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Report of the Working Group on the Effects of Extraction of Marine Sediments on the Marine Ecosystem (WGEXT)

16–20 April 2012

Rouen, France

ICES International Council for the Exploration of the Sea

CIEM Conseil International pour l'Exploration de la Mer

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Executive summary

The Working Group on the effects of extraction of marine sediments on the marine ecosystem (WGEXT) met in Rouen, France between 16 and 20 April 2012. Twelve participants from six ICES member countries attended the meeting.

The objective of WGEXT is to provide a summary of data on marine sediment extraction, marine resource and habitat mapping, changes to the legal regime, and research projects relevant to the assessment of environmental effects.

A continued decline in amounts of extracted marine sediments across member countries was identified by WGEXT although this was not the case for each country reporting data. Similarly to previous years, no significant changes to the policies and procedures for managing marine sediment extraction were reported, with the exception of the UK where the Marine and Coastal Access Act and its implications for marine sediment extraction were discussed. Research into the impacts and effects of marine sediment extraction continued across member countries and a mix of national/ regional focussed and multi-national programmes exist.

Reports were reviewed from 12 (of 21) member countries. Although 11 member countries did not provide reports, the available data is thought to provide a representative assessment of the overall total of material extracted from the member states.

ICES WGEXT agreed to meet again in the Azores in April 2013 as guests of the Laboratório Nacional de Energia e Geologia.

1 Opening of the meeting

The Working Group on the Effects of Extraction of Marine Sediments on the Marine Ecosystem (WGEXT) was welcomed to France and to the University of Rouen by MM. Jean-Paul Dupont, dean of the Sciences Faculty, and Nicolas Massei, sub-director of the Laboratory of Geology, as well as WGEXT member Michel Desprez (University of Rouen) who had organised the meeting in Rouen. The chair of WGEXT, David Carlin, thanked the University of Rouen for hosting the annual meeting and all countries for providing national reports. The meeting included a tour of Honfleur guided by Mr Franck Bruchon (Agence de l'Eau Seine-Normandie, Marine and Coastal Division) who gave an interesting presentation of the work of his division.

Rebecca Walker continued as the rapporteur of the group and the chair thanked all WGEXT members who had data and information for inclusion in the annual report in advance of the meeting.

Brigitte Lauwaert (Belgium), Laure Simplet (France), Kris Hostens (Belgium), Jochen Krause (Germany), Gerry Sutton (Ireland), Rui Quartau (Portugal), Henry Bokuniewicz (USA), Jouko Rissanen (Finland), and Mark Russell (UK) all sent their apologies for being unable to attend.

2 Adoption of the agenda

The agenda was duly adopted by WGEXT members, together with the addition of presentations from Belgium, France, The Netherlands, Sweden and the UK.

3 In response to Terms of Reference (A) and (B)

Term of Reference (A): 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 and take into account any feedback or comments from OSPAR from the information submitted by WGEXT 2011

ICES WGEXT have again attempted to provide information for all ICES countries on the annual amounts of sand and gravel extracted but have still found difficulty in obtaining information from countries not regularly represented in person at ICES WGEXT meetings. WGEXT members again attempted to contact those countries who were unable to submit data for inclusion in the annual report.

Available information is included in Table 3.1 below.

Table 3.1. Summary Table of National Aggregate Extraction Activities in 2011.

Country	A) Construction/ industrial aggregates (m³)	B) Beach replenishment (m³)	C) Construction fill/ land reclamation (m³)	D) Non-aggregate (m³)	E) Total Extracted (m3)	F) Aggregate exported (m³)	New Maps/Data available	New legislation	New Policy	EIA initiated	EIA ongoing	EIA finished	EIA published
Belgium (OSPAR)	2 778 298	699 045	0	0	3 477 343	N/d	Yes[1]	Yes	No	No	No	Yes	Yes
Canada	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d
Denmark[2] (HELCOM)	3 670 000		N/d	N/d	3 670 000		No	No	No	N/d	N/d	N/d	N/d
Denmark[2] (OSPAR)	2 820 000	2 140 000	N/d		4 970 000		No	No	No	N/d	N/d	N/d	N/d
Estonia (HELCOM)	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d
Finland (HELCOM)	0	0	0	0	0	0	Yes	No	No	Yes	No	Yes	Yes
France [3] (OSPAR)	7 230 588	0	0	481 000	7 711 588	0	Yes	No	No	No	Yes	No	No
France (Med)	0	N/d	N/d	0	N/d	N/d	No	No	No	No	Yes	No	No
Germany (HELCOM)	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d
Germany (OSPAR)	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d
Greenland and Faroes (OSPAR)	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d
Iceland (OSPAR)	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d
Ireland (OSPAR)	0	0	0	0	0	0	N/d	N/d	N/d	N/d	N/d	N/d	N/d
Latvia (HELCOM)	0	0	0	0	0	0	N/d	N/d	N/d	N/d	N/d	N/d	N/d
Lithuania (HELCOM)	N/d	119 000	N/d	N/d	119 000	N/d	No	N/d	N/d	N/d	N/d	N/d	N/d
Netherlands [4] (OSPAR)	2 893 967	37 293 360	22 761 325	168 033	62 948 704[8]	3 332 000[5]	Yes[1]	No	No	Yes	Yes	No	No
Norway (OSPAR)	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d
Poland (HELCOM)	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d
Portugal (OSPAR)	126 381	600 000	0	0	726 381	0	No	No	No	No	No	No	No
Spain (OSPAR)	0	0	0	0	0	0	No	No	No	No	No	No	No

Spain (Med)	0	0	0	0	0	0	No	No	No	No	No	No	No
Sweden (OSPAR)	0	0	0	0	0	0	No	No	No	No	No	No	No
Sweden (HELCOM)	0	96 562	0	0	96 562	0	Yes	Yes	No	Yes	Yes	No	Yes
United Kingdom (OSPAR)[6]		712 557	187 624	0	11 515 069	3 673 506	Yes	No	Yes	Yes	Yes	Yes	Yes
United States	778 308	4 489 111	389 923	2 886 189	9 450 499[7]	0	No	No	No	No	No	No	No

Table Definitions

A. Construction/industrial aggregates - marine sand and/or gravel used as a raw material for the construction industry for building purposes, primarily for use in the manufacture of concrete but also for more general construction products.

B. Beach replenishment/coastal protection – marine sand and/or gravel used to support large-scale soft engineering projects to prevent coastal erosion and to protect coastal communities and infrastructure.

C. Construction fill/land reclamation – marine sediment used to support large scale civil engineering projects, where large volumes of bulk material are required to fill void spaces prior to construction commencing or to create new land surfaces.

D. Non-aggregates – comprising rock, shell or maerl.

E. Total Extracted – total marine sediment extracted by Member Countries

F. Aggregates Exported - the proportion of the total extracted which has been exported i.e. landed outside of the country where it was extracted.

[1]Data continually updated and new maps available on demand from database

[2]The OSPAR area and the HELCOM area are overlapping in Denmark. The Kattegat area from Skagen to north of Fyn-Sjælland is included in both Conventions. Therefore the figures from the two Convention-areas cannot be added.

[3] Data relates to licensed amount rather than amount extracted, no extraction for construction and non aggregate in the Mediterranean, no information is available for extraction quantities for other sectors in the Mediterranean although sand extraction for beach replenishment is likely to have occurred.

[4] Total shell extraction including Western Scheldt and Wadden Sea

[5] Quantity estimated based on feedback from licence holders

[6] Conversion from reported tonnes to M^3 achieved using density / specific gravity conversion factor of 1.66

[7] Figures reported for USA pertain to north eastern Seaboard only

[8] Total sand-extraction figures exclude 168,033 m^3 of shells as non-aggregate material

WGEXT will again circulate a copy of the WGEXT 2012 annual report to contact points provided by OSPAR in order that the accuracy of the information presented can be assured.

Similar to previous years, Table 3.2 provides information on countries with data adjustments or those who have never provided information to WGEXT.

Table 3.2. Specific matters highlighted in response to OSPAR request for ICES WGEXT to supplynational data.

OSPAR COUNTRIES FOR WHICH DATA HAS NEVER BEEN RECEIVED (As of 2012)
GREENLAND AND FAROES (DENMARK) – Data for Denmark is reported separately
DATA ADJUSTMENTS FOR SPECIFIC COUNTRIES NECESSARY TO DISTINGUISH DATA FOR THE OSPAR REGION
SPAIN – Atlantic coast activities only (note separation of Mediterranean data)
FRANCE - Atlantic and Channel coast activities only (note separation of Mediterranean data)
GERMANY – North Sea activities only (exclude Baltic)
FINLAND – Exclude Baltic activities
SWEDEN - Delineate activities in the Baltic area (Kattegat) which fall within the boundaries of the OSPAR 1992 DENMARK - As for Sweden

Table 3.3 summarises information, where available, for ICES WGEXT member countries. Although the data are incomplete at this time, it is important to note that the areas in which extraction occurred were much smaller than the areas licensed and, of course, the actual spatial footprint should be used to assess impacts.

Table 3.3 Licensed area and actual areas over which extraction occurs.

	Licensed Area Km²						Area in which extraction activities occur Km²					
Country	2004	2006	2007/08	2009	2010	2011	2004	2006	2007/08	2009	2010	2011
Belgium (Extraction Zone 1)	300	104	104	104	104	104	9	N/d	N/d	N/d	N/d	N/d
Belgium (Extraction Zone 2)	228	152	152	152	152	152	19	N/d	N/d	N/d	N/d	N/d
Belgium (Extraction Zone 4)	0	0	0	0	0	46	0	0	0	0	0	N/d
Belgium Total	528	256	256	256	256	302	28	N/d	N/d /100[1]	40	N/d	N/d
Denmark	800	N/d	429	430	789	650	30	N/d	N/d	N/d	N/d	N/d
France[1]	35.43[2]	73.08[2]	72.97/74.97	74.87	67.87	67.87	N/d	N/d	N/d	N/d	N/d	N/d
Germany (OSPAR)	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d
Germany (Non OSPAR)	N/d	Nd	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d
Lithuania	N/d	Nd	N/d	N/d	70.12	32.46	N/d	N/d	N/d	0.74	N/d	0.74
Netherlands [5]	484	453	456/585	564	490	456	41	47[3]	38[3]/ 35.3[3]	86[3]	86	71
Sweden	0	0	0	0	0	9.70	0	0	0	0	0	9.70
UK	1257	1316	1344	536	552	N/d	134[4]	140[4]	134.7	124	105	N/d

Table Notes

[1] Not all French dredging vessels are fitted with EMS.

[2] Includes 26.59 sand-and-gravel extraction area and 8.84 non-aggregate extraction area in 2004 , and 58.46 sand-and- gravel extraction area and 14.62 non aggregate extraction area in 2006, 51.89 sand-and-gravel extraction area and 21.08 non-aggregate extraction area in 2007 and 2008, 53.89 sand-and-gravel extraction area and 21.08 non-aggregate extraction area in 2009. 46.79 sand and gravel extraction area and 21.08 non aggregate area in 2010

[3] 90% of material extracted in the Netherlands is taken from 7.5 km² (2006) and 9.2 km² (2007) and 8.3km² (2008), and 23 km² (2009), 38 km² (2010) and 23 km² (2011).

[4] 90% of material extracted in UK is taken from 46km² (2003) and 43km² (2004) and 49.2 km² (2006) 49.95 (2007)

[5] Excludes the non aggregate shell-extraction areas due to the very small operational areas on the North Sea and not really marine extraction in the Western Scheldt and Wadden Sea.

WGEXT again noted that this type of information has to be taken from an analysis of electronic monitoring data and this is not a straightforward task to achieve and therefore not possible for all WGEXT members to provide.

Term of Reference (B): Review data on (b1) marine extraction activities, (b2) developments in marine resource and habitat mapping taking into account some of the outputs of ICES WGMHM as appropriate, (b3) information on changes to the legal regime (and associated environmental impact assessment requirements) governing marine aggregate extraction

3.1 Extraction Activities (b1)

Again, WGEXT members reported very different pictures of extraction levels across member countries however it was noted that in 2011, with the exception of the **UK** (increase in tonnage), **Belgium** (increase in tonnage), **Denmark** (slight increase in tonnage) and **France** (maintenance of tonnage), there was a general decline in levels of extraction. **Belgium** opened a new extraction zone (zone 4) in response to a government coastal safety plan. **Portugal** reported extraction levels for the whole of Portugal, rather than just the Azores (as occurred during the 2011 Annual Report) and in 2012 was able to report statistics up to 2011, rather than a year in arrears (i.e. 2010 statistics)

For the first time in a number of years **Sweden** reported extraction activities. Extraction has commenced in **Sweden** as a response to beach erosion issues. A ten year extraction and beach replenishment project commenced in 2011 and will extract a total of 340 000 m³ of sand in four campaigns.

The Netherlands reported a large decrease in the amount of marine sediment extracted due to the reduced requirement from the Maasvlakte 2 project. No specific reasons (such as a particular project) were given for the increase in **UK** or **Belgium** extraction levels.

No extraction occurred in **Finland, Ireland, Latvia or Spain** during 2011. **Poland** did not have any data to present and no information was received from **Canada**, **Estonia**, **Germany**, **Greenland and the Faeroes**, **Iceland** or **Norway**.

3.2 Developments in Marine Resource and Habitat Mapping (b2)

It remains the case that resource and habitat mapping in member countries is undertaken by coordinated and ad-hoc programmes, often related to specific scientific programmes. In many countries, the marine aggregate sector continues to undertake mapping to address their own resource management and EIA requirements. Work has also begun to use mapping data to support decision making via the use of modelled data. Many WGEXT member countries, including the **Netherlands**, have developed capabilities to rapidly produce maps based on existing data holdings.

In 2011, The Management Unit of the North Sea Mathematical Models (MUMM) finalized its seabed mapping in the frame of the **Belgian** Science Policy projects Quest4D (Quantification of Erosion/Sedimentation patterns to Trace the Natural from the Anthropogenically-induced Sediment dynamics) and EnSIS (Ecosystem Sensitivity of Invasive Species), with reports published.

Finland reported that in 2011 about 2400 line kilometres were surveyed by GTK in the Sea of Bothnia covering an area of about 900 km². This includes work to acquire data on the distribution and thickness of various types of sediments and information on stratigraphy, mineralogy and geochemistry of the deposits. Further work to increase knowledge of the physical properties and the geochemical variations in seabed sediments induced by both nature and human activity was also undertaken in Finland along with data collected by the Finnish Inventory Programme for the Underwater Marine Environment (VELMU) on the diversity of underwater marine biotopes and species. The inventories are being conducted in the Archipelago Sea, the Quark, the Gulf of Finland, the Bothnian Bay and the Bothnian Sea.

In **France**, it was reported that IFREMER has published a geological atlas of the Bay of Lannion (Northern Brittany, Western Channel) and also initiated a new program (under contract with the Ministry of Environment) for identification of potential areas for sand and gravel extraction along the Brittany and Atlantic coasts (expected publication: 2012).

While no specific mapping was reported for **Iceland** in 2011, two posters were provided to WGEXT (section 14.9) concerning mapping surveys undertaken between 1940 and 2010 in Hvalfjördur and in 2002 in Kollafjördur.

The Netherlands have begun to focus on the development of a decision-support system for marine-aggregate extraction, follow-up a pilot project in which a resource-information model was developed for the coastal zone of the Netherlands Continental Shelf, between the 15-m depth line and the 12-mile boundary. The decision-support system is intended to answer the question which areas must be cored and mapped in more detail within which timeframe in light of the enormous demand for marine sand that follows from the national policy on coastline maintenance during the 21st century. As part of the associated prioritization, the determining factors are sand quality (for three depth ranges), extractability (for the same three depth ranges), proximity to the final destination of the sand, and existing data density. The resulting information system consists of a GIS file with a series of grids assigning penalty points to highlight areas that are potentially highly suitable to sand extraction but do not have enough core or seismic data available to be sure at the required spatial detail. Case studies for offshore Zeeland and offshore Zuid-Holland have been undertaken using bathymetry and vessel draft are also included as parameters.

Programmes to map the Blekinge Coast, the Uppland Coast, and the southern and northern Bothnian Sea were reported by **Sweden**. It was noted that the majority of the dedicated field work for these programmes has been completed but completion of the associated reports and maps are likely by the end of 2012.

The **UK** reported publication of a series of Regional Environmental Characterisation reports which provide habitat maps for a series of four locations around the English coast specific to aggregate extraction sites.

No mapping activities were reported by the United States during 2011. No information was received from Canada, Denmark, Estonia, Germany, Greenland and the Faeroes, Ireland, Latvia, Lithuania, Norway, Poland, Portugal or Spain.

3.3 Review of Developments in National Authorisation and Administrative Framework and Procedures (b3)

No changes were reported from **Finland**, **Portugal**, **Sweden** or the **United States**.

Belgium reported the assignment of four new extraction areas within Zone 4, together comprising a new exploitation area of 46 km².

In **the Netherlands** the Integrated Management Plan North Sea 2015 has been revised in 2011, and includes a new integral comparative assessment framework for marine activities.

The **UK** reported that UK policy is now described within the Marine Policy Statement, which came into force in April 2011. The key legislation on the extraction of marine minerals also changed during 2011. The new provisions are described in the Marine and Coastal Access Act 2009, in which dredging is included as a licensable activity, with operators requiring a Marine Licence from April 2011. Licenses in England will be issued by the Marine Management Organisation; in Wales by the Welsh Government and in Scotland by Marine Scotland.

No reports were received from Canada, Denmark, Estonia, Germany, Greenland and the Faeroes, Iceland, Ireland, Latvia, Lithuania, Norway, Poland or Spain.

4 In response to Term of Reference (C)

Term of Reference (C): Review approaches to the management and control of marine sediment extraction including a review of approaches to monitoring the effects of this activity and the use of compliance monitoring (e.g. EMS / black box) by member countries

4.1 Review the monitoring of marine sediment extraction with regards management and control of extraction activity

The group reviewed the monitoring table from the 2010 report (ToR D), however it remained that there were no changes to report by countries present at the meeting.

At the 2010 meeting of WGEXT both the UK and the Netherlands described a move within their respective monitoring bodies to a system of more regional monitoring in place of site specific monitoring conditions but no formal system has yet been put in place. It still remains an issue to move forward in the UK however further progress is required before such an approach can be considered for implementation.

WGEXT agreed to keep the approaches to monitoring of marine sediment extraction under review in future years, noting forthcoming changes identified to legislation regulating extraction in a number of member countries. Table 5.1 identified in the 2010 report will be made available to capture additional data from countries who have not yet provided information or where changes to the data already captured has occurred.

4.2 Review of the Use of Black Box and Electronic Monitoring Systems

WGEXT discussed the utilisation of EMS / Black Box systems but noted no change to the information already reported in previous years for those countries present at the meeting. However it was agreed that member countries would be asked to provide additional information on the mechanics of the Black Box / EMS systems operated, including the software and hardware both mounted on the ship and used from processing data.

Dredging Intensity

The group further discussed the different approaches adopted by member countries for measuring dredging intensity based on processing and interpretation of EMS / Black Box data. This clearly has implications for ongoing scientific evaluation of impacts and approaches to mitigation and monitoring of activities. WGEXT therefore agreed the need to collect data on how member countries measure and categorise dredging intensity to better inform discussion on how the impacts of extraction can be better compared.

The group noted that measures currently available include measurement of the time dredged at a particular location (UK) and the amount of material extracted from a particular location (Belgium). To develop understanding the following table (Table 4.1) was suggested as a way of informing discussion on this topic at next year's WGEXT meeting. The table was completed for the UK and Belgium during the meeting and all other member countries are encouraged to provide data for the meeting of WGEXT in 2013. WGEXT agreed a new Term of Reference for the 2013 meeting would be needed to allow for a detailed discussion on the topic and the consideration of the need for, and the nature of, a recommended standard approach to measuring dredging intensity across all member countries.

Table 4.1. Measurement of Dredging Intensity.

Country	Data collection interval	Interpretation of Dredging Intensity
United Kingdom	Location point data measured every 30 seconds	High – greater than 1 hour 15 mins per year in a single location; measured over a grid cell which can be varied, such as 50 x 50 m Medium – Between 15 minutes and 1 hour and 15 minutes of dredging per year Low – Under 15 minutes of dredging per year
Belgium[1]	Location point data measured every 30 seconds when dredging pump status is on (but time can fluctuate strongly)	High: > 10 000 m^3 extracted per ha per year Medium: between 1000 and 10 000 m^3 extracted per ha per year Low: < 1000 m^3 extracted per ha per year

[1]Belgian system of calculating extracted volumes out of time dredged on a certain surface area. (Contribution of Marc Roche from SPF)

Belgian Methodology

As the EMS is not equipped with sensors to record the load of dredged materials in real-time, a method is developed and used in Belgium to estimate the extracted volume of a trailing suction hopper dredger within a certain timeframe. This method is based on the following assumptions:

- The extracted volume (m^3) per second is constant and it is based on the known fixed loading capacity of a ship and the estimation of this capacity and the duration (in seconds) of one track.
- The ship is completely empty when the dredging activity starts.
- The ship is completely loaded when the dredging activity ends (€ logic).

Based on the calculated time difference between consecutive data points, and the fixed loading capacity of a ship, an extra column, representing the extracted volume

(m^3) is added to the data table. By using this extra column in a GIS application, extracted volumes within a certain timeframe and within delimited areas can be calculated. This calculation is further improved and crosschecked by coupling the EMS data with the register data (official declared volume by the captain for each trip). The reliability of the estimation of the extracted volumes from EMS data can be evaluated by comparing the values of annual total volumes estimated from the EMS data with the annual total volumes calculated independently from the extraction registers. A mean deviation of 3% is observed between the two data sets. This low deviation confirms the validity of the assumptions used as basis for calculating the extracted volumes from EMS data. Furthermore, we observe an excellent correlation between the bathymetric difference deduced from the volume maps based on EMS data and the observed difference deduced from the successive multibeam surveys.

5 In response to Term of Reference (D)

Term of Reference (D): Review and report on the outputs of national and multinational scientific programmes, research projects and monitoring programmes relevant to the assessment of environmental effects of the extraction of marine sediments

National scientific programmes with relevance to marine sediment extraction were summarised by WGEXT members and a number of presentations were given on specific projects.

In **Belgium**, research, based on the yearly monitoring, is ongoing regarding bathymetrical changes and the influence of sand extraction on macrobenthos, epibenthos and demersal fish. In October 2011, a study day was organised where the most important research results from the period 2003–2010 of the three different partners occupied in the monitoring were presented and published in a report which can be requested from FSP. The work on the impact of past and present intensive dredging was given during the WGEXT meeting.

In **France,** the SIEGMA project undertaken in the Baie de Seine region ended in December 2011. Three presentations were given on three different objectives of the SIEGMA project: 1) plume dynamics of overflow during extraction and consequences for seabed morphology, 2) impact of sand extraction on demersal fish communities, and 3) impact on the benthos and consequences on trophic relationships between fish and benthos. Furthermore, recent work on the VECTORS project was presented.

While no specific research was detailed from **Iceland** for 2011, a poster was presented that described the work, undertaken since 2000, to characterise the physical properties of marine aggregates in the vicinity of Reykjavik.

In the **Netherlands,** extensive monitoring and research is occurring in two programmes: firstly, the Monitoring and Evaluation Programme (MEP) of Maasvlakte 2 is running (2008- onwards). Secondly Rijkswaterstaat (RWS), a federation of Waterbuilders (LaMER) and the sand extraction project of the Sand Engine have joined to a combined MEP on Sand extraction. Each programme focuses on both on similar issues as well as different monitoring questions, ensuring there is a knowledge exchange between the two programmes. Other related research is also ongoing (e.g. 'Building with Nature Programme'). WGEXT got a brief update on the nourishment programme (Sand Engine) and a comprehensive overview of the monitoring and research in the MEP sand extraction framework.

In **Portugal**, the SANDEX project came to an end, and results are published. In **Sweden**, a new extraction area of 20 km^2 was opened for an amount of 340 000 m^3 sand. It is the first extraction taking place since 1998 and an EIA was undertaken.

In the **UK,** the Marine Aggregate Levy Sustainability Fund (Marine ALSF) came to an end in March 2011. Currently, a literature review of the research done to date (ALSF, Defra, and peer reviewed papers) is underway to identify knowledge gaps, mainly in relation to issuing permits and licence conditions. Monitoring surveys will be continued by the licensed companies.

There were no new programmes to report on in Finland, Sweden (all programmes are already ongoing and have been reported previously) and the United States. No reports were received from **Canada, Denmark, Estonia, Germany, Greenland and the Faeroes, Ireland, Latvia, Lithuania, Norway, Poland or Spain**.

The following projects were presented during the WGEXT meeting (further information is available by contacting the relevant ICES WGEXT members and in Annexes 7 and 8).

- Turbidity plumes and seabed topography – SIEGMA project (**France** – Sophie Le Bot)
- Demersal Fish Communities - SIEGMA Project (**France** – Gwenola De Roton)
- Benthos and trophic relationships - SIEGMA Project (**France** – Michel Desprez)
- VECTORS (**France** – Jean-Paul Delpech)
- Past and present intensive dredging in the Belgian Part of the North Sea (**Belgium** – Annelies De Backer)
- Monitoring and evaluation programme RWS-LaMER-Sand Engine (**Netherlands** – Marcel Rozemeijer)
- An update on the sand engine (**Netherlands** – Jan van Dalfsen)
- New sand extraction in Sweden (**Sweden** – Ingemar Cato)
- An update on work ongoing in the UK (**UK** – Rebecca Walker)

Furthermore, information was provided concerning three European projects of relevance to WGEXT; EMODNET which is ongoing since 2009, MESMA which is ongoing since 2010, and VECTORS which started in March 2011.

EMODNET – Geology

The project is run by a consortium consisting of the national geological survey organisations of the UK, Ireland, France, Belgium, The Netherlands, Germany, Denmark, Norway, Sweden, Finland, Estonia, Latvia, Lithuania and Poland. They work together to deliver the requirements of EC Tender MARE/2008/03. The geological surveys of Europe provide an existing network (through the Association of European Geological Surveys – EuroGeoSurveys) that aims to deliver marine geological information solutions to decision makers in European government and industry, as well as providing baseline information for academic research. The contract between the EC and the EMODNET-Geology project partners was signed in July 2009. The work is in progress and several maps have been produced since the start of the project.

