than the former for the 3 main population parameters (+ 14 % for specific richness, + 48 % for abundance, + 39 % for biomass) but their benthic communities are similar and numerically dominated by the three same species (the worm *Harmothoe ljungmani* and the echinoderms *Echinocyamus pusillus* and *Amphipholis squamata*);
- fine sands are dominant in the deposition area; they are accompanied by coarse ones in stations located more than 500 m easterly, and by very fine sands in proximal stations located either east or south of the dredging area; the latter are biologically poorer than the former for specific richness (−32 %), for abundance (−53 %) and for biomass (−75 %), but their benthic communities are more or less similar and numerically dominated by the two same species (the catworm *Nephtys cirrosa* and the bivalve *Tellina pygmaea*)

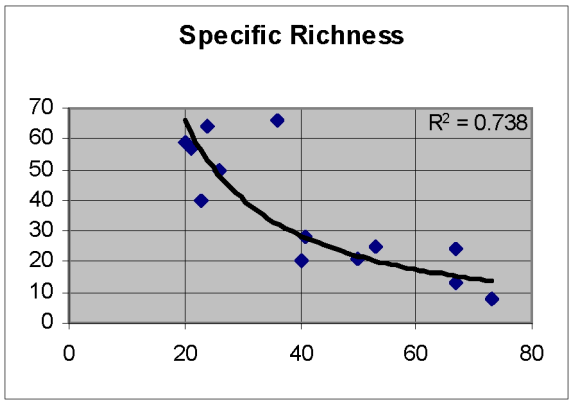
Table A15.1. Synthesis of sedimentological and biological characteristics of area affected by oversanding around the extraction site of Dieppe.

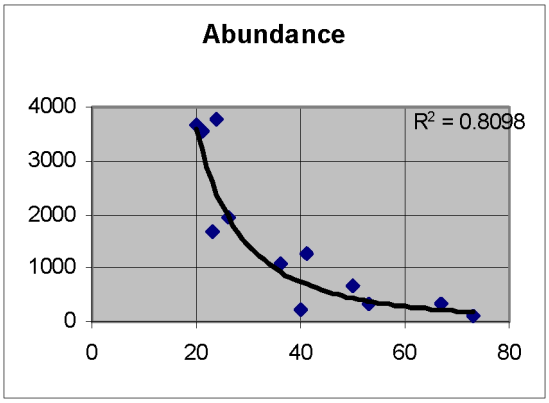
	Reference area	**Moderate deposition area**	**Intensive deposition area**	**Maximal deposition area**
Sediment	29	53	4	9
% Shingles-gravels	47	24	34	11
% Fine Sands	23	21	51	64
% Very fine sands	1.3	2.7	10	14
% Silts	0.5	0.3	0.2	0.3
Community				
Specific richness	51	58	28	19
Abundance m^2	2440	3600	572	268
Biomass m^2	12.2	17	5.5	1.4
Relative Abundance	*Harmothoe ljungmani* 14 % *Echinocyamus pusillus* 12 % *Amphipholis squamata* 9 % *Polycirrus medusa* 5 % *Pomatoceros triqueter* 4 % *Branchiostoma lanceolatum* 3 % *Syllis amica* 3 % *Glycymeris glycymeris* 3 %	*Syllis amica* 6 % *Harmothoe ljungmani* 6 % *Echinocyamus pusillus* 6 % *Amphipholis squamata* 5 %	*Tellina pygmaea* 14 % *Glycymeris glycymeris* 14 % *Nephtys cirrosa* 10 % *Syllis hyalina* 9 % *Lumbrineris impatiens* 3 % *Polycirrus medusa* 3 % *Echinocyamus pusillus* 2 % *Dentalium vulgare* 2 %	*Nephtys cirrosa* 24 % *Tellina pygmaea* 16 % *Tellina pygmaea* 14 % *Glycera capitata* 5 % *Scoloplos armiger* 4 % *Urothoe brevicornis* 3 % *Ophelia borealis* 3 %
Weight Dominance	*Arcopagia crassa* 37 % *Glycymeris glycymeris* 15 % *Branchiostoma lanceolatum* 13 % *Venerupis rhomboïdes* 12 % *Glycera gigantea* 11 % *Lumbrineris impatiens* 7 % *Echinocyamus pusillus* 2 %		*Spisula elliptica* 41 % *Glycymeris glycymeris* 11 % *Branchiostoma lanceolatum* 8 % *Nephtys cirrosa* 6 % *Lumbrineris impatiens* 5 % *Thia scutellata* 5 % *Dentalium vulgare* 2 %	

On average, the fine sand community of the deposition area is about twice less rich than the reference coarse sand one, with a maximal impact close to the extraction site with an impoverishment comparable to that observed in the dredging site itself (Desprez, 2000).