The objectives of the EMODNET-Geology project are to compile information held by the project partners and additional datasets that are publicly available. The outputs will be delivered through the Web using the 'OneGeology' portal. Existing metadata will continue to be stored on the EU-SEASED website, currently being developed and upgraded under the EC-funded GeoSeas project. The consortium is bringing together datasets of all available sea-bed sediments including rate of accumulation or sedi-

mentation; sea-floor geology (including age, lithology and origin); geological boundaries and faults; rate of coastal erosion and sedimentation; geological events and event probabilities (to include information on submarine landslides, volcanic activity, earthquake epicentres); seismic profiles; minerals (including aggregates, oil and gas).

The areas covered in the first step of the project are the Baltic Sea, Greater North Sea and Celtic Sea according to the boundaries shown in Figure 6.1. A continuation of the project (step 2) is planned for the remaining sea-areas of EU (red and green areas in Figure 6.1)

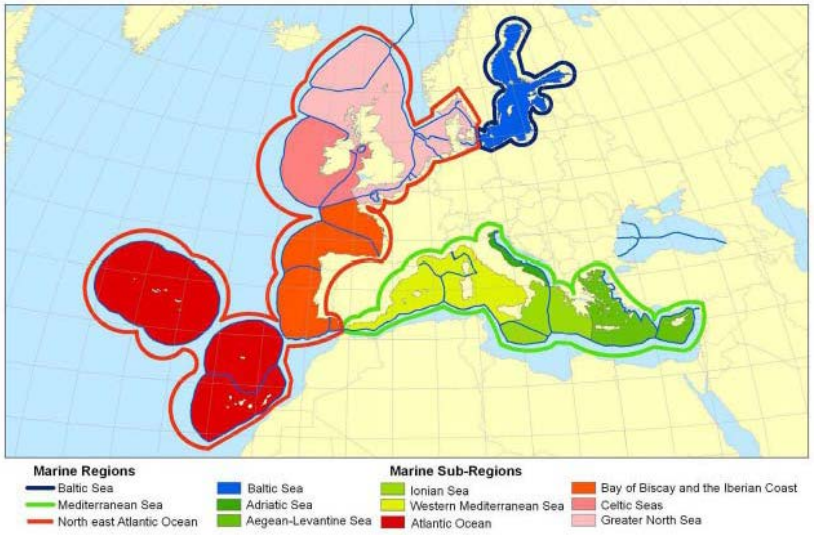

Figure 6.1. Marine Regions and Sub-Regions as defined by the Marine Strategy Framework Directive.

MESMA

The MESMA (Monitoring and Evaluation of Spatially Managed Areas) project is an 8.4 M Euro project funded under 7th EU Framework Program (www.mesma.org). The project started 1st November 2009. MESMA has now 21 partners from 13 EU countries. MESMA focuses on marine spatial planning and aims to produce integrated management tools (concepts, models and guidelines) for monitoring, evaluation and implementation of Spatially Managed Areas (SMAs). The project will support the formalization and implementation of EC policy and will also support integrated management plans for designated or proposed sites with assessment methods based on European collaboration. MESMA covers all EU marine waters, including the ICES area. Within the project a number of case studies will be conducted to different human pressures such as fisheries, renewable energy, shipping, aquaculture and aggregate extraction. Both the information on aggregate activities as well as the stakeholder network build up within WGEXT will be of great interest to MESMA. Some partners of WGEXT are involved in the MESMA project and will play an important role in the transfer of information of the WGEXT into the project.

VECTORS

The EU funded project VECTORS (Vectors of Change in European Marine Ecosystems and their Environmental and Socio-Economic Impacts) focuses on changes in marine life and how these are driven by human activities. Attention is also given to nourishment and extraction activities. Vectors objectives are to develop integrated

multidisciplinary understanding of the different current and potential future pressures and changes taking place in the marine environment, the mechanism for them and the ecological impacts. This project has members from 37 institutes from 16 countries covering the Regional Seas of the Baltic, the North Sea (including the English Channel) and the western Mediterranean. Some partners of WGEXT are involved in the VECTORS project and will be responsible for transferring information from and to the WGEXT. The first annual meeting for this project will take place in Slovenia in March 2012.

EMSAGG

The European Marine Sand and Gravel Group (EMSAGG), established in 1998 by European professionals, is an independent body which provides the marine aggregate industry with the opportunity to discuss the issues affecting this sector. EMSAGG has a website hosted by CIRIA which includes downloadable bulletins, conference reports and papers, details of members, details of relevant CIRIA publications, projects and proposals and also useful links to industry stakeholders (www.ciria.org/emsagg).

Last years' seminar was held at the Turkish Chamber of Shipping, Istanbul, Turkey in May 2011. It provided delegates an understanding of the latest work by EMSAGG, especially focusing on permitting, environmental, engineering and geological aspect of marine sand and gravel. The 2012 meeting will be held in Ostend, Belgium on 20–21 June.

6 In response to Term of Reference (E)

Term of Reference (E): Continue work on a new Co-operative Research Report to cover the period 2005–2011

WGEXT discussed the production of the next Co-operative Research Report during the 2012 meeting and took the opportunity to undertake work on its production. The group decided the report will be titled "Effects of Extraction of Marine Sediments on the Marine Ecosystem" and be published in late 2012 in the *ICES Cooperative Research Report* series. The estimated number of pages is 150, the report will be edited by the WGEXT chair and its publication is already subject to an exciting ICES Resolution. It was agreed that data from 2011 would now also be included in the report to cover the years 2005 to 2011.

Each chapter lead provided an overview of work to date, including a summary of the structure of each chapter. Whilst the structure and nature of each chapter were not suggested to change, WGEXT agreed the final order of chapters may need to change before submission for publication.

All chapter leads committed to providing final drafts of their chapter to the chair by 1 September 2012 for incorporation into a final draft report. WGEXT will have an exceptional intersessional meeting in Lowestoft, UK on 9 and 10 October 2012 to finalise the document prior to its submission to ICES. All chapter leads have agreed to attend and other members will also make efforts to attend where possible.

7 In response to Term of Reference (F)

Term of Reference (F): Continue to review and evaluate the use and application of the ICES WGEXT 2003 Guidelines across member countries. Continue to review and revise the Guidelines, as appropriate, with specific regard to the Marine Strategy Framework Directive. Formulate a draft resolution to ICES regarding the adoption by OSPAR of an amended version of the guidelines

WGEXT again discussed the implementation of the 2003 Guidelines across member countries. It was noted that no changes had taken place to the use of the 2003 WGEXT Guidelines since the last meeting. It remains the case that the Guidelines are widely regarded by member countries and are used via a combination of formal adoption into legislation and policy or by more informal adoption into guidance. WGEXT decided to continue to make the reporting template on the use of the Guidelines available to all member countries to capture additional data and information on the use of the Guidelines.

The group discussed the ongoing validity of the Guidelines and agreed that they remained fit for purpose in their current form and of ongoing use to member countries and OSPAR. However it was noted that at the next meeting of WGEXT in 2013, indicators should have been established under the Marine Strategy Framework Directive. As a result the group consider updates to the Guidelines may be necessary and will therefore be a focus as part of the 2013 meeting agenda.

The group agree that as discussed at the 2011 meeting, the following MSFD recommendations are still relevant to be presented within the 2012 Annual Report:

Recommendations

- ICES member countries, where necessary, to discuss the implication of MSFD GES Descriptor 6 with their own administrations using the text provided by WGEXT.
- WGEXT to continually review the implications of the MSFD with regards to marine sediment extraction.

7.1 Marine Planning / Data to inform the Location of Extraction

WGEXT discussed the problem with all electrical cables, telecommunication cables and pipelines that criss-crossed, primarily in the European shelf area and, in many cases are or could present a barrier to get access to the sea floor non-living resources, among others sand and gravel. Many cables and pipelines are not being used anymore, but stay on as scrap at or in the bottom (down ploughed, submerged or buried due to sedimentation). Cables and pipelines intersect, creating problems for repairs when the data owners in many cases are missing. In general, location information and other metadata about the cables and pipelines, in particular when old, are poor and information, if indeed any, are difficult to obtain. In other cases the knowledge of the existence of a particular cable or pipeline are absent.

It is only a small number of all cables and to some extent pipelines are laid out in national charts, both printed and digital, and usually there are no comprehensive national database of cables and pipeline stretches from ICES member countries. The problems increase with the expansion of wind- and wave farms, new borrholes of oil and gas, the closing of lighthouses, etc.

WGEXT intends to continue these discussions in 2013, but by now it is clear that there is a great need for each ICES country to build a comprehensive national database of pipelines and cables on the seabed and with meta data information as the owner, stretching, year in which the cable and pipeline was located and repaired, the type of

cable and pipeline, material information, down ploughed or not, activity status i.e. is in use or not in use, and other information.

WGEXT refers to the 2013 business meeting try to get information about which organizations in each member country who sits on this type of information and if so on whose behalf they do so with the goal to create an overall picture of the situation with a view to create order where such is missed and to ensafe the best possible access to marine mineral resources by means of careful mangement planning to minimize impacts on the marine ecosystem. WGEXT consider such discussions could for a new recommendation as part of any revision or update to the 2003 Guidelines.

8 In response to Term of Reference (G)

Term of Reference (G): Evaluate potential for collaboration with other EGs in relation to the ICES Science Plan and report on how such cooperation has been achieved in practical terms (e.g. joint meetings, back-to-back meetings, communication between EG chairs, having representatives from own EG attend other EG meetings)

The WGEXT chair reported communication he had with the respective chairs of the WGMHM and BEWG ICES Expert Groups and identified the common desire to work together where appropriate. The group also noted common membership of a number of participants. WGEXT agreed that a common objective relevant to all three EG's will be the implications of the Marine Strategy Framework Directive, particularly Descriptor 6 relating to Seabed Integrity. WGEXT noted the theme session at the ICES Annual Science Conference and agreed that any members attending would feedback to the group at the 2013 WGEXT meeting. Linkages were also discussed with WGECO and following the ASC, efforts will be made to consider the potential linkages between WGEXT and this group.

WGEXT agreed to ask ICES, via the WGEXT chair, to circulate a copy of the forthcoming Cooperative Research Report to all EG chairs, as undertaken previously, to raise the profile of the work of WGEXT. The chair of WGEXT will also extend an invitation of other relevant ICES EG's to attend part of the 2013 meeting, specifically the section of the agenda focussed on presentations of scientific programmes.

9 Closure of the Meeting and Adoption of the Report

The group moved to recommend Ad Stolk of the Netherlands, by means of a vote of members present and email correspondence with those unable to be present, as the new chair elect of WGEXT subject to confirmation from his management that this was possible. The present chair will continue to edit and ensure the final submission of the forthcoming Co-operative Research Report.

The group moved to adopt the final draft annual report and the meeting was formally closed by the chair. He thanked members of WGEXT for attending and again offered thanks to Michel Desprez of the University of Rouen for hosting the meeting.

10 Annex 1: List of participants

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11 Annex 2: Agenda

Monday 16th April 2012	
9.00	Meet in foyer of Ibis Rive droite Hotel OR go direct to University building Maison de l'Université (n°36 on the joint map) just in front of the tram stop T1 coming from the town.
10.00	Meeting begins Welcome by representative(s) of University of Rouen
	Welcome by WGEXT Chair
	Apologies for absence
	Terms of reference
	Adoption of Agenda
10.45	Coffee
11.00	Terms of Reference item (a): OSPAR Summary of Extraction Statistics
12.30	Lunch
13.30	Complete Terms of Reference item (a)
15.00	Coffee
15.15-17.00	Terms of Reference (b): Review of Activities
	Aim to complete (a) and begin (b) by the end of day 1
Tuesday 17th April 2012	
9.00	Complete Terms of Reference item (b) and commence Terms of Reference item (c) Approaches to management and control
10.45	Coffee
	Complete Terms of Reference (c) Approached to management and control
12.30 – 13.30	Lunch
13.30	Reception and Presentations
	Opportunities to work on contributions for Terms of reference item (e) Co-operative research report
	Aim to complete (b) and (c), by the end of day 2
Wednesday 18th April 2012	
09.00	Terms of Reference item (e)
10.30	Coffee
10.30	Complete Terms of Reference item (e)
12.30	Official Lunch and field trip to Honfleur and Terms of Reference (h) Elect

	new chair of WGEXT
	Aim to complete (h) by the end of day 3
Thursday 19th April 2012	
09.00	Terms of Reference item (d) Scientific programmes
10.30	Coffee
10.45	Continue and complete Terms of Reference item (d)
12.30	Lunch
13.30	Terms of Reference item (f) ICES 2003 Guidelines
15.30	Coffee
15.45 – 17:00	Terms of Reference (g) Collaboration with EGs
	Aim to complete (d), (f) and (g) by end of day 4
Friday 20th April 2012	
09.00	Terms of Reference (e)
10.30	Coffee
10.45	Terms of Reference (e)
12.30 – 13.30	Lunch
	Completion of outstanding action items and Recommendations for follow-up work Agree initial text of Working Group Annual Report for 2012. Agree draft Terms of Reference for ICES WGEXT 2013
15:00	Close of meeting

12 Annexes 3 &4: WGEXT draft terms of reference for the next meeting and Recommendations

The **Working Group on the Effects of Extraction of Marine Sediments on the Marine Ecosystem** (WGEXT), chair elect Ad Stolk, Netherlands, will meet in the Azores, Portugal, 22–26 April 2013 to:

a) Provide a summary of data on marine sediment extraction for the OSPAR region that seeks to fulfil the requirements of the OSPAR request(s) for extraction data to be provided by ICES and evaluate any feedback or comments from OSPAR on the information submitted by WGEXT 2011;

b) Review data on (b.1) marine extraction activities, (b.2) developments in marine resource and habitat mapping taking into account some of the outputs of the ICES WGMHM as appropriate, (b.3) information on changes to the legal regime (and associated environmental impact assessment requirements) governing marine aggregate extraction;

c) Review approaches to the management and control of marine sediment extraction including a review of approaches to monitoring the effects of this activity and the use of compliance monitoring (e.g. EMS / black box) by member countries;

d) Review and report on the outputs of national and multinational scientific programmes, research projects and monitoring programmes relevant to the assessment of environmental effects of the extraction of marine sediments;

e) Review approaches to measuring the intensity of dredging across member countries. Consider the recommendation of a standardised approach to measuring dredging intensity;

f) Evaluate the use and application of the ICES WGEXT 2003 Guidelines across member countries. Continue to review, revise and update the Guidelines, as appropriate, with specific regard to the Marine Strategy Framework Directive. Formulate a draft resolution to ICES regarding the adoption by OSPAR of any subsequently amended version of the guidelines;

g) Evaluate potential for collaboration with other EGs in relation to the ICES Science Plan and report on how such cooperation has been achieved in practical terms (e.g. joint meetings, back-to-back meetings, communication between EG chairs, having representatives from own EG attend other EG meetings);

WGEXT will report by 30 June 2013 (via SSGHIE) for the attention of SCICOM.

Supporting Information

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	Links to following high priority research topics from ICES Science Action Plan

justification	2009–2013: Understanding of Interactions of Human Activities with Ecosystems Development of Options for Sustainable Use of Ecosystems (a) This work responds to a request from OSPAR to gather data for the entire OSPAR region on aggregate extraction activities. This information is to be provided and collated in advance of the meeting and reviewed in relation to item (b). We aim to seek the support of existing WGEXT members and participants in an attempt to improve and extend reporting of national data to WGEXT in order to satisfy the OSPAR request. (b) & (c) 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. (d) & (g) To respond to any feedback received to ensure the report accurately reflect the needs of ICES and OSPAR. (f) WGEXT wish to begin to review the 2003 WGEXT Guidelines to ensure they remain fit for purpose across member countries and take account of developments in the underpinning science. (e) & (f) An increasing amount of monitoring activity takes place in connection with licensed aggregate extraction across ICES member countries. WGEXT wish to consider the scientific robustness and rationale behind the design, implementation and effectiveness of such monitoring activities.
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 in the long-term should result in a reduction in effort. Reviews of research activity are of programmes that are already under way and have resources committed.
Participants:	The Group is normally attended by some 20–25 members and guests.
Secretariat facilities:	None required other than services of chair and rapporteur.
Financial:	No financial implications.
Linkages to advisory committees:	SSGHIE, SCICOM
Linkages to other committees or groups:	BEWG, WGMHM, WGRED, WGPMCZM, SGCBNS, WGIAB, WGECO
Linkages to other organizations:	Work is of direct interest to OSPAR and HELCOM.

Annex 4: Recommendations

WGEXT move to make the following recommendations:

Recommendation	For follow up by:
1. ICES member countries, where necessary, to discuss the implication of MSFD GES Descriptor 6 with their own administrations using the text provided by WGEXT.	WGEXT Members
2. WGEXT to continually review the implications of the MSFD with regards to marine sediment extraction.	WGEXT Members

13 Annex 4: Review of National Marine Aggregate Extraction Activities

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

13.1 Belgium

Contributors by e-mail correspondence to the 2012 report are **Marc Roche (**SERVICE PUBLIC FEDERAL ECONOMIE, P.M.E, CLASSES MOYENNES ET ENERGIE, Qualité et Innovation, Service Plateau Continental- Fonds pour l'Extraction de Sable) and **Brigitte Lauwaert.**

In Belgium, the sectors of the Belgian Continental Shelf where sand can be extracted are defined and limited by law (KB of 1 September 2004). In 2011, extraction was granted in sectors 1a, 1b (March to May), 2ab (excluding the closed areas of the central and northern depressions), 2c and 3a (see Figure 13.1). Furthermore, 4 extraction zones were delineated and opened in zone 4 (a-d), and coordinates were published in MB of 24 December 2010 (BS 14 January 2011). The first permit was signed on 22 September 2011 to the Flemish Government. However, no sand has been extracted yet in sector 4. In sector 1b, no extraction is taking place, and sector 3b is still closed as this is also the largest dredge disposal site. Due to the above factors the extraction was limited to zones 1a, 2b, 2c and 3a in 2011 (see Black Box data in Figure 13.2).

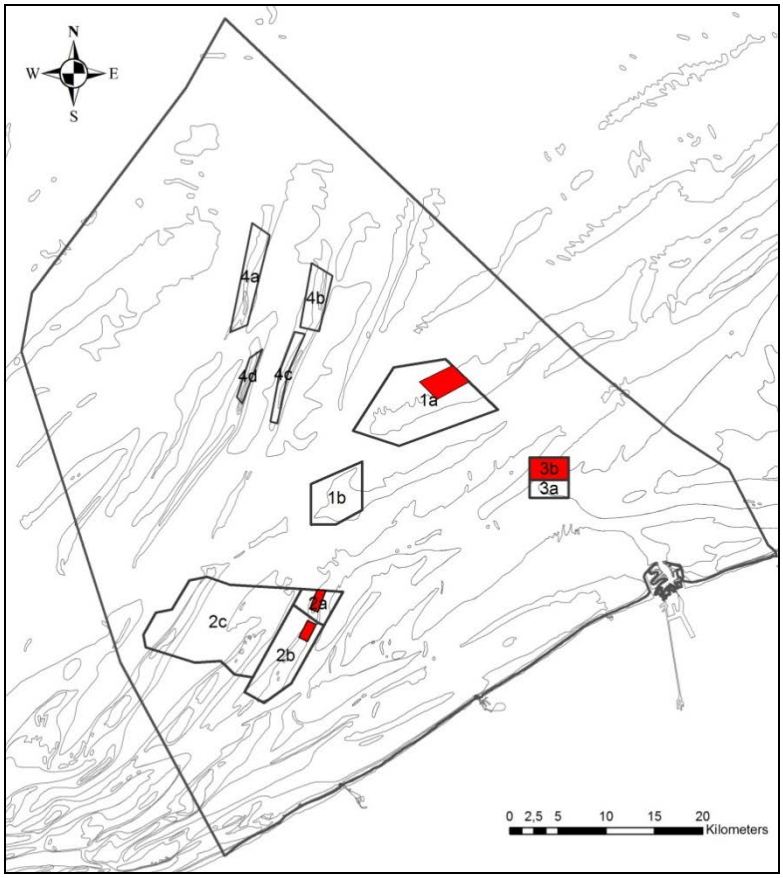


Figure 13.1. Map of permitted exploitation areas for sand and gravel on the Belgian continental shelf as defined in KB of 1 September 2004 (last adapted in 2010) and MB of 24 December 2010 (for exploitation zone 4a-d) with indication of closed areas in red.

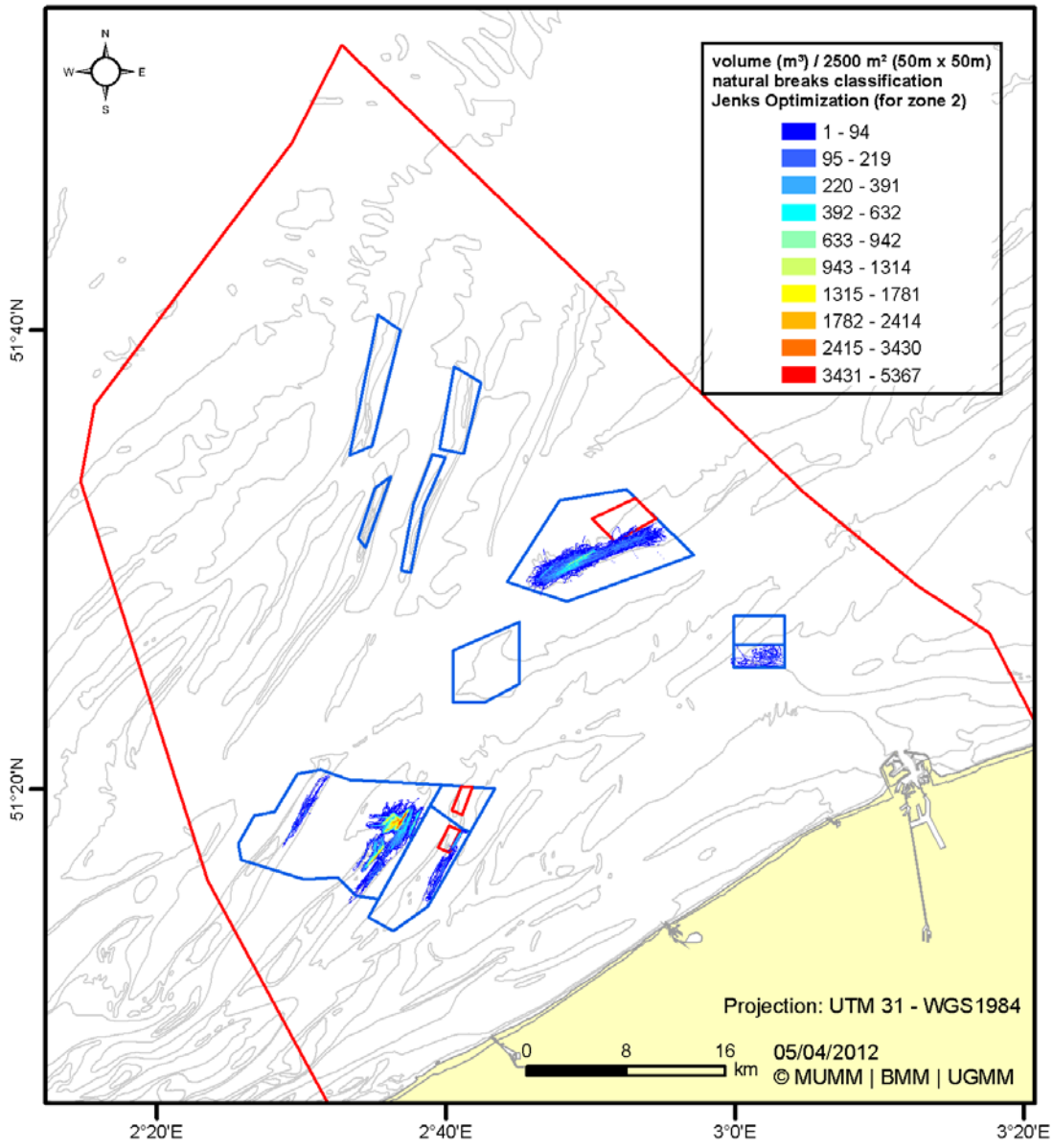


Figure 13.2. Overview of extraction activities on the Belgian Part of the North Sea in 2011, based on the black box data.

In 2011, 2 778 298 m³ sand and no gravel was extracted from sectors 1a, 2 and 3a by 13 private license holders. This sand is mainly used for industrial purposes. Two licenses were also granted to the Flemish Region, Coastal Division and Division Maritime Access. The licenses for the Flemish Region have the same conditions (reporting, black-boxes, etc.) as licenses for the private sector with the exception that they are exempted from the fee system. The Flemish Region-Coastal Division extracted 699 045 m³ of sand, which was used solely for beach nourishment.

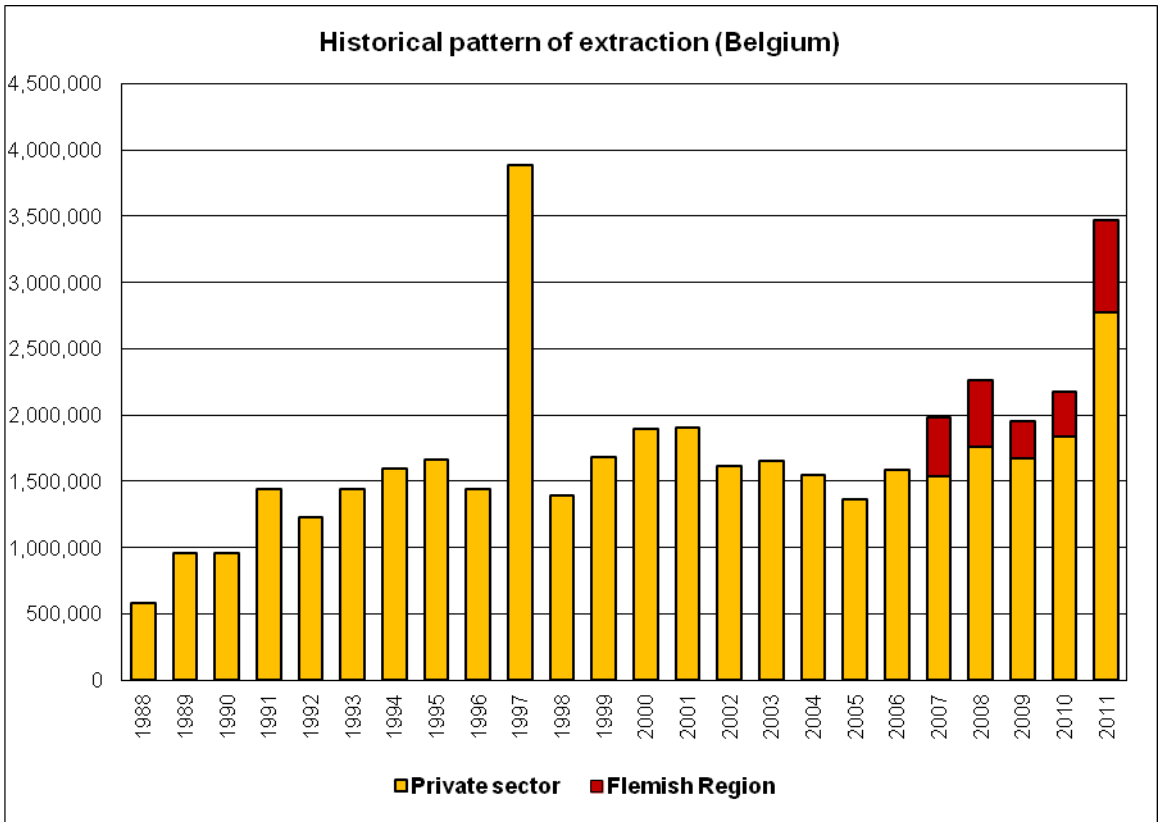


Figure 13.3. Volumes of sand and gravel extracted from the Belgian Continental Shelf between 1988 and 2011.

Although sand extraction on the Belgian Continental Shelf started in 1976 and data are available since then, figure 16.3 only includes data from 1988 onwards. From 2007 onwards the extra quantities extracted by the Flemish Region are included in the graph. The total amount of almost 3.5 Mm^3 sand extracted in 2011 from the Belgian Continental Shelf is an increase of 60 % compared to 2010 and it is the second highest amount ever landed in Belgium (Figure 13.3). Most of the industrial sand allocated to the Belgian market was landed in the coastal harbours of Brugge (including the harbour of Zeebrugge), Oostende and Nieuwpoort. The increase in the extraction of the Flemish Region is in the framework of the Integrated Coastal Protection Plan.

The total area of the sectors where extraction was allowed in 2011 together comprised 302 km^2. This is an increase of 46 km^2 compared to the previous years because a new extraction area (4a-d) was opened on the Hinderbanken, situated 40–50 km offshore (see 13.1). Although zone 4 was opened in 2011, no extraction has taken place yet. First extraction is planned in 2012 by the Flemish Government-Coastal Division for beach nourishment purposes in the framework of the Integrated Coastal Protection Plan.

Although the total area for extraction comprises 302 km^2, most of the sand is extracted from the tops of the banks which limits the used surface area to 90.2 km^2 (internal report FSP-Marc Roche). No exact figures of the extracted area are available yet for 2011 (the black box data can only be analysed after April, which is too late for this report).

However, most of the sand extracted in 2011 came from Zone 2 with 72% extracted of the total volume (just as in the previous years). Although the annual volume ex-

tracted in sector 1a continues to grow over the years to 28% (839.916 m³) of the total annual volume in 2011 (figure 13.4).

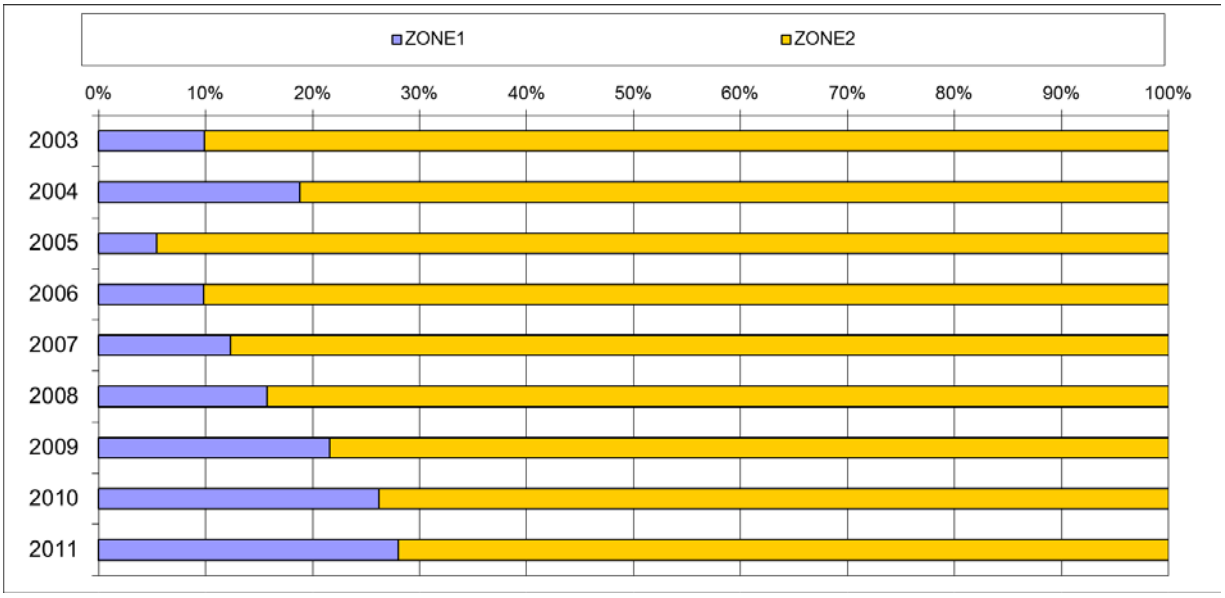


Figure 13.4. Percentages of extracted volumes per zone over the years.

Within Zone 2, we observe a shift in the extraction activities from the Kwintebank (sector 2a and b) to the Buiten Ratel (sector 2c) since 2007/2008 (figure 13.5 and 13.6). Since 2009, extraction is concentrated in 2c and mainly on the central Buitenratel (figure 13.5). In 2011, only 4% of the total extracted volume was extracted on the Kwintebank, while 66% of the total annual volume was extracted in 2c, mainly on the Buiten Ratel (figure 13.6 and 13.2).

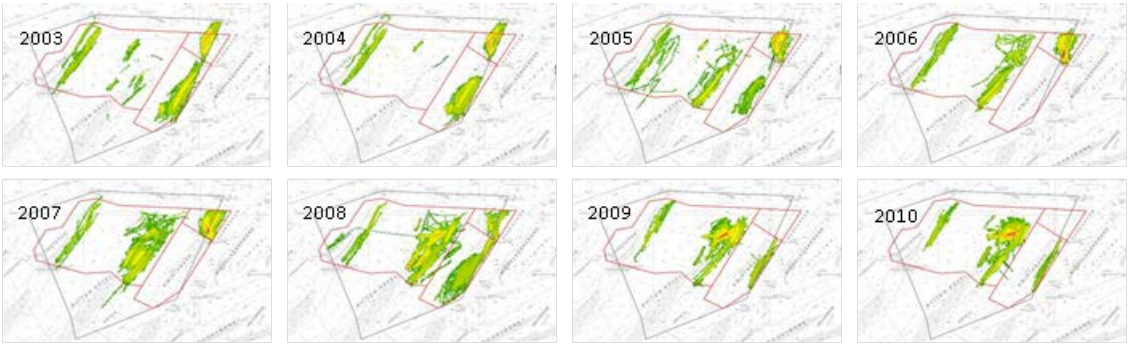


Figure 13.5. Black box data showing the evolution of extraction between 2003 and 2010 in zone 2.

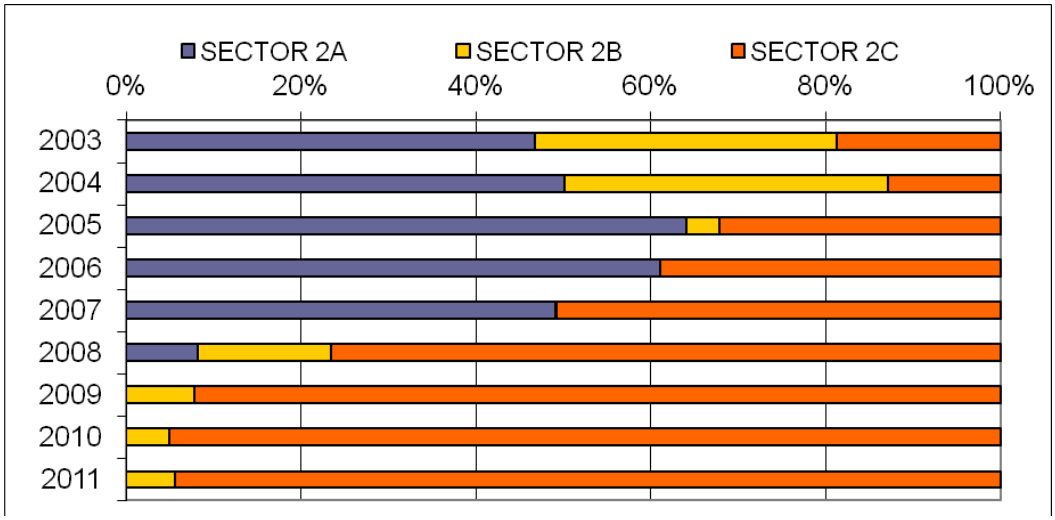


Figure 13.6. Relative percentage of extracted volumes in the different sectors of zone 2 over the years.

13.2 Canada

No information has been provided this year.

13.3 Denmark

Table 13.1. Total extracted 2011.

DREDGING AREA	AMOUNT
Denmark total	7.5 mio. m³
(1)OSPAR area	5.6 mio. m³
(1)HELCOM area	2.3 mio. m³

(1)The OSPAR area and the HELCOM area are overlapping in Denmark. The Kattegat area from Skagen to north of Fyn-Sjælland is included in both Conventions. Therefore the figures from the two Convention-areas cannot be added.

Table 13.2. Construction industrial aggregate (sand and gravel) extraction figures for 2011.

DREDGING AREA	AMOUNT
Denmark total	2.7 mio. m³
(1)OSPAR area	1.0 mio. m³
(1)HELCOM area	1.9 mio. m³

Description of construction industrial aggregate (sand and gravel) extraction in 2011

Table 13.3. Amount of material extracted for beach replenishment projects in 2011.

DREDGING AREA	MATERIAL	AMOUNT
Denmark total	sand	2.6 mio. m³
(1)OSPAR area	sand	2.6 mio. m³
(1)HELCOM area	sand	<0.1 mio. m³

Description of beach replenishment schemes in 2011

A large amount of sand from maintenance and capital dredging has been used for beach replenishment along the west coast of Jutland.

Table 13.4. Construction fill/ land reclamation (m^3) extraction figures for 2011.

DREDGING AREA	MATERIAL	AMOUNT
Denmark total	sand	2.2 mio. m^3
(1)OSPAR area	sand	2.0 mio. m^3
(1)HELCOM area	sand	0.4 mio. m^3

Description of construction fill/ land reclamation in 2009/2010

A large amount of sand from maintenance and capital dredging in Esbjerg Harbour has been used as construction fill for the enlargement of the harbour.

Table 13.5. Non-aggregate (e.g. shell, maerl, boulders etc.) extraction figures for 2011.

DREDGING AREA	MATERIAL	AMOUNT
		No extraction in 2011

Table 13.6. Exports of marine aggregate in 2011.

PORT (landing)	AMOUNT
Sweden	0.05 mio. m^3
Germany	0.01 mio. m^3
The Netherlands	0.1 mio. m^3
Belgium	< 0.01 mio. m^3
United Kingdom	< 0.01 mio. m^3

Table 13.7. Historic patterns of marine aggregate extraction.

Extraction Area	1990	1991	1992–2002	Total 1990–2002
e.g. Disken	0	5 356	0	5 356

Description of historic extraction activities for 1996–2009

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

There are currently app. 100 dredging areas in Denmark. Only app. 60 areas are dredged on an annual basis.

There are currently 10 active exploration licences.

Licensed area in 2011 was 650 km^2.

Estonia

No information has been provided this year.

13.4 Finland

No extraction has taken place this year; however, historical statistics and information are provided.

Table 13.8. Marine aggregate (sand and gravel) extraction figures for 2011.

DREDGING AREA	AMOUNT
-	0

Table 13.9. Non-aggregate (e.g. shell, maerl, boulders etc) extraction figures for 2011.

DREDGING AREA	MATERIAL	AMOUNT
-	-	0

Table 13.10. Exports of marine aggregate in 2011.

PORT (landing)	AMOUNT
-	0

Table 13.11. Amount of material extracted for beach replenishment projects in 2011.

DREDGING AREA	MATERIAL	AMOUNT
-	-	0

Table 13.12. Historic patterns of marine aggregate extraction (m^3).

EXTRACTION AREA	Gulf of Finland	EXTRACTION AREA	Gulf of Finland
2000	0	2007	0
2001	0	2008	0
2002	0	2009	0
2003	0	2010	0
2004	1 600 000	2011	0
2005	2 388 000		
2006	2 196 707	Total (1996–2011)	6 184 707

Description of historic extraction activities for 1995–2011

Sand and gravel extraction from Finnish coastal areas between 1996 and 2004 was negligible. The Port of Helsinki extracted 1.6 million m3 off Helsinki (Gulf of Finland) in 2004, 2.4 million m3 in 2005 and 2.2 million m3 in 2006. Since then, there has been no extraction activities.

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

Loviisa Area, eastern part of Gulf of Finland

A permission to extract 8 million m^3 of marine sand from the Loviisa-Mustasaari area was accepted in April 2007 by the Environment Permit Authority to Morenia, Metsähallitus. However there was a complaint against the decision and the case was under hearing of Administrative Court of Vaasa. The decision on 31.12.2008 was fa-

vourable for the extraction. Extraction has not yet started besides a small experimental dredging exercise in May 2010.

Bay of Bothnia

Morenia, Metsähallitus has selected four areas in the Bay of Bothnia where EIAs have now been started aiming to exploitation of marine sand resources: Suurhiekka-Pitkämatala (Ii and Simo municipalities) , Merikallat (Hailuoto), Tauvo (Siikajoki and Raahe) and Yppäri (Pyhäjoki). The EIA procedure was completed during 2009 and the report passed the examination by authorities in April 2010. The license application was sent to authorities in December 2011 concerning the extraction of 10 Mm^3 of material within the next 15 years in the Yppäri area (1.1 km^2).

Helsinki

The licence was renewed in September 2010 for extraction of 5 Mm^3 sand.

13.5 France

The statistics for 2011 are the same as for 2010. However, the statistics have been repeated for completeness.

Table 13.13. Construction industrial aggregate (sand and gravel) extraction figures for 2011

DREDGING AREA	AMOUNT
Channel	1 202 588 m^3
Atlantic	5 969 000 m^3
Brittany	59 000 m^3

These figures are not extracted quantities but licence quota figures (maximum permitted).

Amount of material extracted for beach replenishment projects in 2011

No data available for beach replenishment.

Construction fill/ land reclamation (m^3) extraction figures for 2011

There is no activity of construction fill or land reclamation in France

Table 13.14. Non-aggregate (e.g. shell, maerl, boulders etc) extraction figures for 2011.

DREDGING AREA	MATERIAL	AMOUNT
Brittany	Maerl	259 500 m^3
Brittany	Shelly sand	221 500 m^3

These figures are not extracted quantities but licence quota figures (maximum permitted).

Exports of marine aggregate in 2011

No data available for exports of marine aggregate.

Table 13.15. Historic patterns of marine aggregate extraction.

DREDGING AREA	SITE NAME	EXTRACTED VOLUMES (m^3) in red Quotas permitted, in black Quantity really extracted										
		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Atantic	Le Pilier	2124326	2271760	2092038	2163848	2491514	2465909	2358107	2466751	2239033	2267000	2267000
	Les Charpentiers	149851	199041	1500000	1500000	1500000	1500000	1500000	1500000	1500000	1500000	1500000
	Sables d'Olonne	No extraction		2349	No extraction	3387	330000	330000	330000	330000	330000	330000
	Chassiron B	Non permitted			330000	330000	330000	330000	330000	330000	330000	330000
	Chassiron C	330000	330000	330000	330000	330000	330000	330000	330000	330000	330000	330000
	Chassiron D	Non permitted			330000	330000	330000	330000	330000	330000	330000	330000
	Chassiron E	Non permitted							482000	482000	482000	482000
	Platin de Grave	117000	143000	174000	103000	400000	400000	400000	400000	400000	400000	400000
Channel	Graves-de-l'estuaire	330000	330000	330000	330000	330000	330000	330000	330000	330000	330000	330000
	Granulats Marins de Dieppe	179575	193673	167690	314857	161477	165850	347828	471200	470588	470588	470588
	Griz Nez	64287	51266	36260	35746	39388	72000	72000	72000	72000	72000	72000
	Baie de Seine	Non permitted					330000	330000	330000	330000	330000	330000
Brittany	Golfe de Saint-Malo	No extraction										License fallen due
	Ilot Saint-Michel	78081	76360	76644	75553	76680	68364	56780	75048	74955	79000	79000
	Lost Pic	130000	129625	130598	131346	123654	124077	60300	130515	129329	169500	169500
	Phare de la Croix	15100	12500	11300	12700	11500	11500	11750	12308	10461.5	11500	11500
	La Horaine	76150	68600	86205	75450	76590	71154	76754	75261.5	76558	83000	83000
	La Cormorandière	19066	21454	22322	16067	24370	22259	16126	18885	15308	22000	22000
	Le Paon	No extraction										
	Jaudy	6062	21233	10709	8070	9034	10464	12688	2110	0	End of extraction	
	Beg an Fry		15308	22111.5	22231	34446	31400	6440	20100	0	16500	16500
	Les Duons	23031	19825	25465	27801	20271	28940	10732	20913	22807	30000	30000
	Le Petit Minou		21808	21496	19315	22275	19300	22700	2272	20450	33000	33000
	Le Grand Minou											
	Kafarnao	7700	12100	7300	8500	5249	6900	6100	4140	1292	20000	20000
	Les Pourceaux		8050	1700	6385	3000	2600	600	0	300	6000	5000
	Les Glénan	87000	80710	67000	63000	55195	52000	46140	35700	39900	25000	25000
	Aber Benoît	21600	17058	No extraction								
	Aber Ildut	No extraction										
	Plateau des Fourches		1230	667	1500	1000	667	500	No extraction			
		3758829	4024601	5115855	5905369	6379030	7033384	6985545	7769204	7534982	7667088	7666088

TOTAL 2000-2010 : 69 839 974

N.B. statistics are the same as for 2010.

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

22 applications (1 for exploration, 13 on actual extraction area for a renewal of license, 9 on new extraction perimeter) for aggregate extraction are being considered by Environment Ministry (MEEDDM), 28 licences and 1 prospection authorisation have been issued by local administration (Préfectures). Figure 13.7 shows the location of these areas.

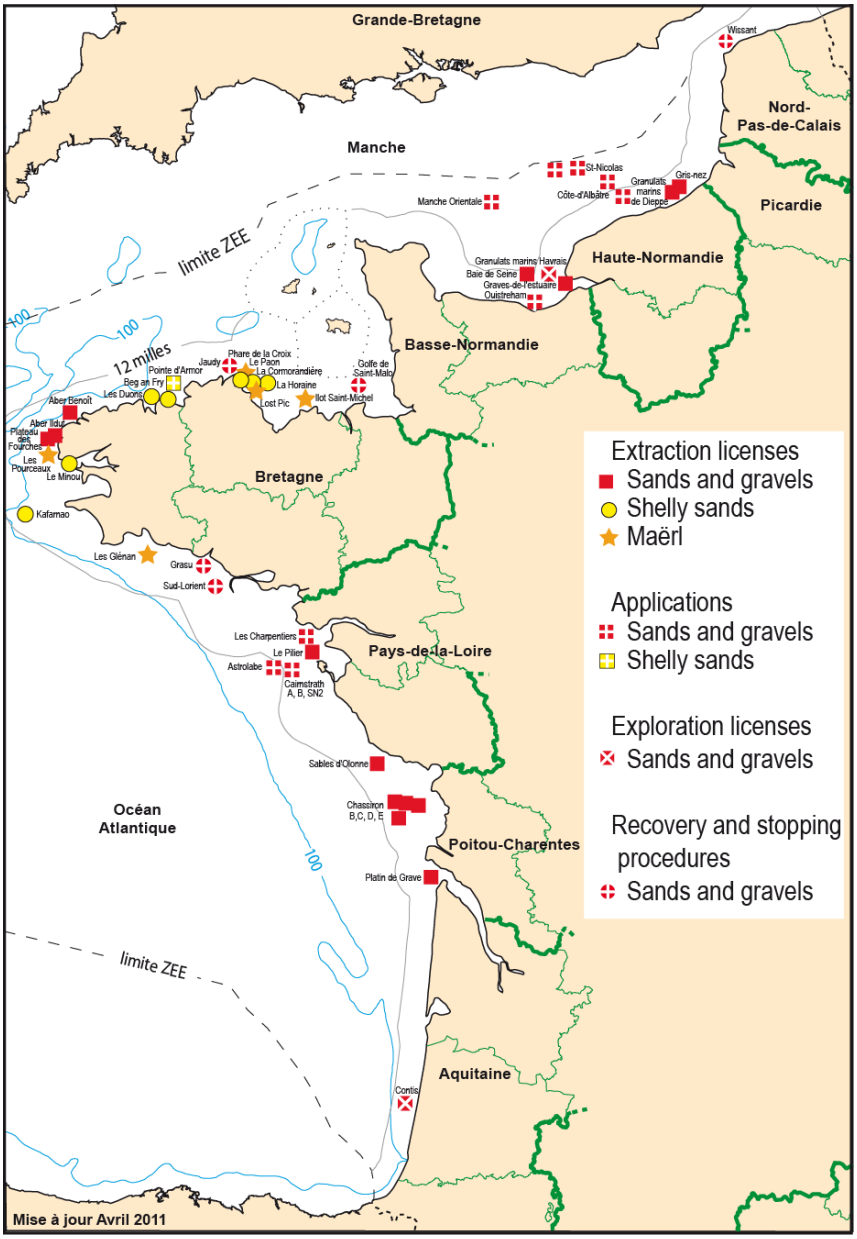


Figure 13.7. Extraction licences.

Table 13.16. Licensed area compared to area in which extraction occurs.

Country	Licensed Area Km²*				Area in which extraction activities occur Km²			
	2008	2009	2010	2011	2008	2009	2010	2011
FRANCE[1]	1238.2[2]	212.57[2]	109.87[2]	109.87[2]	No data	No data	No data	No Data

13.6 Germany

No information has been provided this year.

13.7 Greenland and the Faeroes

No information has been provided this year.

13.8 Iceland

No information has been provided this year, although the poster presented in section 16.9 details that in the period from 2000 to 2009, approximately 11.6 M m^3 of marine aggregates and shell fragments were extracted from three areas, which is 95% of the total extracted in Iceland.

13.9 Ireland

No aggregate extraction activities or non-aggregate extraction (e.g. shell, maerl, boulders etc) conducted during 2011.

13.10 Latvia

No aggregate production took place during 2011.

13.11 Lithuania

Table 13.17. Marine aggregate extraction figures presented in m^3.

Year	Beach nourishment
2010	110 000
2011	119 000

13.12 The Netherlands

Table 13.18. Marine aggregate (sand) extraction figures for 2011.

DREDGING AREA	AMOUNT Mm^3
Euro-/Maas access-channel to Rotterdam	520 538
IJ-access-channel to Amsterdam	746 357
Dutch Continental Shelf	46 018 793
Dutch Continental Shelf / Maasvlakte 2 project	15 663 016
Total	62 948 704

Most of reported quantities are in m3. If reported in tonnes, 1 T = 0.667 m^3

Table 13.19. Non-aggregate (shell) extraction figures for 2011.

DREDGING AREA	MATERIAL	AMOUNT m^3
Wadden Sea	Shells	18 890
Wadden Sea inlets	Shells	81 878
Western Scheldt	Shells	0
Voordelta of the North Sea	Shells	13 390
North Sea	Shells	53 875

Description of non-aggregate extraction activities in 2011

On basis of the Second National Policy Note and EIA for shell extraction (31 august 2004) there are maximum permissible amounts defined from 2005 until 2013.

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

- the Wadden Sea maximum is 85 000 m^3 (but no more than 50% of the total quantity (The Wadden Sea and Sea Inlets)

- the Sea Inlets between the isles until a distance of 3 miles offshore the maximum is 85 000 m³ up to 2013
- the Voordelta 40 000 m³ is permitted
- the Western Scheldt 40 000 m³ is permitted
- the rest of the North Sea, until a distance of 50 km offshore is an unlimited amount.

Table 13.20. Exports of marine aggregate in 2011.

DESTINATION/(landing)	AMOUNT (m3)*
Belgium	3 300 000
Luxembourg	12 000
France	10 000

*** Approximate figures**

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.

Amount of material extracted for the Sandengine project in 2011: 21.525.150 m³

Amount of material extracted for a pipeline project in 2011: 188.085 m³

Table 13.21. Amount of material extracted for beach replenishment projects in 2011.

DREDGING AREA	MATERIAL	AMOUNT in Mm³
L17G(coast of Friesland)	Sand	0.820
M8D (coast of Friesland)	sand	2.424
M9H (coast of Friesland)	sand	3.158
Q2D (coast of Noord-Holland)	sand	0.750
Q5B'/Q8A' (coast of Noord-Holland)	sand	3.043
Q11C (coast of Noord-Holland)	sand	0.746
Q16C-4 (coast of Zuid-Holland)	sand	0.013
Q16G (coast of Zuid-Holland)	sand	2.623
Q16H (coast of Zuid-Holland)	sand	5.266
Q16H-east (coast of Zuid-Holland)	sand	6.861
Q16F1 (coast of Zuid-Holland)	sand	9.385
S5G (coast of Zeeland)	sand	0.645
S7W (coast of Zeeland)	sand	1.557
Total	sand	37.293

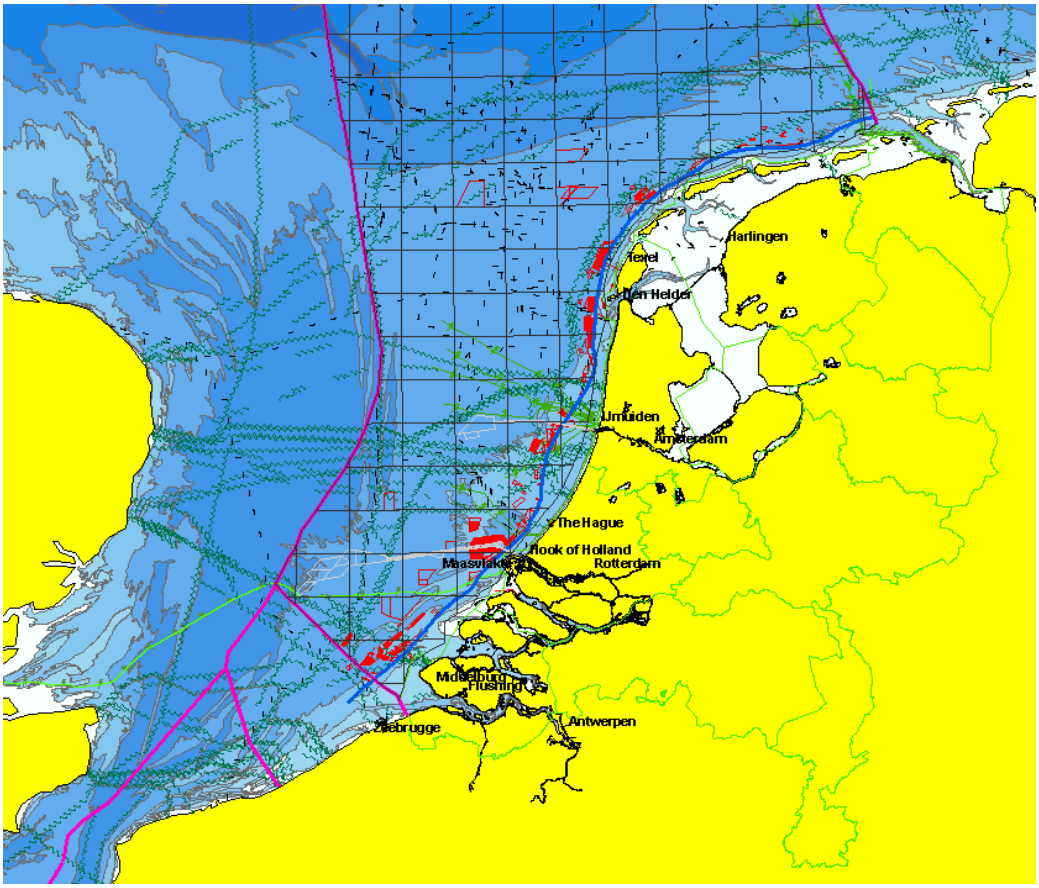


Figure 13.8. Licensed sand extraction areas 2011.