	Distant deposition area (750 m–2 km)	Proximal deposition area (0–500 m)	Dredging area
Specific richness	− 45 %	−63 %	− 60 %
Abundance	− 76 %	− 89 %	− 80 %
Biomass	− 55 %	− 89 %	− 90 %

A clear relationship could be demonstrated between the fine sand content of the sediment and the 3 main population parameters (Figure A15.2), the latter showing a significant decline when the percentage of fine sand is increasing.





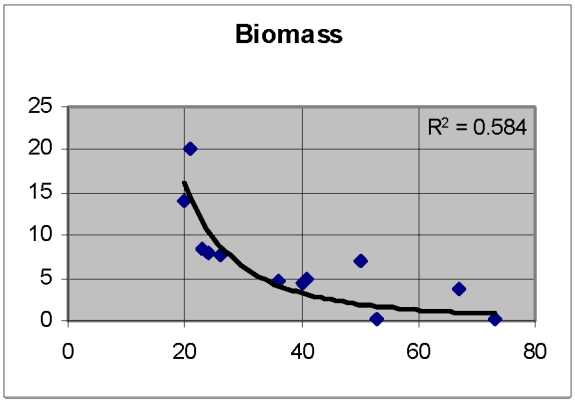


Figure A15.2. Influence of the fine sand content of the sediment on the main benthic community parameters in the deposit area of the extraction site at Dieppe (F).

Our data on biological and sedimentological characteristics of the deposition area are not in accordance with several conclusions of the Regional Environmental Assessment. about potential effects from sand deposition.

R.E.A. (with screening)	Dieppe (without screening)
Intensive deposition is predicted up to 200 m in the direction of the tidal residual	Intensive impacted area is extending up to 500 m along the tidal axis
Seabed sediment could change from sandy gravel to gravely sand… the difference in the size distribution could be as little as 1 %	Percentage of fine sands is twice higher (51 % instead of 23 %) and that of very fine sands nearly tenfold (10 % instead of 1.3 %)
The effect of deposition of this fine sand is temporary and its effect on the benthic resource is therefore considered to be negligible or moderately adverse within approximately 1.2 km of each dredging site	The effect of sand deposition on benthic communities is strongly adverse with a decrease in specific richness (45 %), in abundance (76 % and in biomass (55 %)
A slightly different community is likely to recolonise the habitats in the sandier depositional footprint On the long-term, many of the recolonising communities are likely to vary very little from the original ones (change in the diversity), with a composition always dominated by polychaete worms, although the dominant species may be different	The reference community of gravelly sands is dominated by polychaetes worms (26 %) and echinoderms (21 %) In the deposition area, the community is dominated by bivalves (28 %) and new species of worms (24 %) *No information available on recolonisation after cessation of extraction*

It seems necessary to better assess the "near field" potential effects on the benthos of sediment deposition from overspill and screening, and the resulting habitat alteration.

We agree with Maurer *et al.* (1986) concluding that the greater the difference in sediment, the greater the effect is likely to be. As a consequence of respective sensitivity of various species to burial, to smothering, to sediment mobility and granulometry…the initial community composition in Dieppe evolved with increasing fine sand deposition.

The challenge in moving towards an EcoQO approach is to start to numerically ascribe the degree of change in terms of the numbers and densities of species (Elliott, 1996). Fine sand content of the sediment and main population parameters of the associated macrobenthic community fulfil several conditions of the desirable attributes of an ideal EcoQO (Rees, 2001):

- quantifiable and statistically robust, with minimal associated sampling effort;
- absolute and unambiguous cause/effect relationship;
- responsive in a predictable way to variation in impact.

Annex 16 Apparent incompatibility between biological settings of WG EXT guidelines and current aggregate dredging applications in the Eastern English Channel

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In the WGEXT guidelines for the management of marine sediment extraction, various biologically sensitive areas are described and it is recommended that they should be strictly protected against human activities and particularly aggregate extraction.

These areas are "spawning grounds with particular regard to benthic spawning species, nursery areas, over-wintering grounds for ovigerous crustaceans and known routes of migration".

Many extraction projects have been proposed in Eastern Channel offshore waters over the past years and scientific advice will have to be given regarding their compatibility with the biological functions of the affected seabed.

This potential conflict of interests is often illustrated and assessed through mapping known areas of scientific importance and onto industrial project outlines.

Unfortunately, the combinied thematic maps often underline the following kind of difficulties, for example, for spawning areas. At the moment, we can observe:

- a large uncertainty in the delineation of the spawning areas and an incapacity to determine the ratio presence/absence;
- fact that the current offshore applications globally stand upon biologically sensitive areas as spawning grounds;
- a practical impossibility to avoid a large overlapping between industrial projects and these sensitive areas which potentially cover the largest part of the seabed.