Table 13.22. Historic patterns of marine aggregate extraction in Mm³.

Extraction Area	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Total
Euro-/Maas channel	10,32	3,90	2,94	1,23	2,32	0,49	0,65	1,94	1,22	0,06	0,32	25.39
IJ-channel	2,31	1,41	0,87	1,06	4,31	0	0	0	0	0	0,75	10,71
Dutch Continental Shelf	23,81	28,53	20,07	21,31	22,13	22,88	28,25	24,53	119,59	122,47	68,88	502.45
Total extracted	36,44	33,84	23,88	23,59	28,76	23,37	28,90	26,47	120,81	122,53	69,95	538,55

Table 13.23. Dutch sand extraction 1974–2011.

YEAR	TOTAL EXTRACTED m3	YEAR	TOTAL EXTRACTED m3
1974	2.787.962	1994	13.554.273
1975	2.230.889	1995	16.832.471
1976	1.902.409	1996	23.149.633
1977	757.130	1997	22.751.152
1978	3.353.468	1998	22.506.588
1979	2.709.703	1999	22.396.786
1980	2.864.907	2000	25.419.842
1981	2.372.337	2001	36.445.624
1982	1.456.748	2002	33.834.478

1983	2.252.118	2003	23.887.937
1984	2.666.949	2004	23.589.846
1985	2.724.057	2005	28.757.673
1986	1.955.491	2006	23.366.410
1987	4.346.131	2007	28.790.954
1988	6.954.216	2008	26.360.374
1989	8.426.896	2009	120.700.339
1990	13.356.764	2010	122.532.435
1991	12.769.685	2011	62.948.704
1992	14.795.025		
1993	13.019.441		

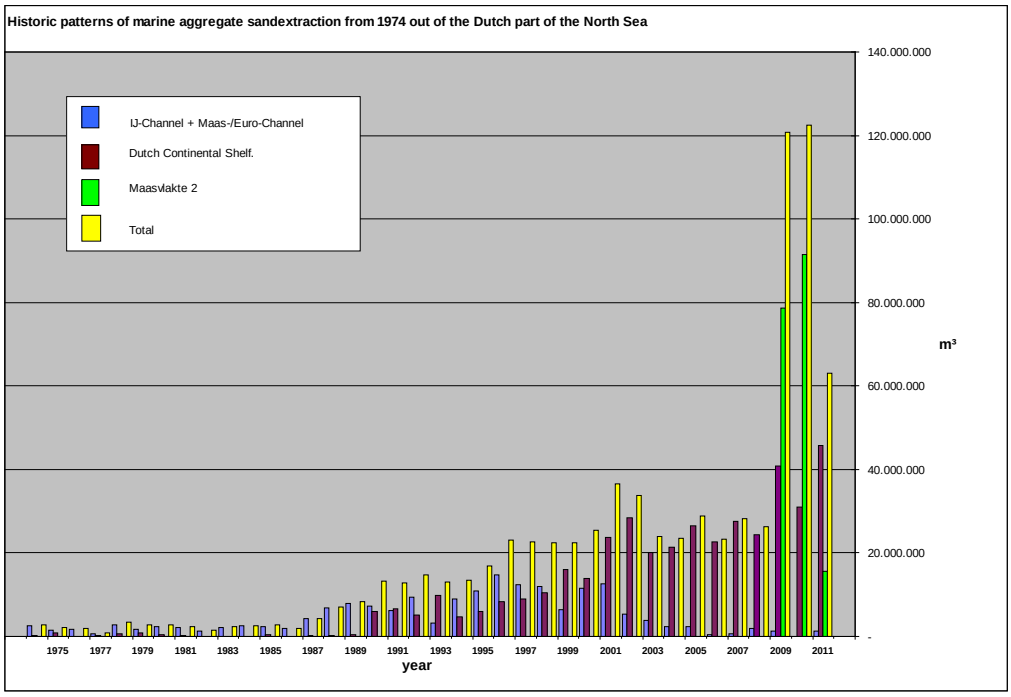


Figure 13.9. Historic patterns of marine aggregate extraction in the Netherlands.

Table 13.24. Licences considered and issued licences Rijkswaterstaat North Sea.

In the year	Amount	In the year	Amount
1998	35	2005	33
1999	30	2006	33
2000	25	2007	24
2001	25	2008	38
2002	42	2009	23
2003	26	2010	15
2004	20	2011	25

Table 13.25. Licensed area and actual area over which extraction occurs (2011).

Country	Licensed Area	Area in which extraction activities occur	Area in which over 90% of extracted material is taken
The Netherlands (data 2011)	456 km^2	71 km^2	23 km^2

13.13 Norway

No information has been provided this year.

13.14 Poland

Table 3.26. Polish historic aggregate extraction.

Year	Beach Nourishment	Construction Aggregate	Total
1990	1 046 358	0	1 046 358
1991	766 450	0	766 450
1992	817 056	54 400	871 456
1993	974798	0	974 798
1994	251 410	6 400	257 810
1995	280 720	0	280 720
1996	134 000	0	134 000
1997	247 310	3 200	250 510
1998	88 870	0	88 870
1999	375 860	73 000	448 860
2000	241 000	280 000	521 000
2001	100 253	86 500	186 753
2002	365 000	167 144	532 144
2003	438414	0	438414
2004	1042896	0	1042896
2005	1043925	0	1043925
2006	548856	0	548856
2007	977358	0	977358
2008	238948	158	239041
2009	702590	0	702590
2010	970923	0	970923
2011	n/d	n/d	n/d

13.15 Portugal

Please note that the new data for this year report only comprises 2010 and 2011 from the Azores and from 2007 to 2011 on the continental shelf areas. The remaining data has already been published in previous WGEXT reports.

Table 13.27. Portuguese aggregate extraction 1995–2011

Extraction volumes (m³)	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Area														
Azores archipelago		6083	149819	146791	118613	176188	197636	189968	181691	141991	144647	134021	124132	126381
Madeira archipelago														
Administração da região hidrográfica do Norte (northern continental shelf)														
Administração da região hidrográfica do Centro (central continental shelf)														
Administração da região hidrográfica do Tejo (southern central continental shelf)										500000	1000000	1000000		
Administração da região hidrográfica do Alentejo (southwestern continental shelf)														
Administração da região hidrográfica do Algarve (southern continental shelf)	1288000								370000				1250000	600000

No data available at the moment
Beach nourishment
Civil construction

13.16 Spain

No extraction to report in 2011.

13.17 Sweden

Aggregate Extraction in Sweden during 2011

In 2011 the Ystad Municipality, in the southernmost part of Sweden was licensed to extract sand from an area 6 km off the coast (Figures 13.10 and 13.11). The permission involved the right to extract 340 000 m³ of sand from "the General Water Area" (inner part of the Swedish territorial waters) during a 10 year period (2011–2020). The sand masses will be used to counteract the ongoing beach erosion in the Ystad Sandskog and Löderups Strandbad areas, which contain beaches that are important for tourism. The retreat of the shoreline is due to a combination of isostatic sinking and sea-level rise.

Ystad municipality originally applied for permission to extract sand in two areas; one named "Nord" (North) and the other one named "Väst" (West). The consultation

process involved 11 consultees, with most of them advising that no extraction should take place within the "Nord" zone. Finally, permission was given by the Geological Survey of Sweden (SGU) in accordance with the Swedish Continental Shelf Act for the "Väst" zone. No permission was given for the "Nord" zone.

The extraction permission is as follows:
100 000 m^3 in 2011
80 000 m^3 in 2014
80 000 m^3 in 2017, and
80 000 m^3 in 2020

If any sand is not extracted and remains within the permitted tonnage for a single year, then the municipality is granted the right to extract these volumes the following year or at the next withdrawal date.

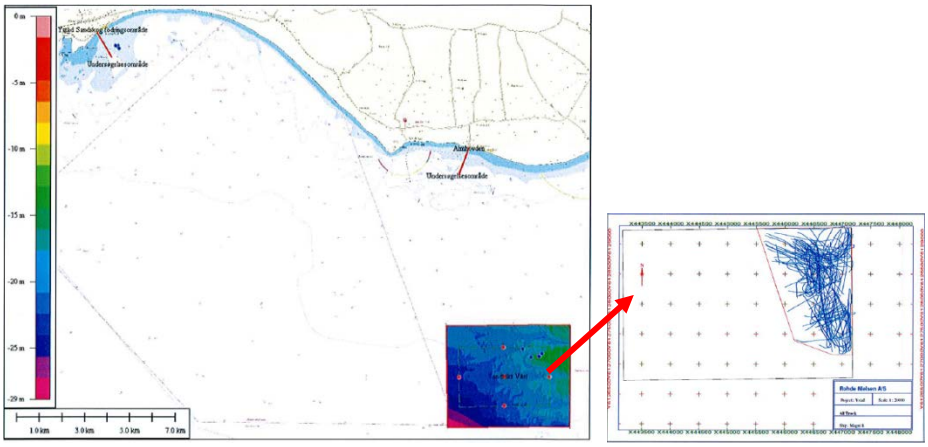


Figure 13.10. Areas permitted for extraction (little map inserted) and areas of sand dispersion (red lines) in the seachart (left). Black Box report from the area extracted in 2011 (right).

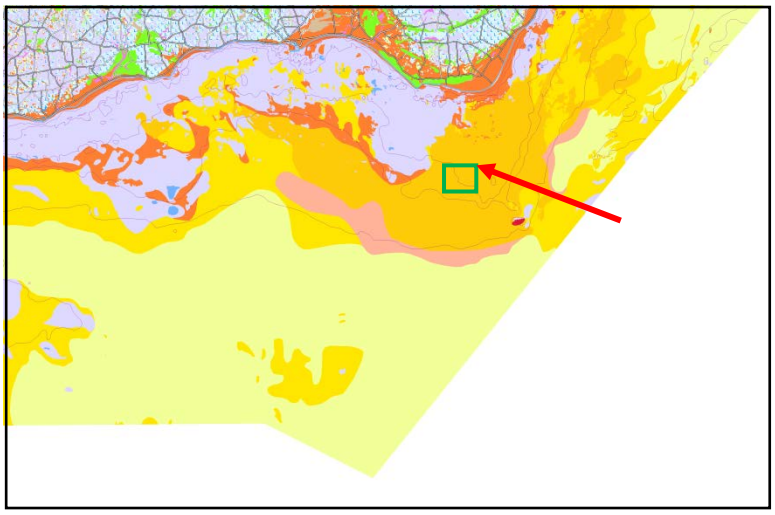


Figure 13.11. Seabed sediment map of the Sandhammaren Bank, southern Sweden. Area of extraction (= green rektangulare) located to sand accumulation (=light brown). Light blue = till, dark yellow = glacial clay, light yellow = postglacial clay, rose = silt, dark brown = coarse sand/gravel (from SGU 2011).

Table 13.28. Marine aggregate (sand and gravel) extraction figure for 2011

(Includes aggregate and material for beach replenishment)

Dredging area	Amounts m3
Sandhammaren	95 562 m3
TOTAL	95 562 m3

b) Non-aggregate (e.g. shell, maerl, boulders etc.) extraction figures for 2011

None during 2011.

c) Exports of marine aggregate in 2011 from The Crown Estate ownership

None during 2011.

d) Amount of material extracted for beach replenishment and reclamation fill projects in 2011

(Only beach replenishment, figure 13.12)

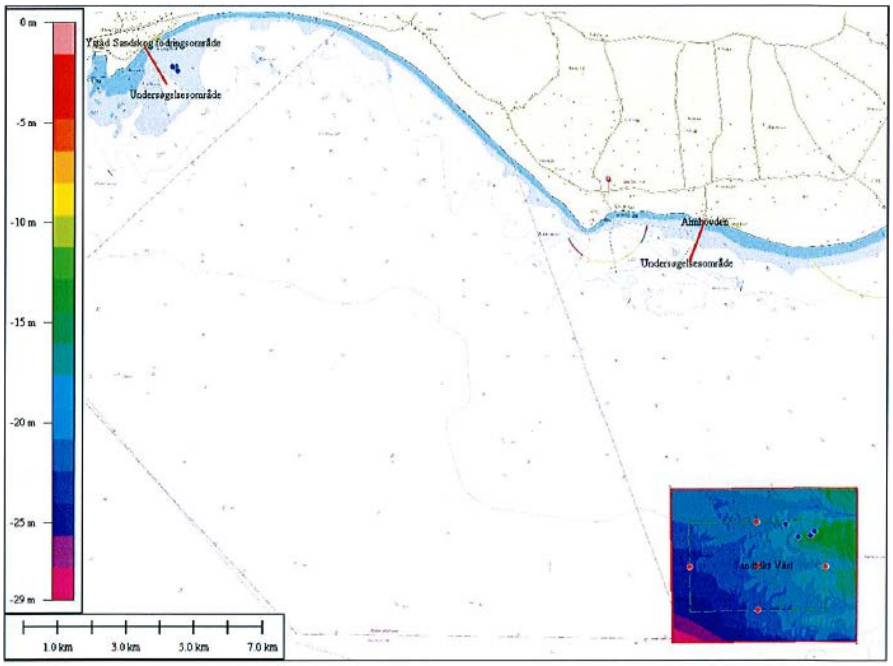


Figure 13.12. Cut of sea-chart showing the area south of Scania, southern Sweden. The extraction area "West" (=small inserted map) for beach-nourishment in two beach areas (=red lines).

e) Historic patterns of marine aggregate extraction (m3)

Table 13.29. Extraction of Marine Aggregate (m^3) in Sweden 1990–2011.

Extraction Area	1990	1991	1992	1993-1997	1998	1999-2005	2006-2010	2011	Total 1990-2011
Disken									0
Sandflyttan	1,692	0,423							2,115
Vastra Haken	31,302	33,840	52,739						117,881
L. Middelgrund									0
S. Middelgrund	138,776	82,534							221,310
Faro									0
Oresund Link					2,500,000				2500,000
Sandhammaren Väst								96,562	96,562
TOTAL	**171,770**	**116,797**	**52,739**	**0**	**2,500,000**	**0**	**0**	**96,562**	**2937,868**

13.18 United Kingdom

Table 13.30. Marine aggregate (sand and gravel) extraction figures for 2011 from The Crown Estate ownership *(Includes aggregate and material for beach replenishment and fill contract)*

All UK statistics reported as tonnes

Dredging Area	Amount (tonnes)
Humber	2 905 879
East Coast	5 275 569
Thames Estuary	806 735
East English Channel	4 344 081
South Coast	4 236 566
South West	1 232 087
North West	314 098
Rivers and Miscellaneous	0
TOTAL	19 115 015

Extraction tonnages for fill contracts and beach replenishment were as follows:

Contract Fill 311 457 tonnes

Beach Replenishment 1 182 846 tonnes

Non-aggregate (e.g. shell, maerl, boulders etc.) extraction figures for 2011

None during 2011 from The Crown Estate ownership.

Table 13.31. Exports of marine aggregate in 2011 from The Crown Estate ownership.

Port (landing)	Amount (tonnes)
Amsterdam	1 411 992
Antwerp	462 630
Bruges	335 409
Calais	68 906
Dieppe	25 623
Dunkirk	204 344
Fecamp	64 082
Flushing	1 145 828
Gent	443 418
Harlingen	68 958
Honfleur	79 028
Le Havre	462 586
Le Treport	38 532
Ostend	476 059
River Seine Wharves	200 624
Rotterdam	379 837
Zeebrugge	230 164
TOTAL	6 098 020

Table 13.32. Amount of material extracted for beach replenishment and reclamation fill projects in 2011 from The Crown Estate ownership.

Dredging Area	Amount (tonnes)
Bulverhythe	22 028
Eastbourne	253 849
Felixstowe	142 106
Lincshore	730 033
Pevensey	34 830
Seaton	311 457
TOTAL	1 494 303

Table 13.33. Historic patterns of marine aggregate extraction (tonnes) from The Crown Estate ownership.

(Figures exclude beach replenishment and fill contracts)

Extraction Area	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	*Total*
Humber	2 694 977	2 840 261	3 122 080	2 933 623	2 710 881	2 928 366	3 031 699	3 392 015	3 521 737	3 184 814	3 154 070	2 524 328	2 622 126	*2 175 846*	*40 836 823*
East Coast	8 923 562	9 131 512	9 129 635	9 636 697	9 011 323	8 611 199	8 538 073	7 881 670	8 006 736	7 715 428	6 075 899	5 637 296	4 871 443	*5 275 569*	*108 446 042*
Thames Estuary	862 834	971 960	854 483	909 141	1 291 103	838 185	758 257	696 012	899 852	977 027	1 735 141	405 485	518 881	*664 629*	*12 382 990*
East English Channel	2 180 099	1 958 476	1 387 450	875 030	1 163 892	1 212 951	457 102	474 553	323 824	1 961 035	2 443 367	2 256 919	2 409 476	*4 317 153*	*23 421 327*
South Coast	3 641 602	3 926 856	4 226 088	4 752 978	4 235 188	4 445 311	4 691 857	4 914 793	5 127 989	4 752 843	3 934 692	3 492 424	3 430 463	*3 917 315*	*59 490 399*
South West	1 886 289	1 719 803	1 602 394	1 549 431	1 467 122	1 515 241	1 633 383	1 591 610	1 545 275	1 769 197	1 470 719	1 019 174	931 951	*956 102*	*20 657 691*
North West	275 590	355 044	316 090	421 068	482 270	470 962	558 398	611 983	608 314	633 405	432 889	271 598	307 509	*314 098*	*6 059 218*
Rivers & Misc	6 238	6 273	46 120	73 047	78 597	85 153	99 079	124 506	111 687	109 399	87 787	92 263	39 458	*0*	*959 607*
Yearly Total	*20 471 191*	*20 910 185*	*20 684 340*	*21 151 015*	*20 440 376*	*20 107 368*	*19 767 848*	*19 687 142*	*20 145 414*	*21 103 148*	*19 334 564*	*15 699 487*	*15 131 307*	*17 620 712*	*272 254 097*

Table 13.34. Summary of current licence position and forecasts for future exploitation of marine aggregates within The Crown Estate ownership.

TYPE	STATUS	No.
Licences	Extraction licences	65
Applications*	New applications	30
Prospecting	Prospecting licences	0

*** Applications excludes current licences which have a renewal application submitted**

13.19 United States

Table 13.35. Marine aggregate (sand and gravel) extraction figures for 2011.

DREDGING AREA	AMOUNT
New York Harbor(Ambrose Channel), New Jersey	778 308 cubic meters
New York Harbour navigation channels	389 923 cubic meters

Description of aggregate extraction activities in 2011

The only active operating for the extraction of marine sand to be used for aggregate continues to be that done by a private company, Amboy Aggregates, which removes sand from the seaward section of the main shipping channel into New York Harbour (the Ambrose Channel). This commercial operation extracted 778 308 cubic meters of sand in 2011. An additional 389 923 cubic meters of sand was dredged from navigation channels in New York Harbour and used as submarine capping material in the restoration of a former, offshore disposal site known as the Historic Area Remediation Site (HARS), approximately 22 km outside on New York Harbour.

Table 13.36. Non-aggregate (e.g. shell, maerl, boulders etc) extraction figures for 2011.

DREDGING AREA	MATERIAL	AMOUNT Cubic Meters
New York Harbour	Glacial till	767 613 cubic meters
New York Harbour	Silt/clay	1 760 000 cubic meters
New York Harbour	Rock	358 576 cubic meters

Description of non-aggregate extraction activities in 2011

This material was dredged from navigation channels in New York Harbour both for routine maintenance and channel-deepening. The dredged material used to cap an abandoned, offshore, dredged sediment disposal site. The site is on the shelf 22 km outside on New York Harbor. The disposal site, when active, was referred to as the "Mud Dump" site. It is now the HARS (Historic Area Remediation Site).

Exports of marine aggregate in 2011: None

Table 13.37. Amount of material extracted for beach replenishment projects in 2011.

DREDGING AREA	MATERIAL	AMOUNT
Brigantine, New Jersey	sand	133 796 cubic meters
Atlantic City, New Jersey	sand	766 844 cubic meters
Avalon, New Jersey	sand	344 048 cubic meters
Cape May City, New Jersey	sand	811 188 cubic meters
Lower Cape May Meadows/Cape May Point, New Jersey	sand	229 365 cubic meters
Sea Isle City, New Jersey	sand	287 429 cubic meters
Stone Harbor, New Jersey	sand	443 439 cubic meters
Strathmere, New Jersey	sand	350 242 cubic meters
Surf City (Long Beach Island), New Jersey	sand	229 365 cubic meters
Ventnor City, New Jersey	sand	133 796 cubic meters
Monmouth Beach, New Jersey	sand	626 931 cubic meters
Montauk, New York	sand	9175 cubic meters
Orchard Beach, New York	sand	22 937 cubic meters
Assateague Island	sand	100 558 cubic meters

Description of beach replenishment schemes in 2011

The total volume of marine sand extracted and placed as beach nourishment in 2011 was 4 489 111 cubic meters.

Historic patterns of marine aggregate extraction in millions of cubic yards

1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
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	1.4	1.6	1.4	1.2	1.2	1.0	0.7	0.8	0.8

14 Annex 5: Review of National Seabed Resource Mapping Programmes

14.1 Belgium

Development of Maps by the Belgian Sand Fund

Bathymetric maps

The Sand Fund of the Ministry of Economic Affairs in the framework of their monitoring program for sand and gravel extraction are producing maps of the extraction areas on a regular basis. An overview of all monitored areas in the framework of the Belgian Sand Fund is given in Figure . Most of these areas are at least monitored once a year.

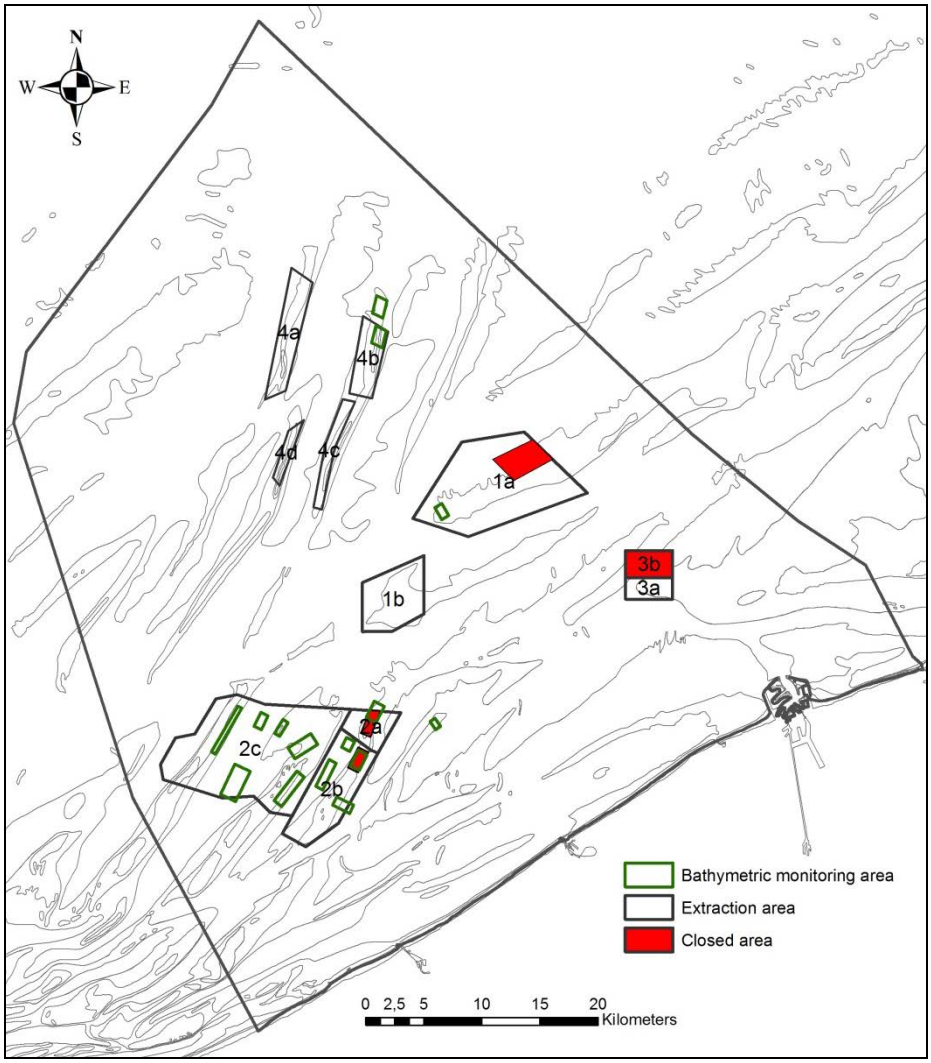


Figure 14.1. Overview of all bathymetric monitoring areas sampled with EM3002D by The Sand Fund of the Ministry of Economic Affairs.

For all explored areas, data on bathymetry, backscatter and acoustic sediment classification are available. With the new multi beam system EM3002D on the R.V. Belgica (since 2008) detailed maps can be produced rapidly.

For more information, the Sand Fund can be contacted directly (see address below).

Marc Roche, SERVICE PUBLIC FEDERAL ECONOMIE, P.M.E, CLASSES MOYENNES ET ENERGIE, Qualité et Innovation, Service Plateau Continental- Fonds pour l'Extraction de Sable, North Gate - Bureau 4B28, Boulevard du Roi Albert II, 16 - 1000 Bruxelles, Belgique Tel : 02 277 77 47, GSM : 0475 73 05 71, Fax : 02 277 54 42, Email : Marc.Roche@economie.fgov.be

Developments in marine resource mapping in other institutes in Belgium

The Management Unit of the North Sea Mathematical Models (MUMM) has continued seabed mapping in the frame of the Belgian Science Policy projects Quest4D (Quantification of Erosion/Sedimentation patterns to Trace the Natural from the Anthropogenically-induced Sediment dynamics) and EnSIS (Ecosystem Sensitivity of Invasive Species). Both projects were finalised in 2011 and the reports were published. References to both:

Van Lancker V., Baeye M., Du Four I., Janssens R., Degraer S., Fettweis M., Francken F., Houziaux J.S., Luyten P., Van den Eynde D., Devolder M., De Cauwer K., Monbaliu J., Toorman E., Portilla J., Ullman A., Liste Muñoz M., Fernandez L., Komijani H., Verwaest T., Delgado R., De Schutter J., Janssens J., Levy Y., Vanlede J., Vincx M., Rabaut M., Vandenberghe H, Zeelmaekers E and Goffin A. (2012). QUantification of Erosion/Sedimentation patterns to Trace the natural versus anthropogenic sediment dynamics (QUEST4D). Final Report. Science for Sustainable Development. Brussels: Belgian Science Policy, 97 pp. + Annexes. (link to pdf)

Short summary: Sustainable development requires the quantification of human impacts, against the seafloor's ecological value. Recent impact studies have shown only localised effects, though indications of a longer-term and broader-scale degradation of the seafloor exist. This is due to cumulative anthropogenically-induced effects, but also to natural evolution and the response of the seafloor due to sea-level rise. New insights have been revealed based on the combination of advanced modeling, validated with experiments; targeted observations/samplings, within the space, depth and time domain (4D); and various long-term datasets. Erosion/sedimentation processes have been quantified. This is important for: the development of criteria for a sustainable exploitation/management and sustainable coastal protection schemes; allocating efficient dumping grounds; understanding coastal habitat change; and the prediction of sources/sinks of pollutants.

Houziaux J.S., Craeymeersch J., Merckx B., Kerckhof F., Van Lancker V., Courtens W., Stienen E., Perdon J., Goudswaard P.C., Van Hoey G., Vigin L., Hostens K., Vincx M. and Degraer S. (2011). 'EnSIS' - Ecosystem Sensitivity to Invasive Species. Final Report. Brussels : Belgian Science Policy 2011 – Research Programme Science for a Sustainable Development. 100 pp.

For more information contact can be made directly with:

Dr. Vera Van Lancker, Royal Belgian Institute of Natural Sciences Management Unit of the North Sea Mathematical Models Gulledelle 100, 1200 Brussels, Belgium, Tel. +32 (0)2 773 21 29. Fax +32 (0)2 770 69 72, Email: vera.vanlancker@mumm.ac.be, Website http://www.mumm.ac.be

14.2 Canada

No information has been provided this year.

14.3 Denmark

No information has been provided this year, however from the 2011 report:

Organisation(s) undertaking seabed mapping programmes:

Danish Ministry of the Environment, Nature Agency is responsible for the mapping of marine aggregates. The mapping projects are carried out by contractors.

14.4 Estonia

No further information has been provided this year, however, from the 2010 report:

Organisation(s) undertaking seabed mapping programmes:

Geological Survey of Estonia

14.5 Finland

Developments in marine resource mapping

Organisation(s) undertaking seabed mapping programmes:

Geological Survey of Finland (GTK)

Scope of seabed mapping programmes being undertaken in 2011

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 seismic and side-scan sonar and multibeam sonar equipment. 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 nature and human activity. Also the demand of various practical and scientific needs arising in a surrounding community should be met.

The Finnish Inventory Programme for the Underwater Marine Environment (VELMU) collects data on the diversity of underwater marine biotopes and species. The inventories are being conducted in the Archipelago Sea, the Quark, the Gulf of Finland, the Bothnian Bay and the Bothnian Sea. VELMU is a cooperation programme between seven ministries (environment, internal affairs, defence, education, communication, agriculture and forestry, employment and the economy) (http://www.ymparisto.fi/default.asp?contentid=210670&lan=fi&clan=en).

In the year of 2011 about 2400 line kilometres was surveyed by GTK in the Sea of Bothnia covering an area of about 900 km². An example of the work undertaken is shown in figure 14.2.

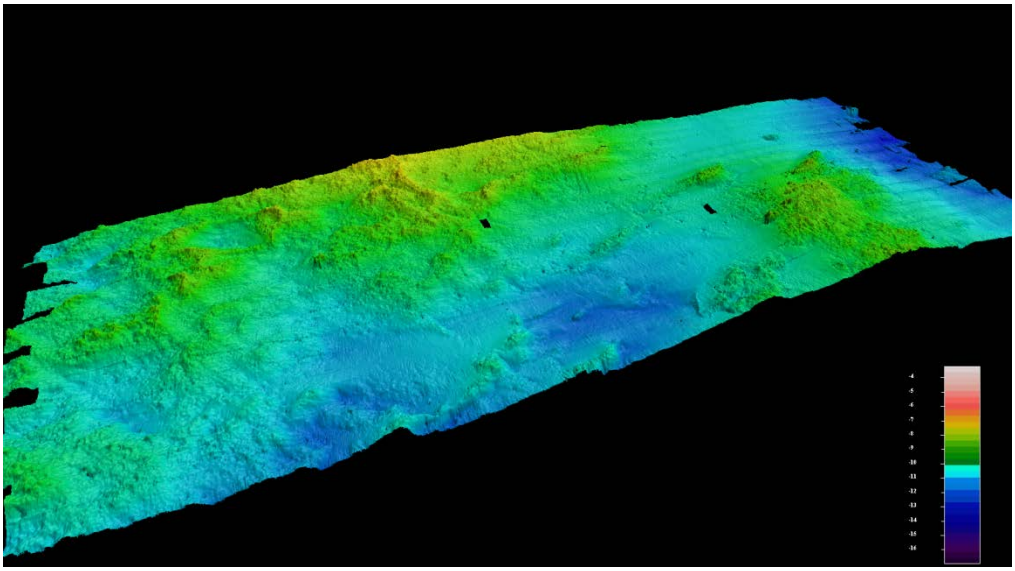


Figure 14.2. Example of the mapping work being undertaken in Finland.

Published seabed resource maps in 2011

The marine geological mapping index is shown in Figure 14.3 below.

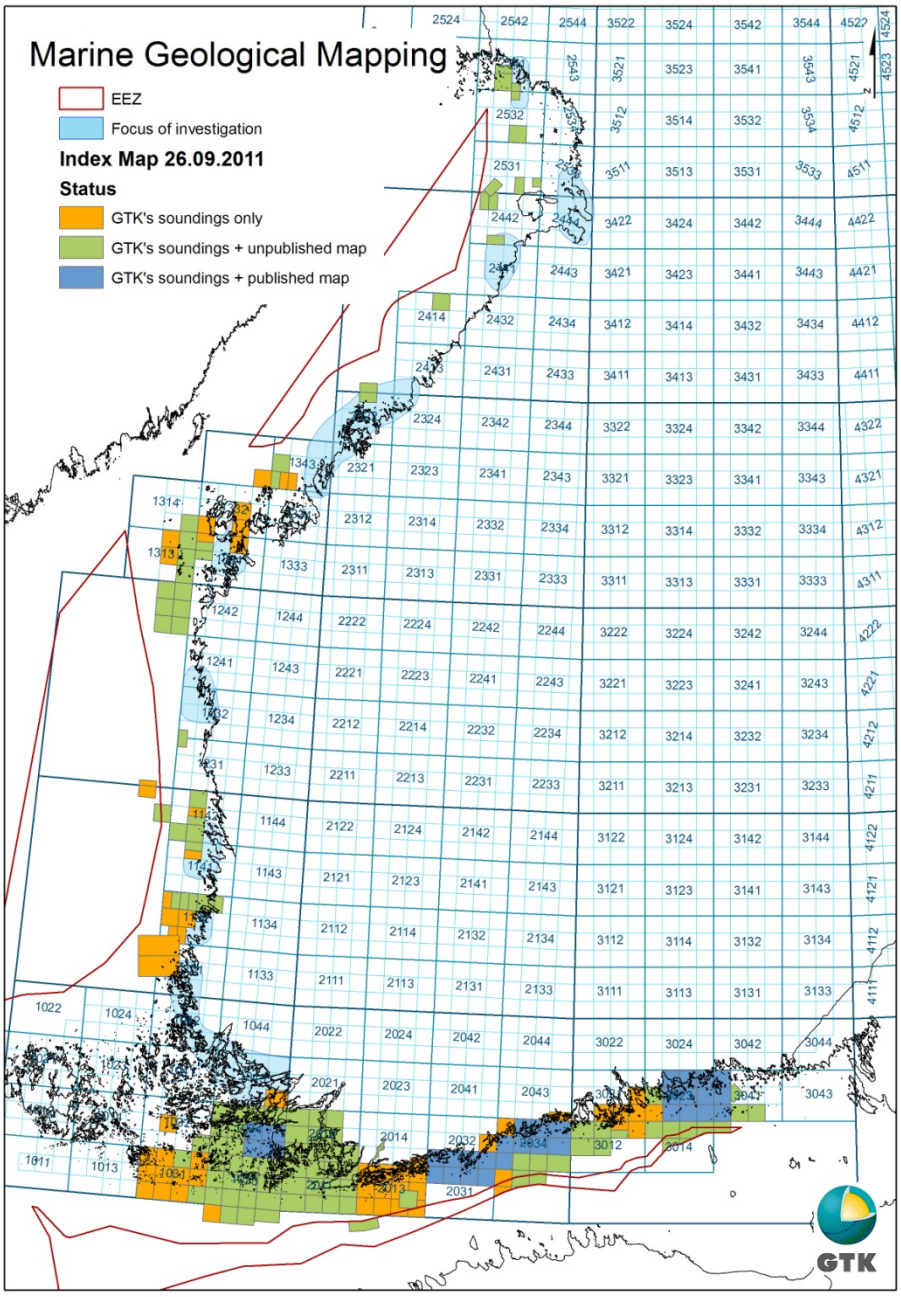


Figure 14.3. The Marine Geological Mapping Index.

Future marine resource mapping programmes

The annual goal of seabed survey is about 500 km². In the year 2012 main focus areas are in the Bay of Bothnia and in the Eastern Gulf of Finland. The main focus will be in the areas under utilization pressures and major construction sites.

14.6 France

IFREMER has published a geological atlas of the Bay of Lannion (Northern Brittany, Western Channel). Ref: Augris C., Simplet L. (coord), 2011. «Atlas géologique de la

Baie de Lannion, Côtes d'Armor, Finistère ». Partenariat Ifremer Conseil Général des Côtes d'Armor et Lannion-Trégor agglomération. Ed Quae. 7 maps, scale 1/20,000, livret d'accompagnement, 112 pp.

In 2011, IFREMER (France) initiated a new program (under contract with the Ministry of Environment) for identification of potential areas for sand and gravel extraction along the Brittany and Atlantic coasts (expected publication: 2012).

In 2011 in France there are some ongoing EIA, and one is finished in the Eastern English Channel (Baie de Seine: see SIEGMA project) but the final report will be available in 2012.

14.7 Germany

No information has been provided this year.

14.8 Greenland and the Faeroes

No information has been provided this year.

14.9 Iceland

Posters of the mapping undertaken between 1940 and 2010 are presented:

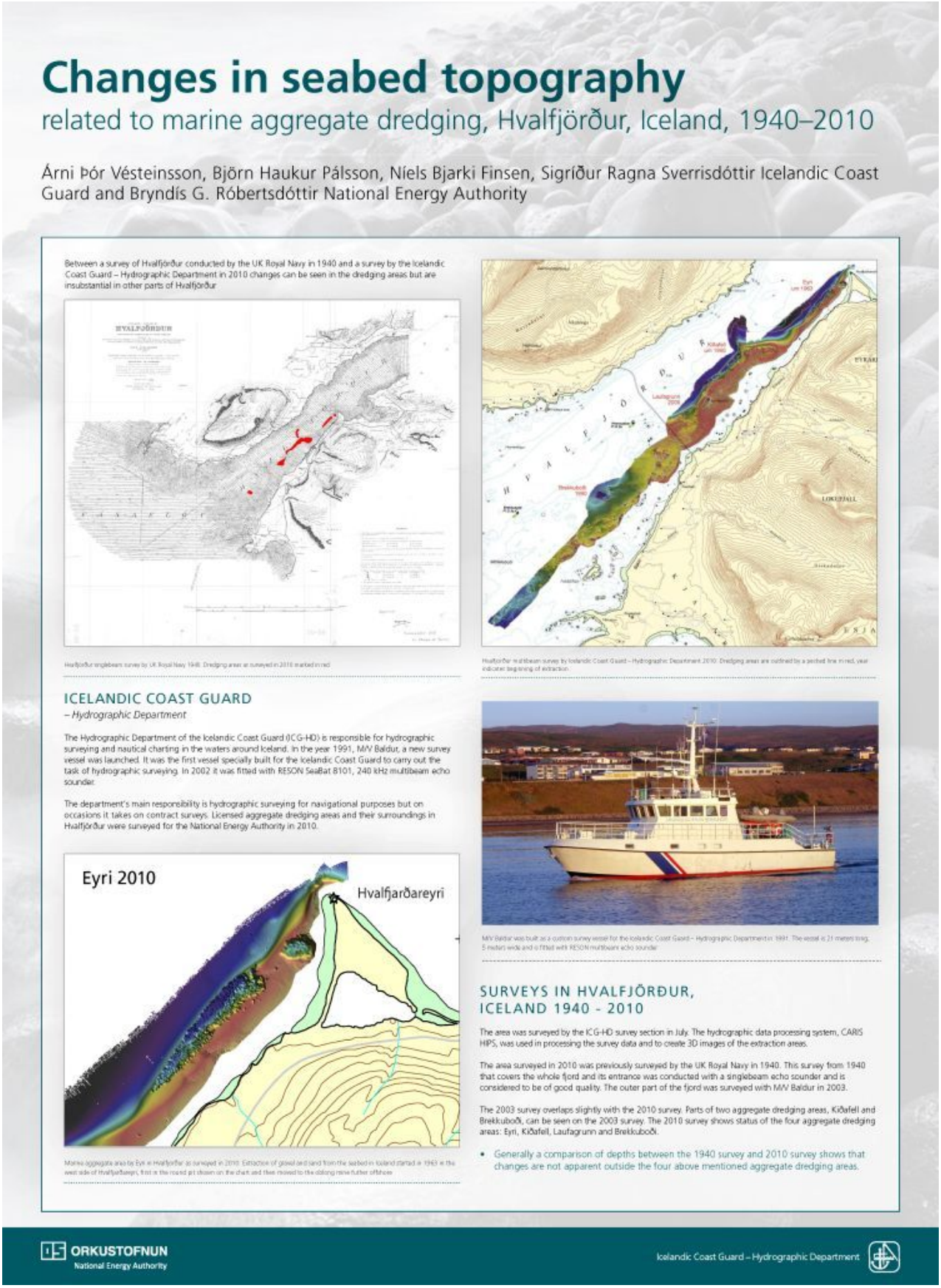


Figure 14.4. Mapping surveys undertaken in Iceland between 1940 and 2010.

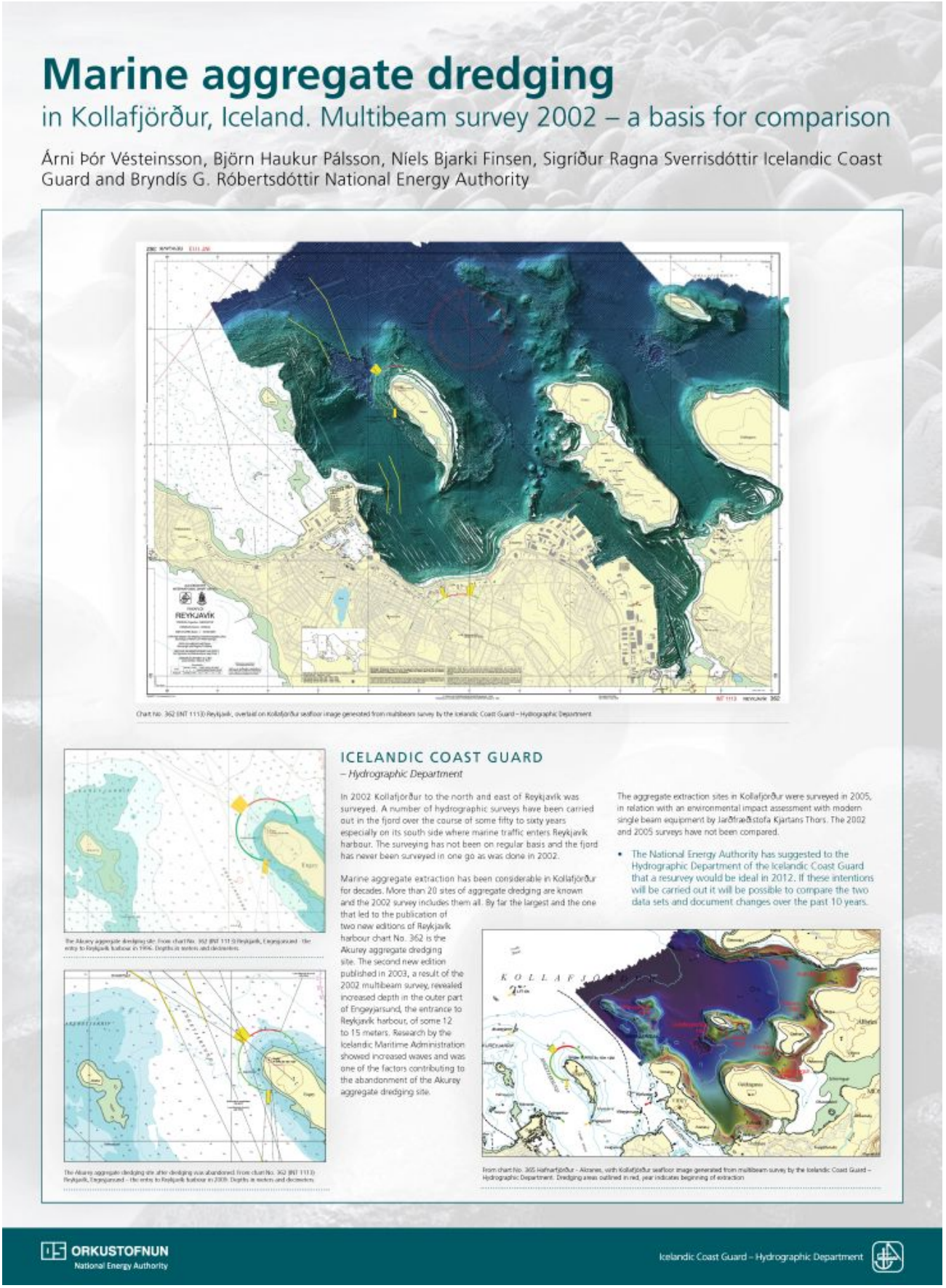


Figure 14.5. Mapping undertaken for marine aggregate dredging.

14.10 Ireland

No information has been provided this year.

14.11 Latvia

No information has been provided this year.

14.12 Lithuania

No information has been provided this year.

14.13 Netherlands

Maps are produced on a continuous basis as demand requires from data held in a central database. They are used for licensing, monitoring and prospecting purposes.

Resource mapping and modelling is the responsibility of two organizations: the Geological Survey of the Netherlands and Deltares, an independent institute for applied research in the field of water, subsurface and infrastructure. The Geological Survey manages, queries and analyzes the central geological database, whereas Deltares has extensive expertise in the areas of geophysical monitoring and numerical modelling.

The overall mapping program for the Dutch part of the North Sea covers the entire Netherlands EEZ and the territorial sea. The 3D model of the Quaternary record as created for the onshore part of the Netherlands is being extended to the North Sea realm. A recent pilot study has shown that 2D and 3D seismic data, originally collected for hydrocarbon exploration, are very useful in delineating much shallower stratigraphic units. This is best achieved by interpreting 3D seismic surveys together with high-resolution 2D seismic lines and well data. In the pilot, focus has been on the Oyster Grounds and Silver Well areas in the central part of the Dutch continental shelf. The units modelled thus far include Middle- to Late-Pleistocene strata that have accumulated in the North Sea Basin. In time slices showing sub-horizontal map views, the 3D seismic surveys reveal some remarkable, well-preserved sedimentary features that cannot be delineated using 2D profiles or cores but are clearly visible in horizontal time slices.

In 2011, resource mapping has concentrated on the development of a decision-support system for marine-aggregate extraction. It is a follow-up of a pilot project in which a resource-information model was developed for the coastal zone of the Netherlands Continental Shelf, between the 15-m depth line and the 12-mile boundary. The decision-support system is intended to answer the question which areas must be cored and mapped in more detail within which timeframe in light of the enormous demand for marine sand that follows from the national policy on coastline maintenance during the 21st century. As part of the associated prioritization, the determining factors are sand quality (for three depth ranges), extractability (for the same three depth ranges), proximity to the final destination of the sand, and existing data density. The resulting information system consists of a GIS file with a series of grids assigning penalty points to highlight areas that are potentially highly suitable to sand extraction but do not have enough core or seismic data available to be sure at the required spatial detail.

To demonstrate the usefulness of the model, cases have been worked out for offshore Zeeland and offshore Zuid-Holland. In these cases, bathymetry and vessel draft are also included as parameters. First results show that the approach is suitable for de-

termining at which distance from the final destination and x volume of sand can be extracted at minimum cost.

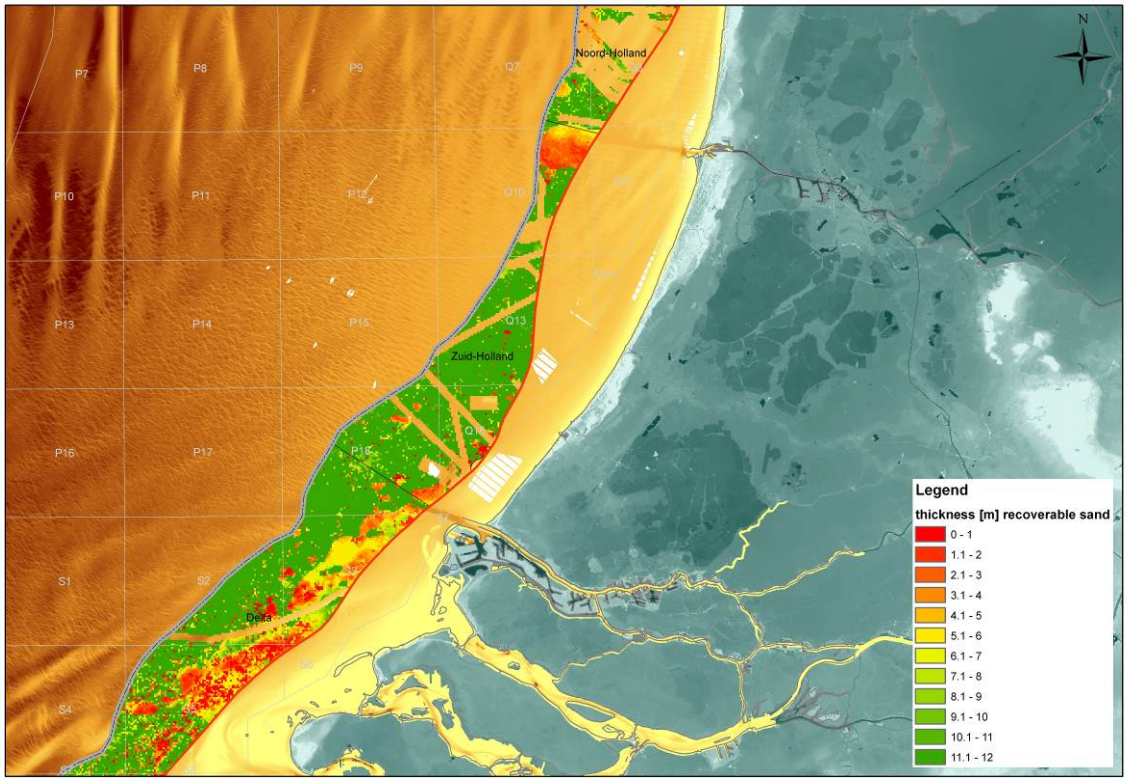


Figure 14.6 **Thickness of potentially extractable sand in the first 12 m of sediment below the seabed for a 140-km long coastal area offshore the provinces of Zeeland, Zuid-Holland and Noord-Holland. Green is abundant sand, red is little sand. Exclusion areas, particularly abundant offshore Noord-Holland, are left blank.**

14.14 Norway

No information has been provided this year.

14.15 Poland

No information has been provided this year.

14.16 Portugal

No mapping work has been provided by Portugal this year, however, from the 2011 Annual report:

Organisation(s) undertaking seabed mapping programmes:

Laboratório Nacional de Energia e Geologia (LNEG). It's the Portuguese Geological Survey institute. Within the marine area it is responsible to do the geological mapping and assess the mineral resources of the submerged area under national jurisdiction (EEZ);

Instituto Hidrográfico (IH). It's the Portuguese Hydrographic Institute. It is responsible to provide the national, defence and civil, information for navigational and

other hydrographic purposes (e.g. tidal previsions, marine weather forecast, nautical and hydrographical charting);

Estrutura de Missão para a Extensão da Plataforma Continental (EMEPC). It's the Task Group for the Extension of the Portuguese Continental Shelf beyond the 200 nautical miles.

14.17 Spain

No information has been provided this year.

14.18 Sweden

The Overview Mapping Programme 1999–2008 (presentation scale 1:500 000)

The field work of this programme was ended in 2008, when the last part of the Swedish continental shelf area (162 000 sqkm) was mapped in this sparse grid. The programme was run with the same technique as the mapping programme in the scale 1:100 000 (see, below), but the grid was less dense (c. 10–12 km distance between the track lines) and fewer samples have been analysed (Figure 14.7a). This means that the outcome of the project is corridors, about 1 km wide, showing the distribution of sea-bed sediments, stratigraphy, the distribution of elements and organic micro-pollutants in the topmost sediments of the corridors and the recent accumulation rate.