In order to avoid opposition between biologists and other stakeholders it appears necessary either to improve knowledge or to put scientific certainties in perspective.

As it looks difficult to quickly get significant new knowledge about spawning areas and routes of migration, current industrial applications will have to be assessed in terms of acceptable risk to the various marine resources, sensitive areas and fishing activities.

The principles of EcoQ and EcoQO may be useful in this kind of issue.

Annex 17 Recommendations and proposed terms of reference for WGEXT 2004

Draft Resolution 1: Future meeting of WGEXT

The Working Group on the Effects of Extraction of Marine Sediments on the Marine Ecosystem [WGEXT] (Co-Chairs: Prof. J. Side, and Dr. S. Boyd, UK) will meet on the Isle of Vilm, Germany from 30 March–2 April 2004 as guests of the Federal Agency for Nature Conservation in order to:

a) review data on marine extraction activities, developments in marine resource mapping, information on changes to the legal regime (and associated environmental impact assessment requirements) governing marine aggregate extraction;

b) review scientific programmes and research projects relevant to the assessment of environmental effects of the extraction of marine sediments;

c) provide a summary of data on marine sediment extraction for the OSPAR region that seeks to fulfil the requirements of the OSPAR request for extraction data to be provided by ICES;

d) receive feedback from OSPAR on WGEXT 2003 proposals for gathering this data for the OSPAR region on an annual basis;

e) receive feedback and any specific observation from OSPAR on the WGEXT 2003 revision to the ICES Guidelines for the Management of Marine Extraction;

f) compile and collate drafts of individual contributions to the *ICES Cooperative Research Report*, and in particular to this end:

   i) consider recommendations for the use of risk assessment methods as a tool in the management of marine sediment extraction activities;

   ii) review the variability of data emerging from observed impacts of marine sediment extraction in scientific research programmes with a view to developing understandings and possible models for the explanation of these;

   iii) consider opportunities for further developing the ecosystem approach to the management of marine sediment extraction;

   iv) review progress and text of the draft report.

WGEXT will report for the attention of the Marine Habitat and Resource Management Committees and ACME and ACE.

Priority:	Current activities are concerned with developing the understanding necessary to ensure that marine sand and gravel extraction is managed in a sustainable manner, and that any ecosystem (and fishery) effects of this activity are better understood so that mitigative measures can be adopted where appropriate. These activities are considered to have a very high priority.
Scientific Justification:	a,b) An increasing number of ICES Member Countries undertake sand and gravel extraction activities and others are looking at the potential for future exploitation. Each year relevant developments under these headings are reviewed and summarised. This provides a useful forum for information exchange and discussion. National reports are submitted electronically prior to the meeting and WGEXT has been developing an electronic reporting format. National Reports should be submitted, using the new reporting template, no later than 15 March 2004. c,d) This is in response to a request from OSPAR tabled by Denmark at WGEXT's meeting in 2003. WGEXT will produce a summary of aggre-

	gate extraction activities for the OSPAR region, and seeks feedback on the suggestions made in its 2003 Annual Report from OSPAR on proposals for gathering this data on an annual basis. d) The new Guidelines (finalised at WGEXT 2002, and amended to incorporate some observations from OSPAR at WGEXT 2003) provide both guidance on EIA for aggregate extraction activities, and guidance contained in the previous ICES Code of Practice on sand and gravel extraction. WGEXT will review any responses to this revision. e) This work is ongoing and responds in particular to the recommendations contained in previous *ICES Cooperative Research Reports* (Nos. 183 and 247). It will also incorporate the most recent work undertaken by WGEXT on risk management and on effects of sediment extraction activities on fisheries, together with the review of all major research projects on the ecosystem effects of sediment extraction activities. This is seen by WGEXT as a major periodic deliverable from its work.
Relation to Strategic Plan	The principal focus of WGEXT work is in relation to Objective 2(c), but other terms of reference also relate to Objectives 1(a), 1(c), 1(e), and 4(a).
Resource Requirements:	Most countries collect data and information routinely on aggregate extraction activities. The additional work in presenting these data in a summary form for the OSPAR region was discussed at WGEXT 2003 and is considered small. Reviews of research activity are of programmes that are already under way and have resources committed.
Participants:	WGEXT is normally attended by 20–25 members and guests.
Secretariat Facilities:	WGEXT 2004 will be hosted by the Federal Agency for Nature Conservation in Germany
Financial:	No additional financial implications
Linkages to Advisory Committees:	ACME
Linkages to other Committees or Groups:	BEWG, WGMHM, SGASC
Linkages to other Organisations:	Work is of direct interest to OSPAR and HELCOM.
Cost share	ICES 100 %