The Swedish Marine Geological Mapping Programme (presentation scale 1:100 000)

This mapping programme started in the end of the 1970s and was reduced in1999, when the overview programme was launched, to start up at full scale again in 2009. Below the activities carried out in 2011 are presented.

The Blekinge Coast 2009–2012

The fieldwork of the Swedish Marine Geological Mapping Programme was in 2009/2010 carried out along the Blekinge Coast in northern Hanö Bay and in the southern Kalmar Sound between the Swedish mainland and the Öland Island. The Programme was in 2011 extended with the middle part of Kalmar Sound. The aim of the programme is to produce a map for presentation in the scale 1:100 000; showing the distribution of the sea-bed sediments and the stratigraphy of the bottom area all the way from the shoreline of the mainland to about 2 km off the base-line. The area has been completely covered with a side scanning sonar mosaic and along the track lines shallow reflection seismic (air-gun) and sub-bottom profiling (3.5 kHz) records have been performed. In addition the distribution of 57 elements and 30 organic micro-pollutants has been investigated in the topmost sediments in accumulation areas. The recent accumulation rate has been determined by ^{137}Cs-profiles analysed on board the survey vessel, S/V Ocean Surveyor. Several 0.5 m long cores also have been recorded and analysed with digital x-ray technique (ITRAX sediment scanner) placed on board the survey vessel. This is a quality control of the sediment used for geochemical analyses.

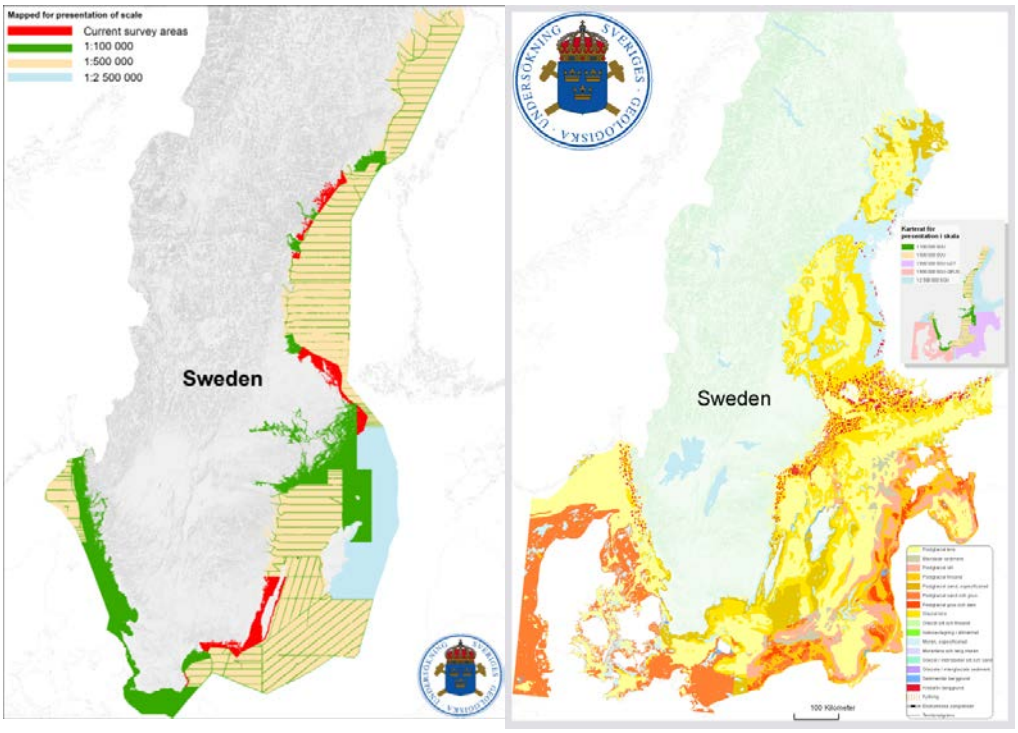


Figure 14.7a Left **Current survey status in Sweden showing the track-lines (corridors) in the overview mapping programme 1999–2008. Filled areas mark the Mapping Programme (1977-and onwards) in the scale 1:100 000.**

Figure 14.7b Right **Seabed sediment map of the Baltic Sea, Kattegat and Skagerrak.**

The Uppland Coast, southern Bothnian Sea 2008–2012

The fieldwork of this project started in 2008 and was finalized in 2010 and the compilation is planned to be finalised in 2012. The extent of the area is shown in figure 14.7a. The programme was run with the same technique as the mapping described above. The Swedish SEPA plans to make a second marine national park in the Gräsö Archipelago.

The Uppland Coast, northern Bothnian Sea 2010–2012

This project commenced in 2010 and is currently ongoing. The mapping project is linked to the Fibre bank research reported in section 16.17.

14.19 United Kingdom

A programme of data collection is currently underway in the UK to enable effective mapping of Marine Conservation Zones but this does not specifically focus on aggregate extraction sites. Aggregate companies and other marine users continue to undertake their own ad-hoc prospecting surveys, under licence, to identify new resources. A number of discrete habitat mapping programmes associated with aggregate extraction have been commissioned as a result of standalone research initiatives funded through the former Marine Aggregate Levy Sustainability Fund (Marine ALSF). Outputs from these programmes are available from (www.cefas.defra.gov.uk/alsf.aspx).

Four Regional Environmental Characterisation (REC) data collection surveys commissioned through the former Marine Aggregate Levy Sustainability Fund (MALSF) to augment aggregate industry-led Regional Environmental Assessments (REA) are now available. These cover the Thames Estuary, Isle of Wight, Anglian and Humber

regions (http://www.cefas.defra.gov.uk/alsf/projects/rec-projects.aspx). These studies were commissioned to provide an environmental context within which marine aggregate extraction could be placed and consisted of significant data collection and mapping, including mutlibeam mapping, biotope classification and heritage mapping. In conjunction with industry led REA's, the REC's will help to identify key issues which need to be addressed within site specific Environmental Impact Assessments to support specific applications to extract marine aggregate. The data and maps generated by the REC programme also augments wider marine data needs.

14.20 United States

No new mapping programmes have taken place this year.

15 Annex 6: Review of Developments in National Authorisation and Administrative Framework and Procedures

15.1 Belgium

The legislation for aggregate extraction in Belgium came into force on 1 September 2004. No changes were made to that legislation in Belgium for exploitation zones 1, 2 and 3. On 14 January 2011, the new MD 24.12.10 was published, in which 4 extraction zones (4a,b,c & d) were assigned in exploration zone 4 on the Belgian Continental Shelf, together comprising a new exploitation area of 46 km².

A major review of the RD of 1 September 2004 was ongoing in 2011, and will probably be published in 2012.

As such no major new developments in the authorization and administrative framework and procedures are to be reported for 2011. The regulations on the use of black boxes also didn't change in 2011.

15.2 Canada

No information has been provided this year.

15.3 Denmark

No information has been provided this year.

15.4 Estonia

No information has been provided this year.

15.5 Finland

No changes to report.

15.6 France

In May 2010, Ministry of Environment produced a new Guidelines for impact assessment of aggregate extraction project on the Natura 2000 sites. The additional content is to take into account habitats and species of communautary interest, and to investigate mitigation measures.

15.7 Germany

No information has been provided this year.

15.8 Greenland and the Faeroes

No information has been provided this year.

15.9 Iceland

No information has been provided this year.

15.10 Ireland

No information has been provided this year.

15.11 Latvia

No information has been provided this year.

15.12 Lithuania

No information has been provided this year.

15.13 Netherlands

Policy and management

The National Water Plan (NWP) from 2009 has defined the area between the established NAP -20 meter depth contour and the 12 miles boundary as a zone were sand extraction has priority to other uses of the sea.

In the revised Integrated Management Plan North Sea 2015 (2011), as implementation of the NWP, an integrated comparative assessment framework is formulated consisting of the following elements:

1. Description of the activity, including spatial claim and taking into account the precautionary principle.

2. Assessment of spatial claim regarding other use of the sea. Sand extraction is defined as of national interest and has priority in the zone mentioned in the NWP. Seawards of this zone other uses of national interest, as wind energy, have priority over sand extraction. Landwards of this zone sand extraction is not allowed, with a few exceptions.

Off the coast of the Delta Area a zone is defined were extraction of coarse sand has priority.

3. Assessment on the necessity of the activity to take place in the North Sea and the influence on nature areas. Sand extraction, as activity of national interest, is not involved in this assessment.

4. Mitigation of negative effects of the activity, including sand extraction, on nature and other uses of the sea.

5. Compensation of effects when mitigation is not completely possible.

To anticipate on an increase in sand extraction for coastal nourishments due to sea level rise, a new strategy on marine sand extraction is formulated that aims at a regional approach from one or more of the following starting points: costs, natural and ecological values, sustainability, spatial planning and resource management.

To implement the sand extraction strategy a number of studies are done on economical approach of sand extraction (Morselt *et al.*, 2010; Morselt 2010; Briene *et al.*, 2011), natural values of the Zeeland Banks Area (Cleveringa *et al.*, 2012) and the use of the new developed resource-information model, which is described in section 14.13 (Maljers *et al.*, 2010; Vonhögen *et al.*, 2011).

Most of the literature mentioned below is available on www.noordzeeloket.nl

Briene, M., T. De Gier, J. De Ronde, L. de Swart and M. Van den Bossche. 2011. Strategy of systematic planning of sand extraction (in Dutch). Ecorys, Rotterdam.

Cleveringa, J., F. van Vliet, J.H. Bergsma and R.J. Jonkvorst. 2012. Sand extraction on the Zeeland Banks. Research on effects on ecological and geomorpholical values and costs aspects (in Dutch). Report 11-180. Bureau Waardenburg b.v., Culemborg.

Maljers, D., J. Stafleu and L. Vonhögen. 2010. Extension of the resource-information model for the Netherlands Continental Platform (in Dutch). Report 1203426-000. Deltares, Utrecht.

Morselt, T.T., J.Brakel and M.van Zanten. 2010. Ecomomical and environmental effects of the sand extraction strategy (in Dutch). Report P09014. Blueconomy, Zaltbommel

Morselt, T.T. 2010. Financial implications of the sand extraction strategy - pricing of interests (in Dutch). Report P10009. Blueconomy, Zaltbommel.

Vonhögen, L. and S. van Heteren. 2011. Sand extraction strategy: towards a decision-support system for marine sand extraction (in Dutch). Deltares, Utrecht.

15.14 Norway

No information has been provided this year.

15.15 Poland

No information has been provided this year.

15.16 Portugal

No changes to report

15.17 Spain

No information has been provided this year

15.18 Sweden

No changes to report this year.

15.19 United Kingdom

During 2011, the key legislation governing the extraction of Marine Minerals (Aggregates) in the UK changed. The previous legislation was replaced by provisions made under the Marine and Coastal Access Act 2009 (http://www.legislation.gov.uk/ukpga/2009/23/contents). Specifically dredging is included as a licensable activity under Section 66 of the Act which came into force on 6th April 2011:

"To carry out any form of dredging within the UK marine licensing area (whether or not involving the removal of any material from the sea or sea bed)."

In England, the regulations are accompanied by procedural guidance in:

Marine licensing guidance 3: Dredging, disposal and aggregate dredging. April 2011.

(http://www.marinemanagement.org.uk/licensing/documents/guidance/03.pdf).

Previous guidance documents, namely "Marine Minerals Guidance Note 2" which supplement the existing "Marine Minerals Guidance Note 1" are still available. These documents contain guidance on environmental assessment, mitigation and monitoring criteria, based in part on the 2003 ICES WGEXT Guidelines.

In England the Marine Licence will be issued by the Marine Management Organisation (MMO), in Wales by the Welsh Assembly Government and in Scotland by Marine Scotland. Further information on these regulations and the changed responsibilities as a result of the Marine and Coastal Access Act can be found at www.marinemanagement.org.uk, for Wales at www.wales.gov.uk and for Scotland at www.scotland.gov.uk/marinescotland.

15.20 United States

No changes to report in 2012.

16 Annex 7: Review of Approaches to Environmental Impact Assessment and Related Environmental Research

16.1 Belgium

EIA/Continuous monitoring

The EIA that was published in 2008 is still valid for Belgium for extraction zones 1, 2 and 3. In 2010, a new EIA was published for zone 4, and it is used for all new concession demands. Since marine sand and gravel extraction started in Belgium (1978), continuous monitoring has been carried out by the three responsible governmental institutes, i.e. Fund for sand extractions of the Federal Public Service (FPS) Economy, the Management Unit of the North Sea Mathematical Models (MUMM) of the Belgian federal public planning service Science Policy, and the Institute for Agriculture and Fisheries Research (ILVO-Fisheries) of the Flemish Government. These monitoring programs are funded by the fees which concession holders have to pay per m^3 extracted.

As part of the legislative obligations, the three institutes officially involved in the monitoring programs should organise a workshop every three years. Last year, the workshop was organised on 17 October 2011 in Bredene (Belgium) with as title: "Study day on marine aggregate extraction: needs, guidelines and future prospects". During this day the three partner institutes presented their monitoring results in a combined presentation. Additionally, work from other research and government institutes and from the industry is presented. The presentations during the day were split in four major parts:

1) Continuous monitoring
    - Synthesis of the monitoring results on sand extraction in Belgium

2) International guidelines
    - Natura 2000/Habitat guidelines and implications for sand extraction
    - MSFD, is there space for sand extraction?
    - Influence of EU directives on monitoring

3) Sand extraction by the Flemish Government – Research in the framework of EIA for Zone 4
    - Integrated Master Plan for Flanders future coastal safety
    - Baseline studies on the Hinderbanken (Zone 4)
    - Results EIA for Zone 4
    - Results MEP for Zone 4

4) Sand extraction in practice
    - Sea sand in practice
    - Maasvlakte 2: large-scale sand extraction

5) Conclusion

The presentations (mostly in Dutch) are joined on a CD-rom created by the Fund for Sand extraction (FSP) and the extended papers behind the presentations (in English) are combined in the following publication:

Anon. (2011) Study day on Marine aggregate extraction: needs, guidelines and future prospects. FOD-Economie publicatie, pp.172

Copies of the CD-rom or the publication can be requested to:

Marc Roche, SERVICE PUBLIC FEDERAL ECONOMIE, P.M.E, CLASSES MOYENNES ET ENERGIE, Qualité et Innovation, Service Plateau Continental- Fonds pour l'Extraction de Sable, North Gate - Bureau 4B28, Boulevard du Roi Albert II, 16 - 1000 Bruxelles, Belgique. Email : Marc.Roche@economie.fgov.be

Presentation

On the WGEXT meeting, a presentation was given by Annelies De Backer based on the work done by FPS (Marc Roche *et al.*), the work done by ILVO-Fisheries (Annelies De Backer *et al.*)and the work done by MUMM (Vera Van Lancker *et al.*). The presentation was based on part of the results presented on the triennial workshop. A brief summary of the presentation is included here:

Whilst monitoring the impact of dredging, the electronic monitoring system (black box) has proven its importance in the quantitative follow-up of the extracted volumes in time. Analysis of the EMS data showed that dredging between 2003 and 2010 is, just as in the previous years, concentrated in zone 2 with over 75% of all extraction activities taking place in this area. Dredging in zone 2 has always been concentrated on the Kwintebank in the past. Recently, however, dredging activities shifted towards the Buiten Ratel and totalised 70% in 2010, which is comparable with earlier activities on the Kwintebank. Bathymetric evolution in both areas was measured with multibeam echosounder (Kongsberg EM3002D). The results of the period 2003 to 2010 confirm the almost perfect correlation between extracted volumes and bathymetric evolution. All bathymetric changes can be explained by dredging activities and in closed areas no recovery of the morphology takes place.

The biological study in these areas has assessed the impact of intensive extraction after the closure of the areas on the Kwintebank, and during the current intensive dredging activities on the Buiten Ratel. For both closed areas on the Kwintebank, similar patterns have been observed within the biological recovery processes. A rapid recolonisation of opportunistic, interstitial and juvenile species is observed as soon as the anthropogenic pressure is stopped. The results suggest that there are no immediate long-term effects of the intensive dredging activities, and that recolonisation takes only 1 to 2 years in these highly dynamic sandy areas. Biomass recovery, however, takes longer ranging from 2 to 5 years. While intensive extraction on the Kwintebank pauperised the benthic community, the current intensive dredging on the Buiten Ratel seems to contribute to a more diverse benthic community. This increase in diversity is due to the inflow of species characteristic for fine sediment to this naturally coarse sediment area. These species are attracted to the area because of the presence of a low percentage of very fine sand, which is probably induced by the dredging activities due to overflow and/or increased availability of these fines due to heavy disturbance of the sea floor. These contrasting results indicate that the outcome of the biological impact of intensive dredging is dependent on the local natural conditions.

More detailed information can be found in the publication of the workshop Anon. (2011) Study day on Marine aggregate extraction: needs, guidelines and future prospects within:

Roche M., Degrendele K., De Mol L., Schotte P., Vandenreyken H., Van den Branden R. and De Schepper G. (2011). Synthesis of the monitoring of the impact from the aggregate extraction on the Belgian Continental Shelf, pp. 3-45.

De Backer A., Van Hoey G., Wittoeck J. and Hostens K. (2011). Biological monitoring: Impact of past and present intensive dredging, pp. 47-63.

Van Lancker V., Van den Eynde D., Fettweis M., Francken F., Fernández L., Komijani H. and Monbaliu J. (2011). Natural variability assessment in support of environmental monitoring, a sediment transport modelling approach, pp. 65-75.

16.2 Canada

No information on the EIA process or research has been provided this year.

16.3 Denmark

No information on the EIA process or research has been provided this year.

16.4 Estonia

No information on the EIA process or research has been provided this year.

16.5 Finland

No changes to report.

16.6 France

Preliminary conclusions on impact and recolonisation in an experimental site in Baie de Seine (eastern English Channel): SIEGMA project

Date project commenced: 2006 (Demersal fish baseline survey)

Duration of project: 6 years (2006–2011)

Organisation(s) undertaking research project: Scientific Interest Group "SIEGMA" (Monitoring of Impacts of Extraction of Marine Aggregates) involving the following laboratories : UMR M2C - University of Rouen; Cellule de Suivi du Littoral Normand - Le Havre; IFREMER - Boulogne sur Mer.

Funding bodies: European Union (FEDER), French Ministry of Research, Regional Council Haute-Normandie, aggregates licence operator (GIE GMN) and national association (UNPG).

Description of research project:

This experimental site had 2 main objectives:

1) Perform our knowledge on impacts of marine aggregate extraction activity:
   - In a different physical environment than the first monitoring area off Dieppe (2003–2007): lower tidal currents, deepening of a flat gravely seabed instead of erosion of a shingle bank;
   - With different dredging methodologies (intensity, fallow, levelling);
   - Would the effects on benthos and recolonisation rate, on demersal fish species and trophic relationships, on habitats and biodiversity… be the same than those observed in Dieppe?

2) Evaluate the conditions for a potential development of marine aggregate extraction in the submerged paleovalley of the River Seine.

In the authorized licensed area (8.6 km²), two sites of 0.6 km² were successively exploited with different objectives, according to the initial scientific programme:

+ site A was dredged during a single year (2008) with a low intensity (2.5 $h.ha^{-1}.year^{-1}$) to study during the three following years the restoration process; a levelling of furrows and ridges was tested on one half of this site to demonstrate the potential benefit of such a practice on the recolonisation rate by benthic macrofauna;

+ site B was exploited during three successive years (2008–2011) to study the spatial impact of pluriannual extraction activity with a higher intensity ($4h.ha^{-1}.year^{-1}$).

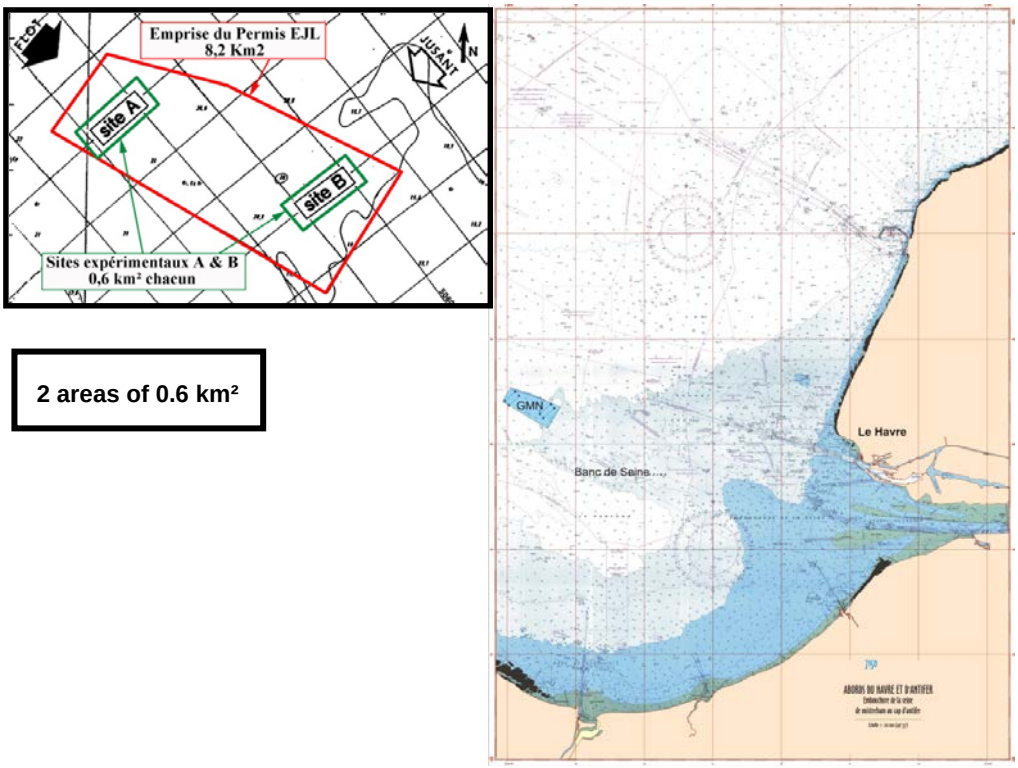


Figure 16.1. Location of the experimental site in Baie de Seine (eastern Channel).

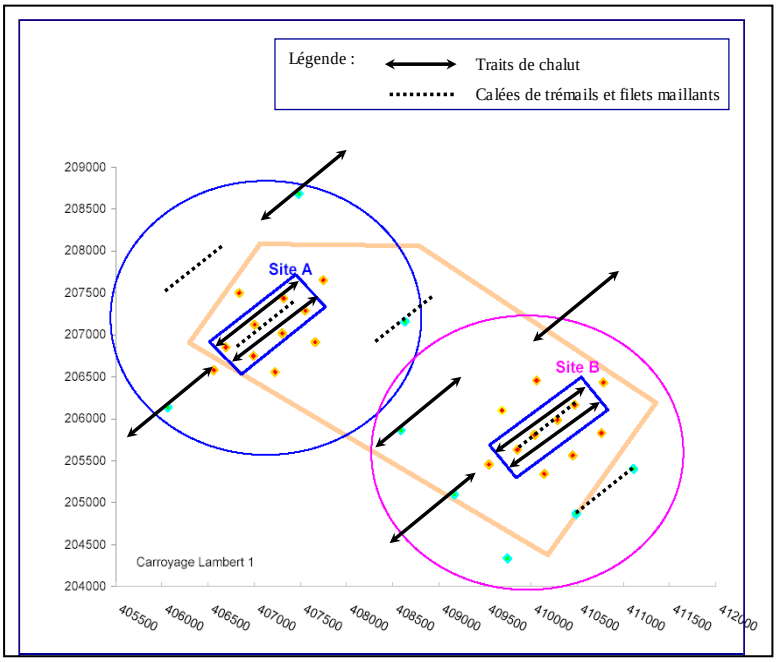


Figure 16.2. Location of benthos sampling stations (control ones in yellow, reference ones in green), trawling traits (black arrows) and fixed nets (dashed lines).

Baseline survey of demersal fish communities (4 seasonal campains with trawling and fixed nets) was achieved in July 2007 and extraction activity began in November; a time-table for the extraction was adopted with cessation of dredging activity in December and January and from July to September when fishing activity is the most intensive (scallops, sole, cuttlefish).

Baseline survey of benthic communities was done in February 2007 on site A (11 stations) and in February 2008 on site B (14 stations).

Environmental monitoring lasted 4 years with the following research topics:

- dispersion of the turbid plume (ADCP) and of its vertical dynamics;
- seabed topography and sediments (multibeam);
- benthic communities;
- demersal fish communities;
- trophic relationships between fish and benthos;
- physical and biological impact on the site B after three years of extraction;
- recolonisation rate on the site A (fallow test) after one year of extraction.

1. Spatio-temporal evolution of the turbid plume

The experimental area is characterized by strong tidal currents (0.9 $m.s^{-1}$) and natural turbidity values of 1–3 $mg.l^{-1}$ (calm weather) up to 5–15 $mg.l^{-1}$ (rough sea).

Maximal values of turbidity (0.2–1 $g.l^{-1}$) which could disturb fish were observed in the immediate vicinity of the dredge (i.e. within the licensed area where coarser particles decant rapidly) during the 2–3 hours the dredge was infilling and excess water was going back to the sea through overflow.

Monitoring of the vertical evolution of suspended matter in the water column after overflow showed a rapid dilution in marine water, with a narrow column slightly more concentrated (up to 15–20 $mg.l^{-1}$) close to the dredge, lasting 10–15 mn after

overflow. In the same time, a benthic plume generated by the draghead extended vertically up to 12 m and was visible up to 2 h after the beginning of exploitation.

The lateral extension of the plume could reach 300 m 10–20 mn after overflow and the longitudinal one could reach up to 6–8 km from the dredge respectively during ebb or flow. These concentrations were however a limited risk and a slight refinement of sediment could only be observed in the immediate vicinity of the extraction site with deposition of very fine sand particles.

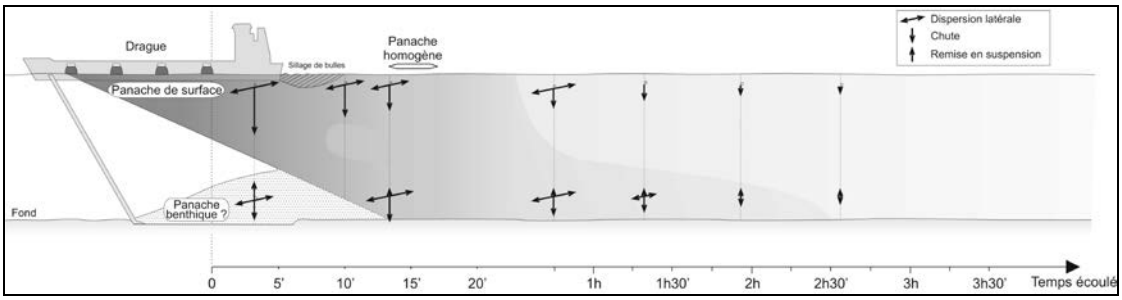


Figure 16.3. Synthesis of the dynamics of a turbid plume generated against tidal currents. Arrows indicate the intensity of vertical (decantation, resuspension) and lateral dispersion of suspended material in the water column.

2. Seabed topography and sediment

Extraction during one year (site A) with a low-medium intensity (2.5h.ha^{-1}.year^{-1}) led to an irregular deepening of the seafloor (mean = 0.3 m, local maximum = 2 m) with mean slopes of 6° for furrows (maximum = 48°).

After 2 years of restoration, isolated furrows were 3m wider, 15 cm less deep and their slope was 6 lower; the levelling test did not perform the seafloor restoration (depth and slope of furrows).

Full restoration time of the bottom (smoothing of furrows) was estimated to 10.5 years.

Sediment of site A did not change deeply, except the appearance of some pebbly areas; restoration of the original sediment needed more than 1.5 year under the influence of natural transit. Surrounding sediments showed a slight tendency to refinement (within natural variability values).

After two years of extraction (site B) with a higher intensity (4h.ha^{-1}.year^{-1}), the mean deepening of the seafloor was 0.9 m with local maximal values of 3.9 m and a more regular level of the seafloor (mean slope of furrows of 5° with a maximum of 35°).

Evolution of the sediment showed a higher proportion of shingles within the site and of fine sediments in the immediate vicinity.

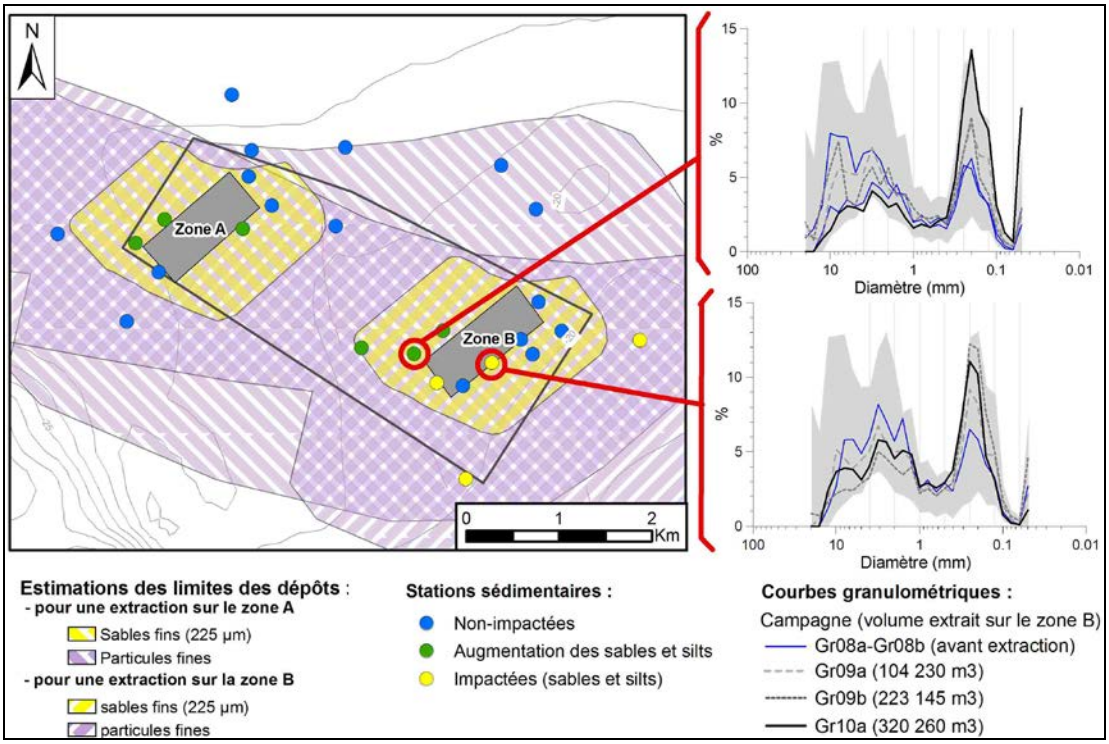


Figure 16.4. Cartography of stations enriched (yellow and green) or not (blue) with fine sands and silts by extraction activity, and examples of granulometric curves.

3. Benthic communities: impact and recolonisation

After one year with a low extraction intensity (2.5 $h.ha^{-1}.year^{-1}$ on site A), a biological impact was observed on species number (- 22 %) and mainly on abundance and biomass (respectively - 66 % and - 75 %) of the benthic community whose composition was however unchanged, probably as a consequence of the absence of change of the sediment type.

Cessation of extraction activity enabled the benthic recolonisation of the site in 2.5 years, mainly from lateral areas where no impact could be observed.

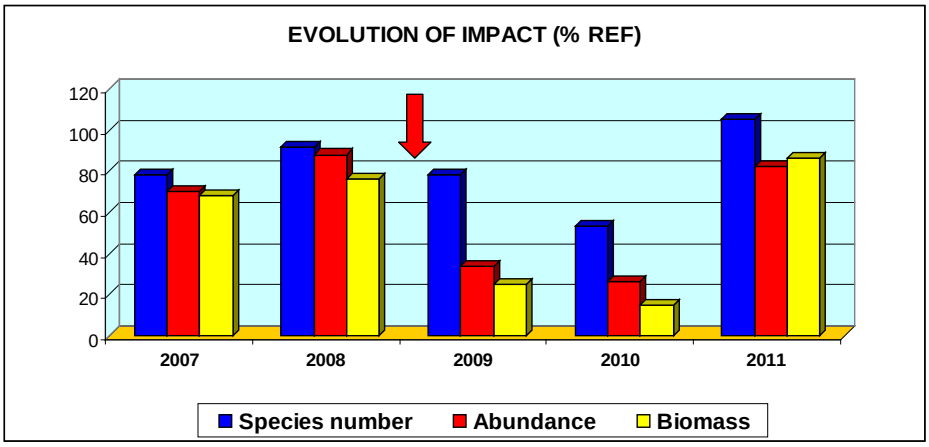


Figure 16.5. Evolution of the three main population parameters for site A (fallow test) between 2007/2008 (baseline surveys) and 2011 (recolonisation).

(The red arrow indicates the extraction period in November 2008)

On site B more intensively exploited (4 $h.ha^{-1}.year^{-1}$), the impact on benthos was twice higher for species number (- 42 %), whereas abundance (- 71 %) and biomass (- 81 %) were only slightly more affected than on site A. Moreover, the original benthic community evolved to a community with *Balanus* (opportunistic colonisation of shingles) with a lower trophic value.

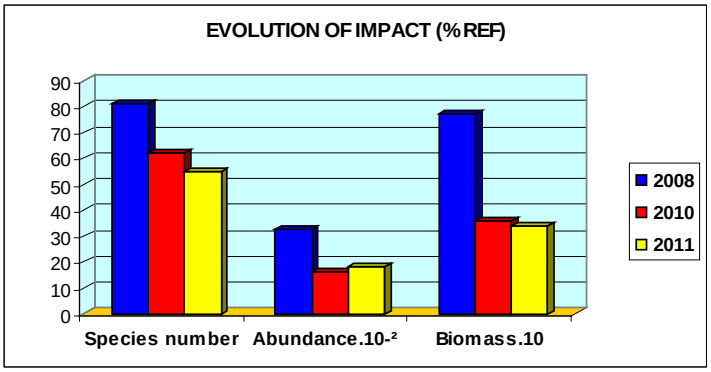


Figure 16.6. Evolution of the relative impact of extraction (% reference value) on site B for the three main population parameters between 2008 (baseline survey) and 2010/2011 (extraction).

Like for site A, no impact was detected outside the extraction area.

The answer of benthos confirms its status of best ecological marker of anthropogenic disturbances.

4. Demersal fish communities

On site A, the impact on the fish community was slightly higher than that observed on benthos with a decrease of 35 % for species number, 82 % for abundance and 74 % for biomass, with important differences between species ; whereas most of benthic and demersal species were no longer fished in the extraction site (avoidance), abundance of common sole was strongly increasing during the first stages of extraction while the upper layer of sediments colonised by the benthos was exploited ; this positive effect was immediate and temporary (1 to 3 months).

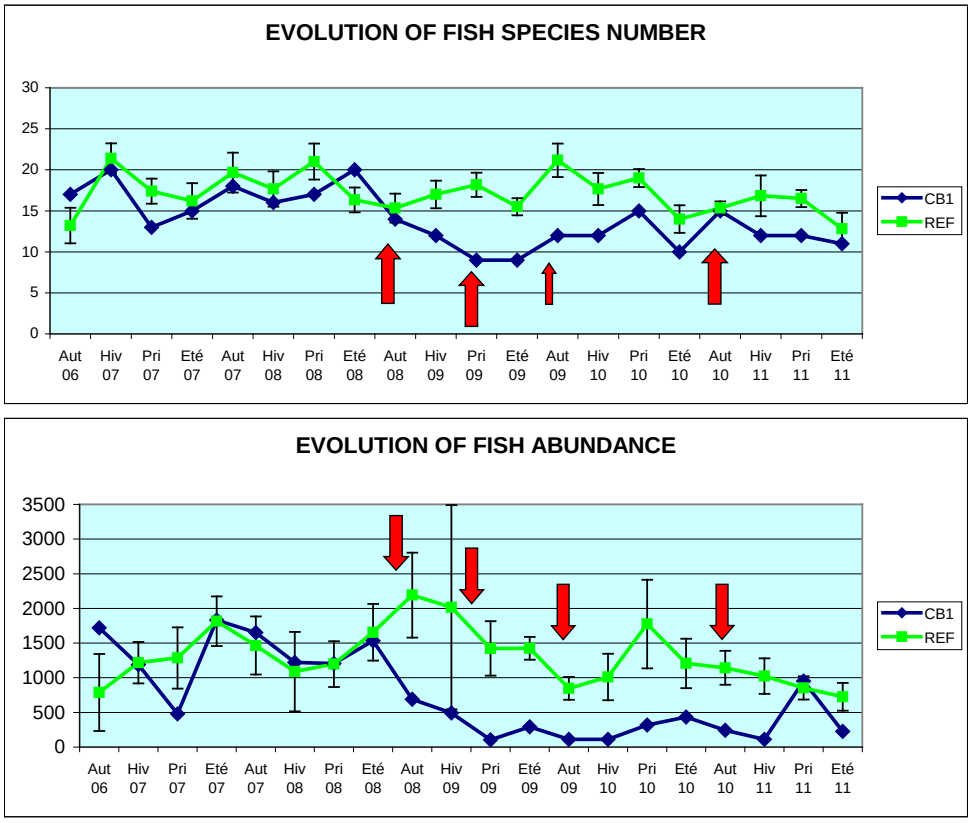


Figure 16.7. Evolution of fish abundance (ind.h^{-1}) during the 5 years of monitoring (2006–2011) on site B and on reference stations.

Red arrows indicate extraction stages.

Recolonisation rate of fish was similar to that of benthos, with differences between species; it was complete in less than 2 years in gadids (pout) but was only beginning after 3 years in gurnards.

On site B, the impact on fish was higher than in site A (decrease of 51 % for species number, 92 % for abundance and 91 % for biomass), but without any change of community (same dominant species than in the reference area); abundance of species characteristic of coarse sediments was increasing.

For sole, the temporary attraction was confirmed during the first stages of extraction.

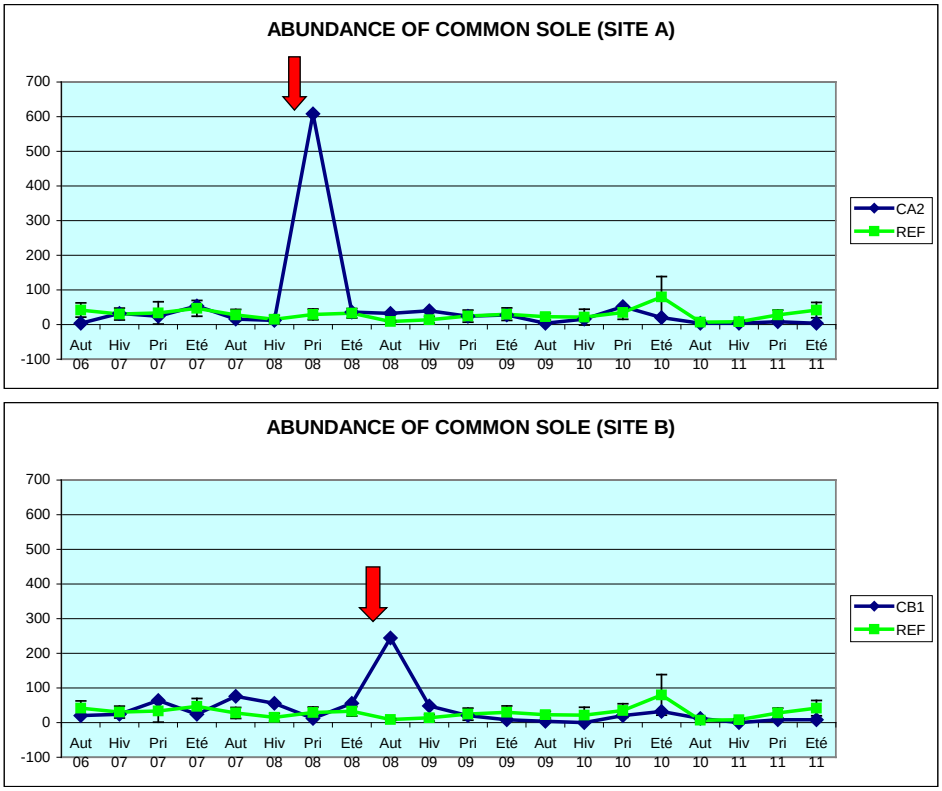


Figure 16.8. Evolution of abundance (ind.h^{-1}) of common sole during the 5 years of monitoring (2006–2011) in each experimental site.

5. Trophic relationships benthos-fish

The parallelism observed for impact intensity and recolonisation rate between benthos and fish could be validated by the study of trophic relationships between these two levels of the food-web.

The rapid decline in abundance of most fish species could be linked to the disappearance of their preys consecutive to extraction activity, but also to their inability to switch their diet; on the contrary, the opportunistic way of feeding of the common sole explained its rapid and temporary abundance in extraction sites during the initial stages of extraction, as a consequence of the availability of numerous benthic preys throwed back to the sea with overflow.

d2. Literature review on: "Impact of marine aggregate extraction on marine ecosystems and biodiversity". 93pp.

Date project commenced: 2008

Duration of project: 4 years (final report expected in 2012)

Organisation(s) undertaking research project: UMR M2C - University of Rouen.

Funding bodies: UNPG (French National association of Granulate Producers)

Description of main results:

The literature review on the "Impact of marine aggregate extractions on marine ecosystems and biodiversity" attempts to reveal the level of knowledge about marine biodiversity acquired from studies on extractive activity at sea.

A total of 280 international publications, theses, reports, studies and scientific programmes (mainly for the period 2000–2009) concerning **marine biodiversity and the impact of human activities on the seabed** have been identified and cited, of which 127 concern marine extractions. They have then been analysed following the MSFD framework, in particular using the vocabulary, definitions and objectives contained therein.

The critical literature review shows that marine aggregate extraction is unlikely to constitute a serious threat to biodiversity unless the exploitation projects concern small biotopes, with scant representation in the geographical area, and/or if the impacts may affect sensitive, threatened species or certain functionalities.

But it is difficult to manage and predict the effects of large scale extractions (cumulative effects) because experience is reduced to sites with limited space and time scales.

Several studies agree on the choice of structural criteria and indicators (impact evaluation based on reference conditions) and highlight those species that are sensitive and tolerant to extraction. Questions remain on the specific nature of extraction indicators to be taken into account (extraction surface area, duration and intensity) and on the level of "acceptable" disturbance thresholds (tolerance thresholds) for optimum restoration of functional communities.

To open this subject, recent studies indicate that functional restoration of the environment occurs more quickly than restoration of the composition of communities which takes several years to return to previous levels. This work is still at an early stage of development and other studies are needed to complement our understanding of the impact of aggregate extractions on the functioning of marine ecosystems and their restoration potential.

d3. Monitoring report on "Sedimentological and benthic monitoring of the CNEXO experimental extraction site, 30 years after cessation of extraction"

Date project commenced: 2010

Duration of project: 1 year

Organisations undertaking research project: UMR M2C (University of Rouen) & CSLN (Le Havre).

Funding bodies: Grand Port Maritime de Rouen

Description of main results: Sediments and benthic fauna were sampled in December 2010, 30 years after cessation of extraction activity. A net decrease in differences between the licensed area and the surroundings was observed for both physical and biological characteristics by comparison with the previous survey of 1995.

Sediments of the study area were more homogeneous but always dominated by fine sands:

- Within the site, sediments were heterogeneous muddy fine sands with localised dominance of fine fractions;
- In periphery, sediments were coarser sands slightly more muddy than in 1995.

This change in sediment was accompanied by an important evolution of benthic communities:

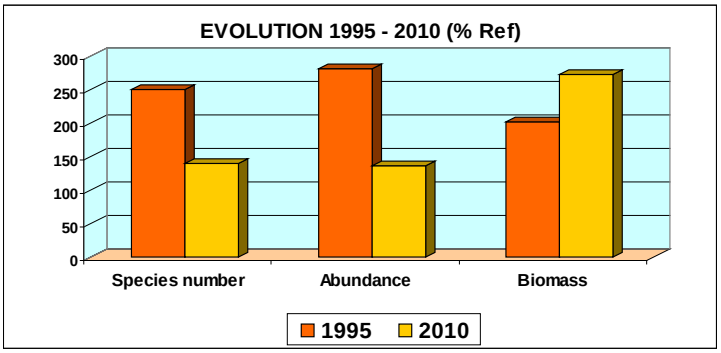


Figure 16.9. Evolution of study area between 1995 and 2010.

By comparison with the reference surrounding area, the 3 main population parameters of the inner community showed :

- a net reduction of relative specific richness (- 45 %) and abundance (- 52 %) within the site;
- but an increase of relative biomass (+ 36 %).

The important difference observed in 1995 between inner and outer communities was no longer so obvious in 2010 where an homogeneisation of communities (faunal structure, dominant species) was in progress.

In 1995, a community characteristic of fine silty sands had been observed within the extraction site, with a more diversified and abundant community than the outer one, dominated by species characteristic of fine clean sands.

In 2010, thirty years after cessation of extractions, differences in nature and richness of both habitats (sediments and associated benthic fauna) were mitigated.

d4. VECTORS

"Vectors of change in European Marine Ecosystems and their Environmental and Social-Economic Impacts"

In the framework of this project, two documents were presented during symposiums:

- Collaboration IFREMER-University of Rouen (UMR M2C):

Poster: "Spatial interactions between fishing activities and aggregate extractions in the Eastern Channel: a preliminary investigation". Symposium Biarritz (F), October 2011.

- Collaboration University of Rouen (UMR M2C)-CSLN Le Havre in the framework of WP42 (Regional seas: North Sea and English Channel):

Poster: "Mechanisms of change in the distribution of fish species at the local scale of extractions sites in the eastern English Channel". Annual VECTORS meeting in Slovenia, March 2012.

d5. CHARM 3

"Channel Integrated Approach for Marine Resource Management"

This multidisciplinary international project (Interreg IV A France-England) meets the demands of the new European Marine Strategy.

The project (expected end in 2012) seeks to:

- harmonise scientific information;
- develop research work based on this information to produce further scientific understanding;
- develop information systems and tools for an integrated and rational management of the English Channel (fisheries and aggregates activities);
- use innovative ways of making them accessible.

It follows three main themes: data collection, information integration, tools and dissemination.

Web site: www.charm-project.org

d6. European Marine Strategy Framework Directive

Following a global reflection at the French national level ("Grenelle de l'Environnement") since 2011, there is an application of this strategy at the regional scale. All human activities are taken into account, such as fisheries and sand extraction. This application requires the definition of a good ecological status (with descriptors).

16.7 Germany

No information has been provided this year.

16.8 Greenland and the Faeroes

No information has been provided this year.

16.9 Iceland

A poster is provided below showing research undertaken to investigate the properties of marine aggregates in the vicinity of Reykjavik.

Physical properties of marine aggregates

in the vicinity of Reykjavik, Iceland

Pétur Pétursson[1], Margrét I. Kjartansdóttir[2], Erla María Hauksdóttir[2], Kristinn Lind Guðmundsson[3], Bryndís G. Róbertsdóttir[4], Hreggviður Norðdahl[5], Gunnar Bjarnason[6] and Óskar Örn Jónsson[2]

INTRODUCTION

Marine aggregate extraction for deepening harbours in Iceland began at the turn of the last century. Trailer dredgers were first used in 1953, when experimental dredging for shell fragments took place at Sydra-Hraun for the cement factory in the town Akranes. In the year 1963 extraction of gravel and sand as construction material started in Hvalfjordur and 1970 in Kollafjordur.

Figure 1. Location of the extraction areas in Kollafjordur 2005

In the period 2000 to 2009 approximately 11.6 M m³ of marine aggregates and shell fragments were extracted from the three areas, which is about 95% of the total extracted marine aggregates in Iceland. It should be kept in mind that these three areas are close to the major market of construction aggregates, i.e. the Reykjavik area and neighbouring communities, where about 65% of the population of Iceland lives.

Figure 2. Dredging sand and gravel from the seabed in Kollafjordur

In August 2008 the responsibility for administration of extraction licenses was moved from the Ministry of Industry, Energy and Tourism to the National Energy Authority (NEA). In the year 2009 NEA granted licenses until 2019 for 15.9 M m³ in 15 extraction areas in Kollafjordur, Hvalfjordur and Sydra-Hraun area. It is therefore important for the NEA to have a good overview of the properties of sand and gravel deposits from all the licensed marine aggregate extraction areas. Also to obtain up to date and reliable maps of the seabed.

Figure 3. Taking samples of the dredged material in Kollafjordur

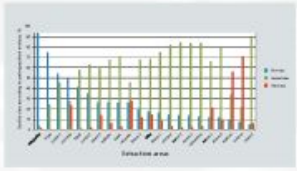
THE PROJECT

The National Energy Authority has started a research project which involves systematic mapping of the physical properties of sand and gravel extracted from the seabed in the Reykjavik vicinity. The project is carried out in collaboration with the Innovation Center Iceland, PP-Consult and the Faculty of Earth Sciences at the University of Iceland.

The main purpose of this project is:

- To establish a database including type and physical properties of gravel, sand and shell fragments extracted from Icelandic seabed.
- Material quality assessment as a basis for a tariff for marine aggregate extraction.
- Material quality assessment as a basis for decision making concerning issuing licenses for utilization of marine aggregates in the future.

The first licensed marine aggregate extraction areas to be studied in this project are situated in Kollafjordur. In the period 2000 to 2009 the extraction from Kollafjordur amounted to 4.9 M m³, or about 40% of the total marine aggregate extraction in Iceland. The quality of the material in the Kollafjordur extraction areas has not been analyzed in detail before, although one dredged sample from each area had previously been collected for grading and petrographic analysis.



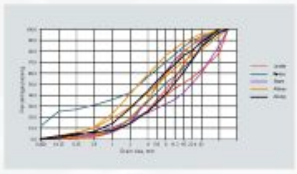


Figure 4. Kollafjordur A. Example of quality classification according to petrographical analysis, and B. Example of different grain size distribution between locations

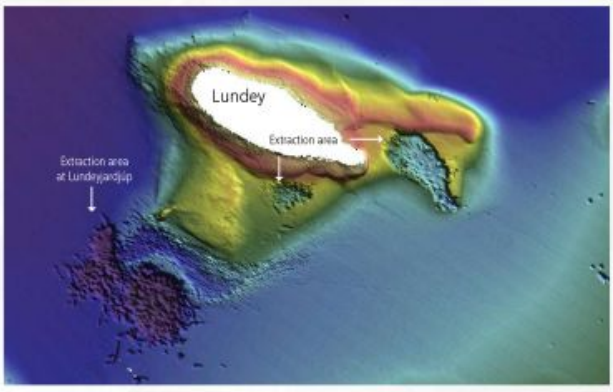


Figure 5. Seafloor image at Lundey surroundings generated from multibeam survey

This data is insufficient to be representative for the physical properties of the materials in these vast extraction areas. Still these analyses suggest that variation in quality is broad in the Kollafjordur extraction areas, which would benefit the establishment of the database. Trailer dredger was used to obtain new samples, at selected locations for testing physical properties, such as grading, petrographical composition, shape, mechanical strength and weathering resistance. Other factors that possibly influence the test results will also be studied.

Repeated sampling in selected areas are expected to reveal the variations in grading and petrography by studying the following points:

- The variation in petrographical composition of different grain sizes.
- The relationship between grading and petrographical composition.
- The minimum frequency of sampling and testing required.
- The sampling procedure which will be validated.

NEXT STEPS

The second and third licensed marine aggregate extraction areas to be studied are situated in Hvalfjordur and Sydra-Hraun. In the period 2000 to 2009 the extraction from Hvalfjordur amounted to 4.8 M m³, or about 39% of the total extraction and in the Sydra-Hraun area the extraction amounted to about 2 M m³, mostly shell fragments, or about 16% of the total extraction.

1. PP Consult 2. Innovation Center Iceland 3. Faculty of Earth Sciences, University of Iceland 4. National Energy Authority 5. Institute of Earth Sciences, University of Iceland 6. Icelandic Road Administration

Figure 16.10. Research investigating the physical properties of Icelandic aggregate.

16.10 Ireland

No information has been provided this year.

16.11 Latvia

No information has been provided this year.

16.12 Lithuania

No information has been provided on EIA and monitoring research this year.

16.13 Netherlands

Maasvlakte 2

The first fase of the construction of Maasvlakte 2, the enlargement of Rotterdam harbour, is almost completed. Most of the sand extraction was done in 2009 and 2010. In 2011 a relatively smal amount was extracted (see figure 16.11). Till December 2011 a total amount of 184 million cubic meters of sand was extracted in the offshore sand extraction pit. The pit has a maximum depth of 20 meters below the original sea bed.

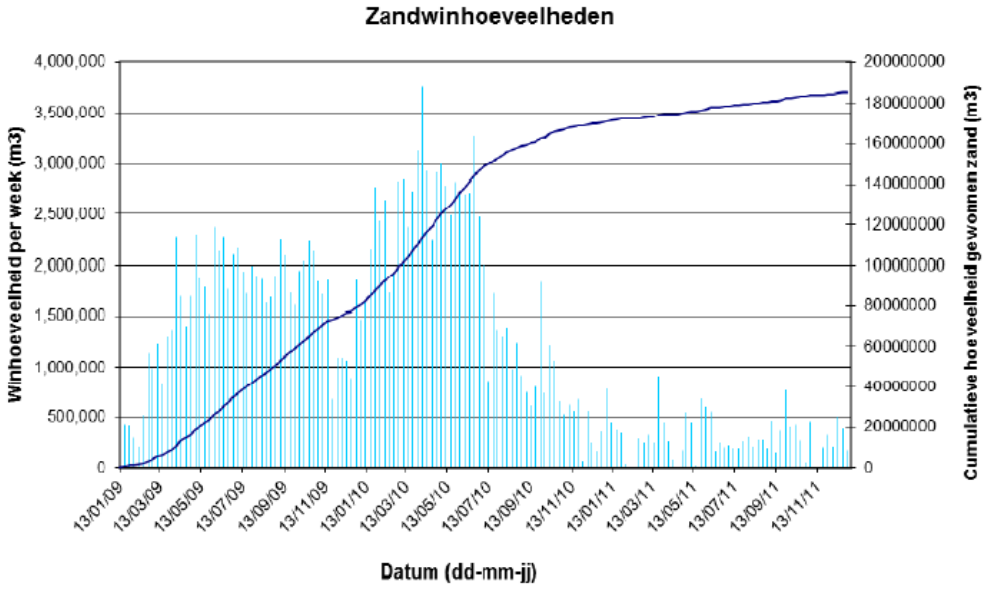


Figure 16.11. Weekly amounts of extracted sand for Maasvlakte 2.

Monitoring the effects of the sand extraction is in full operation. Measurements are done on bathymetry, sediment composition of the sea bed, diversity and biomass of benthic fauna, underwater noise as well as changes in the amount of suspended matter in a broad area and the influence of these changes on the timing of the yearly algae bloom and related benthos fauna.

For the determining of the extra amount of suspended matter in the environment due to the sand extraction a model is developed (MoS²) to combine modelling with satellite data and shipborn data to incorporate data assimilation into the model. The model leads, among others, to atlases with the suspended matter during years with and without major sand extraction (Blaas *et al.*, 2012).

During the years in which the extraction was on its maximum (2009 and 2010, see figure 1) there were no effects found on growth of benthic fauna due to less available algae.

Therefore the monitoring on this topic has ended.

Intensive measurements has been done on underwater noise during two campaigns. The results show that the effects are within the expectations formulated in the EIA. The reports on underwater noise are to be found on www.noordzeeloket.nl (De Jong *et al.*, 2010; Dreschler *et al.*, 2009).

Blaas, M., M.A. Eleveld, G.Y. El Serafy, H.J. van der Woerd, S. Gaytan-Aguilar, N.O. De Reus, K. Cronin, G.H. Keetels and Y.F. Friocourt. 2012. MoS². Model supporting monitoring of suspended matter in the coastal zone of the Netherlands. Model set up, data assimiliation and skill assessment. Including an atlas of SPM in the southern North Sea 2007. Deltares, Delft. VU University, IVM Institute for Environmantal Studies, Amsterdam.

De Jong, C., M. Ainslie, J. Dreschler, E. Jansen, E. Heemskerk and W. Groen. 2010. Underwater noise of trailing suction hopper dredgers at Maasvlakte 2: Analysis of source levels and background noise. Report TNO-DV 2010 C335. TNO Defence, Security and Safety, Den Haag.

Dreschler, J., M.A. Ainslie and W.H.M. Groen. 2009. Measurements of underwater background noise Maasvlakte 2. Report TNO-DV 2009 C212. TNO Defence, Security and Safety, Den Haag.

Several sand extracting projects are in process: e.g. extracting beach nourishment sand (Rijkswaterstaat), construction sand (federation of Waterconstructors) and sand extraction Sand Engine. To achieve maximum coordination on the scientific and management level, these three initiators have unified in one MEP. The scope of this MEP is based on wishes for monitoring and gaps in knowledge as defined in the EIA, urgencies as addressed by the Committee of EIA and stakeholders, specific demands by the Legal Authority and precaution measures issued in the license to protect the environment. The resulting gaps in knowledge and topics of the MEP are summarised below:

1) **Silt and modelling**. Two topics were addressed:
   a. What is the behaviour of the plume that is generated by the extraction (near field and midfield effect) in order to derive settling rates of silt? Here is was concluded that plume measurements are not a suitable means for that. In addition the plume only represents 8-15% of the total silt mass assumed.
   b. What is the exchange coefficient of silt between water and bottom for impact modelling purposes? Based on both measurements and modelling exercises, an improved exchange coefficient was implemented in the impact modelling used for the new Environmental Impact assessments in progress this moment.

2) **Impact of silt and algae on Benthos**. Two main questions were posed:
   a. What are the effects of the reduced food conditions on the growth of Ensis directus?
   b. When does food limitation occur as a result of these changed conditions?

The approach taken is to describe and explain the growth in the field together with high frequency (a)biotic measurements. Also a physiological growth model was developed for *Ensis directus*: aDEB (Dynamic Energy Budget) model, using field measurement and dedicated laboratory experiments. Currently, the DEB model was

linked to the output of a water-quality-model to apply for the EIA of Rijkswaterstaat for 2013-2017. In the future field measurements will be used to improve both DEB model as well as its coupling with water-quality-models. Major questions arise about the actual population dynamics of Ensis.

3) **Disturbance by transport and above water presence of TSHDs for**:

a. Seals: attention was focussed the direct behavioural response of Harbour Seals and Gray Seals during haul out. For several locations and types of disturbances, both species seem rather imperturbable. Only when disturbances (e.g. TSHD) come really near and make more noise, reactions are observed. However, for TSHDs, habituation can occur.
b. Common Scooter: regular airplane flights are performed to describe their distribution near the Waddensea Islands coastal zone, in addition with the presence of other bird species and potential factors of disturbance (e.g. fishing boats). At spots with high numbers of scooters, benthos samples are taken for both quantity and quality of the shells.

4) **Disturbance of seals by underwater sound**

A feasibility study was performed to develop the appropriate method for testing the disturbance dose effect relationship in a controlled environment. It was concluded that a spacious enclosure is needed to accommodate the lower frequencies of the dredging underwatersound. In addition it was shown in another study that TSHD sound is not one of the main problems. This research has been halted till its urgency is evaluated.

5) **Quick Scan methods for shell banks.** Four methods have been tried so far to assess the presence of shell banks in planned extraction areas:

a. Medusa: this measure device uses a radiometric signal for silt. In addition an acoustic signal is measured that detects e.g. shells. In the end the signal appears to be too unspecified: both live shells and shell debris are measured. More additional boxcores are necessary to control the signal.
b. Side scan sonar: an area was described with van Veengrabes and SSS. The resolution of the SSS was not able to distinguish concentrations of Ensis (>160 small individuals/m2 or Echinocardiumcordatum(>20 individuals/m2). More extra calibrations are necessary to correlate large scale signals versus actual concentrations and communities of Benthos.
c. Camera: Hauled by a ship, large stretches of bottom can monitored easily and frequently. The images also enable to generate an indicative idea of biological activity. One is also able to distinguish shell banks. Disadvantages are the fact that clear waters are necessary, not too much wave action and that biomass cannot be assessed and numbers of individuals are less accurate.

d. Dredge: the regular programme of shell fish surveys uses dredge-methods hauling 100–150 m, it is more accurate than the camera method but less dynamic and flexible.

6) **Trend analysis on Benthos**. Currently trend analysis on the species levels are performed based on both the boxcore sampling programme of Rijkswaterstaat and dredge sampling programme of Imares. First results show that for the boxcore method, species in general lack continues presence in the time lines whereas for the dredge samples they are continuous. Coming period, the boxcore samples will be analysed on more aggregated levels like species diversity and others.

Recolonisation of the Zeeland banks. The Zeeland banks represent an area that has been scarcely monitored. In 2009, 2010 and 2011 more outspread monitoring campaigns have been done in order to assess the natural dynamics of the potential reference areas (showing e.g. a slight overall decline in number of species). The communities found represent transition between the communities found at the Flemish Banks (related to the Nephtys- and Ophelia communities there) and coastal zone and Southern Bight communities. In 2012 the first year of recolonisation will be monitored.

Monitoring nourishment Ameland

To counteract coastal erosion at the Wadden Sea island of Ameland a beach and foreshore nourishment was started in 2010 which was completed in autumn 2011. The effects of the nourishments are followed through a 5 year monitoring program. This is aimed at gaining more knowledge on the ecology of the shallow coastal zone, including the dunes, as well as to monitor the recovery of the macrobenthic community after the nourishments were ended. The contracted work for the nourishment followed a rather new approach allowing the dredging companies to complete the contracted work at own insight within a 2 year period in order to be more cost efficient. This resulted in the nourishment being conducted at different times and areas over a period of 2 years, complicating a proper set-up of the monitoring program.

In 2009 a baseline survey was conducted using a grid strategy, followed by monitoring in 2010 and 2011 aimed at the describing the benthic community in relation to the morphology. This takes into account the characteristic breaker bank system present at large parts of the Dutch coast. Monitoring is conducted between August–October and includes bathymetry, sediment parameters, macrobenthos and juvenile fish at the impacted zone, a nearby potential effected zone and at a comparable reference area at the adjacent island of Schiermonnikoog.

Monitoring sand extraction and compensation areas Port of Rotterdam

Directly to the west of the current port of Rotterdam, an extension of the port is created in the North Sea, Maasvlakte 2. The land reclamation will measure around 265 million m^3 of sand which will be extracted from the North Sea outside the -20 m depth contour. The extension, however, is situated in a Natura 2000 area. As part of the licensing procedure, compensation of the loss of nature due to the construction of Maasvlakte 2 is obligatory and comprises a total of 31 250 hectares. The Rotterdam Harbor authorities have set up a monitoring project that comprises extensive mapping and ground truthing activities from the delta region up to the Wadden Sea entrance at the Marsdiep both at the compensation area as well as at the sand extraction

area. Measurements include multibeam, sediment, infauna (box corer) and epifauna and larger infauna (benthic sledge).

Ecoshape: Building with Nature

The Dutch program Building with Nature is an innovative research program aimed at developing new design concepts for the layout and sustainable exploitation of river, coastal and delta areas. It is coordinated by EcoShape, an initiative of Dutch dredging industry. Within the program opportunities to use natural processes are identified and integrated into the planning and designs process, balancing natural ecosystems and human intervention. These are tested in real-world projects initiatives. The potential for the development of innovative, sustainable solutions which anticipate to the scale increase in Dutch Coastal Zone Management was briefly illustrated on the basis two examples: the application of mega-nourishments for coastal development and ecological landscaping in sand extraction areas.

Sand Engine

The Province of South-Holland initiated a mega nourishment under the name "Sand Engine". This project can be seen as the next step in coastal management, seeking an alternative for the present frequent nourishment of small-scale coastal stretches. The Sand Engine project consists of nourishing a large volume of sand in the order of 20,5 Mm^3. The mega nourishment at Delfland has a hook shape which is envisioned to lead to wider beaches and possible salt marsh development. It will also instigate active dune formation in the coming decades. Beaches, salt marsh and dunes are all habitats under the Habitat and Bird Directive, and part of the Natura 2000 network in the Netherlands. The nourishment was completed in July 2011. A monitoring program is formulated to follow the development of the Sand engine and the goals that were set out for the coming 10 years. Three main objectives were identified for the monitoring:

1) Determine the feasibility of the targets listed in the EIA "Construction and Sand Dredging Delflandse Coast";
2) Collect sufficient and appropriate information for high quality management of the Sand Engine and its surroundings;
3) Provide the necessary monitoring data satisfying the requirements listed in the permit from the Nature Conservation Authority.

A first ecological survey was conducted in October gathering information on sediment, infauna (van Veen grabs) and juvenile fish and epifauna. Larger infauna and epifauna is studied using a benthic sledge.

During the design most researches on the morphological behaviour of the Sand engine was focused on the long term development, based on model calculations with an average wave climate for the next 20 years. Aerial photos up to January 2012, however, show significant morphological changes within months due to a more extreme wave climate. To understand the changes short term (i.e. monthly) morphological behaviour of the Sand Engine is studied by hindcast modelling using data of July 2011 to January 2012. Based on wave climate data, bathymetric information from monthly measurements, aerial photos, the hydrodynamic and morphodynamic processes around the Sand Engine have been analyzed. This analysis has resulted in a conceptual model, which presents the morphological change of the Sand Engine due to waves from different directions.

The Building with Natures project 'Ecological Landscaping in a sand mining pit' will investigate the promotion of an ecosystem approach in marine extraction projects through an ecological design and realization turning threats into sustainable opportunities. Through landscaping of an extraction area according to a predefined design of its dimensions (shape and contours) the characteristics of the seabed within the extraction area will be arranged or modified, even with possible effects on the surrounding area. The understanding of the interactions and feedbacks between the physical and biological processes can therefore be deployed to alter the environment in such a way that ecologically valuable habitats can develop, attracting benthos, fish and birds giving opportunities for enhancing the ecological and economic potential of the post-dredging situation. Being allowed to use the large dredging site which is created for the extension of the Rotterdam harbour (Maasvlakte 2) as test site the possibilities for landscaping a dredging site will be investigated.

Within this project, a PhD study investigates the ecological possibilities for and benefits of landscaping extraction areas. The aim is to improve knowledge on physical and biological interactions and their implications for habitat development in and around extraction areas. This knowledge will support eco-dynamic design (EDD) of extraction areas such that ecological and economical (e.g. fisheries) goals are met.

- Inventory of past and current research on marine aggregate dredging, ecological effects of ex-traction activities (recolonisation, biodiversity and density) and existing models.
- Quantifying macro- and meso-scale habitat relationships for benthos and fish in the Southern North Sea.
- Develop assessment methodology to describe physical and biological interactions and ecosystem effects of deep dredging and ecological landscaping, based on identified macro- and mesoscale habitat relationships, for the pilot study in the borrow pit for MV2.
- Formulating predictions of habitat changes due to sand extraction by the use of an eco-morphological hydrodynamic models for different scale levels (present Maasvlakte borrow pit, individual borrow pits, a network of pits and the Dutch coastal zone).
- Identify the most effective sand extraction site designs for creating valuable North Sea habitats during future meso-, macro- and mega-scale sand mining operations.

EU projects with a relation to extraction and nourishment activities

MESMA

The MESMA (Monitoring and Evaluation of Spatially Managed Areas) project is an 8.4 M Euro project funded under 7th EU Framework Program (www.mesma.org). The project started 1st November 2009. MESMA has now 21 partners from 13 EU countries. MESMA focuses on marine spatial planning and aims to produce integrated management tools (concepts, models and guidelines) for monitoring, evaluation and implementation of Spatially Managed Areas (SMAs). The project will support the formalization and implementation of EC policy and will also support integrated management plans for designated or proposed sites with assessment methods based on European collaboration. MESMA covers all EU marine waters, including the ICES area. Within the project a number of case studies will be conducted to different human pressures such as fisheries, renewable energy, shipping, aquaculture and aggregate extraction. Both the information on aggregate activities as

well as the stakeholder network build up within WGEXT will be of great interest to MESMA. Some partners of WGEXT are involved in the MESMA project and will play an important role in the transfer of information of the WGEXT into the project.

VECTORS

The EU funded project VECTORS (Vectors of Change in European Marine Ecosystems and their Environmental and Socio-Economic Impacts) focuses on changes in marine life and how these are driven by human activities. Attention is also given to nourishment and extraction activities. Vectors objectives are to develop integrated multidisciplinary understanding of the different current and potential future pressures and changes taking place in the marine environment, the mechanism for them and the ecological impacts. Some partners of WGEXT are involved in the VECTORS project and will be responsible for transferring information from and to the WGEXT.

New EIA

A new Environmental Impact Assessment on extraction of sand for regular coastal nourishment for the period 2013 to 2017 is started in 2011. It is aimed at the extraction of 12 million cubic meters of sand during the years 2013 and 2014, increasing to 20 million cubic meters in the years 2015–2017. The sand will be extracted along the whole coast of the Netherlands in the zone between the established NAP - 20 m depth contour and the 12 miles boundary.

A parallel EIA is started for the extraction of 20–40 million cubic meters for a coastal nourishment in the province of North-Holland.

Special attention is given at far field effects of suspended matter due to overflow and its impact on algae and subsequently benthos.

16.14 Norway

No information has been provided this year.

16.15 Poland

No information has been provided this year.

16.16 Portugal

It finished in the end of 2011 a scientific project (2008–2011) to assess the physical impacts of sand mining on the shoreface and shoreline evolution. It is called SANDEX (SAnD EXtraction in the Portuguese continental shelf: impacts and morphodynamic evolution). One offshore area in the mainland Portuguese continental shelf located in the southern coast was chosen to look at the physical impacts of sand extraction from the shoreface to beach nourishment. Around 370 000 m3 of sand was extracted leaving a sandpit with approximately a rectangular shape with 900 m length and 150 m width and was located 4000 m away from the shore at depths between 15–20 m, with average depth of the excavation around 5 m. There was a morphologic (bathymetric) and sedimentologic characterization before and after the excavation and hydrodynamic modelling was run to study the changes on the tidal flow and wave propagation due to influence of the sand pit.

Results of wave propagation modelling show that the pit affects the wave propagation pattern. Despite the mild effect of the pit in the average values of the wave parameters height and direction, its effect is more significant for more energetic sea conditions, when the sediment transport is higher. The pit reduces the mean wave

height at its lee and slightly modifies the incident wave direction in its vicinity. Beyond the small variations in the wave climate, which always result in a predominant transport eastward, the shoreline evolution presents an evident response to the introduction of the excavation. It results in accumulation at the shoreline in the back of it and erosion on the sides. The coastline evolution model was able to reproduce the coastline evolution trend although the retreats and advances (due to beach nourishment) seem to be exaggerated.

Bathymetric analysis between May 2006 and November 2008 showed an accretion of sediments of around 60 000m3 Theoretical predictions concerning the recovery time of excavation point to a value about 24 years, very similar to the modelling results that indicated 21 years.

Published results

Lopes, V., Silva, P. A., Bertin, X., Fortunato, A.B., Oliveira, A., 2009. Time-evolution of an offshore sandpit: validation of a morphodynamic model, Journal of Coastal Research, SI56, 529-533.

Silva, P.A., Bertin, X., Oliveira, A., Fortunato, A.B., 2009. Intercomparison of sediment transport computations in current and combined wave and current conditions, Journal of Coastal Research, SI56, 559-563.

Rosa, J., Silva P.A., Bertin, X., Fortunato, A.B. 2011. Waves, wind and tidal forcing on a sandpit morphodynamics. Journal of Coastal Research, SI64, 1170-1174.

Proença, B., Oliveira, F.S.B.F., Sancho, F. e Bertin, X., 2012. Impact of marine sand extraction in the southern Portuguese coastline. Journal of Coastal Conservation, (in press)

16.17 Spain

No information has been provided this year

16.18 Sweden

No developments in EIA to report in 2011.

Research

Fibre sediments 2010–2012

In co-operation with the County Administration in Västernorrland (bordering the northern Bothnian Sea), a 2-year project was launched where SGU is investigating where discharges of pulp have accumulated as well as the associated volume and degree of pollution through hydroacoustic methods, sampling, visual observations and chemical analyses. Within the project, a testing of hydroacoustic methods is also performed in order to detect sediments rich in fibres discharged from the pulp-mill industries. The fibre sediments threat the environment, mainly because of its content of mercury and chloroorganic chemicals as e.g. dioxins and PCBs. The land uplift of approximately 7 mm/year will eventually result in erosion and dispersal of toxic sediments to other areas.

BalticPOPs 2010–2012

BalticPOPs is a 2-year research programme funded by the Swedish Environmental Protection Agency (SEPA). Scientists from eight universities and institutes/agencies in Sweden, Finland and Russia are participating. The programme was launched in early 2010. BalticPOPs focuses on the dioxin problems in the Baltic region. The scientists investigates the reasons of the high dioxin concentrations in Baltic fish (WP1)

and the sources of dioxins in air (WP2). Previous and new knowledge will be combined and evaluated in a system synthesis, for which the multimedia fate and transport model POPCYCLING-Baltic will be used (WP3).

Black carbon

In co-operation with the Stockholm University the role of Black carbon (BC), i.e. soot particles, in the Baltic bottom sediments have been studied and partly been financed by SGU in 2006–2011.

EMODNET-Geology 2010–2012

SGU is one of 14 partners in the 3-year EU-project EMODNET-Geology (European Marine Observation and Data Network) co-ordinated by NERC/BGS. The aim of the project is to deliver (through the Association of European Geological Surveys – EuroGeoSurveys) the most complete and updated marine geological datasets to the EMODNET, which will among other themes provide marine geological information solutions to decision makers in European government and industry, as well as information for academic research.

Environmental Assessment Criteria of Marine Sediments 2010/2011

On request of the Swedish Environmental Protection Agency (SEPA), SGU is updating and extending the Swedish assessment criteria of environmental quality and status of marine sediments (SQC). The criteria will be based on statistical processing of data (elements and organic micropollutants) mainly held and collected by SGU. Another partner, the Swedish Environmental Research Institute (IVL), evaluates the toxisity of the chemicals included in the project.

COMMISSIONS

Data base host of environmental geochemical data in marine and lake sediments and the National Swedish Status and Trend Monitoring Programme

In 2006 SGU was appointed by the Swedish Environmental Protection Agency (SEPA) as a National Data Base Host of national and regional environmental geochemical data in both marine and lake sediments. SGU designed and built the database, and are responsible for loading the database and the quality control of data delivered from regional authorities and Water Conservation Associations. These data are open and available at the website of the Survey: *www.sgu.se/environment/sediment*.

On request of the SEPA and since 2003, SGU carries out the National Swedish Status and Trend Monitoring Programme based on Chemical Contamination in Offshore Sediment. The sampling is carried out every 5th year and about 150 chemicals are analysed and evaluated. The results are presented on both the website (see, above) and in yearly produced books together with other national environmental trend monitoring programmes.

In 2011 this database was on request of the SEPA extended with a new layer showing dumping sites of dredged sediments and information about type and amount of sediments dumped in Swedish territorial waters.

Duping sites of uncontaminated dredged sediments

Commission works (evaluation and reporting) have been carried out in 2011; among others bottom investigations and advices in connection with dredging and dumping activities in Karlshamn harbour and Åhus harbour. Since 1974 dumping is banned in the Baltic Sea according to the Helsinki Convention, but the government or an agency

appointed by the government may make exceptions from this rule and give permissions.

Wind-mill parks

Basic marine geological mapping at Hanö Bank in Hanö Bay was carried out in 2009–2011 on the request of a private company who plans to establish the biggest Swedish wind-mill park at the bank.

Forsmark

Marine geological mapping using the new swathsonar on the survey launch R/V Ugglan was carried out outside the nuclear plant Forsmark on the Swedish east coast for the Swedish Nuclear Fuel and Waste Management Company (SKB) in 2010. Below the seabed in this area, a site for disposal of spent nuclear fuel is planned to be built. These data, together with reanalyzed survey data retrieved in 2002 from the same area, were used to produce maps of seabed and underlying bedrock surface morphology as well as horizontal and vertical extension of sediments.

An esker is discovered running approximately in a north northwesterly-south southeasterly direction in the area, which may be causing submarine groundwater discharge. Pockmarks, which are caused by sediment gas of thermogenic and/or microbial origin, are detected in the area.

EUNIS classification

On request of the Swedish EPA, SGU has during 2008–2010 transformed and classified the superficial seabed sediment information in parts of the Swedish sea areas into the EUNIS system. The project was finalized in 2010.

Environmental trend monitoring studies along the Swedish west-coast 2011

On the request of the Bohus Coast Water Conservation Association (Bvvf), the superficial bottom sediments along the Swedish Bohus Coast, from the Norwegian border down to Gothenburg in the south, was sampled in 2011 at c. 40 sediment trend monitoring stations. The sediment samples will be analysed for most of the priority chemical parameters in the EU WFD. SGU has been commissioned to carry out this work, examination and evaluation every 5th year since 1990.

Environmental trend monitoring studies of the Stockholm Archipelago and Lake Mälaren 2007–2011

The Geological Survey of Sweden (SGU) has also been commissioned, by the Division of Environmental Analysis at the County Administrative Board of Stockholm, and by the Environmental Administration at Stockholm City to conduct sampling of surface sediments at c. 40 stations for environmental chemical analysis of both the City as the Stockholm County coastal waters, and the east-most part of Lake Mälaren. The project was finalized in 2011 with a final evaluation report on the trends and environmental status of the sediments in the Archipelago.

16.19 United Kingdom

EIA remains the responsibility of the operator/ developer in the UK and therefore no national programmes of EIA are undertaken in relation to marine aggregates. National and industry specific programmes of research have been commissioned over the course of several years. Of particular note are:

Aggregate Levy Sustainability Fund

A significant amount of marine aggregate related research was funded through the Aggregates Levy Sustainability Fund (ALSF) since its establishment in 2002. The fund ended in March 2011 and over its lifetime has delivered projects focussing on marine mapping, assessment of environmental impacts, monitoring / mitigation associated with improving the way marine aggregate extraction is planned, assessed and managed worth around €30m.

Details on commissioned projects and information on accessing raw data associated with these projects can be accessed via http://www.cefas.defra.gov.uk/alsf.aspx.

Other Programmes

The UK Department of Environment, Food and Rural Affairs (Defra) continue to fund research programmes focussing on their areas of interest, including the marine environment. Further information on projects can be found at http://randd.defra.gov.uk/

Industry Led Initiatives

As reported in previous years, the UK Marine Aggregate industry and Crown Estate continue to fund initiatives. These include Regional Environmental Assessments, regional monitoring in the Eastern English Channel and annual area involved reports. Further information can be found from the BMAPA (http://www.bmapa.org/) and Crown Estate (http://www.thecrownestate.co.uk/marine_aggregates) websites.

16.20 United States

No changes to report in 2012, however, the 2011 report states:

The Guideline for obtaining offshore sand sources can be found at:

http://www.csc.noaa.gov/beachnourishment/html/human/law/borrow.htm

17 Annex 8: MEP RWS, LaMER and sand extraction Sand Engine (the Netherlands): outline and first results

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17.1 Introduction

In order to be able to extract sand from the Dutch Marine environment, one has to obtain a permit within the framework of the Extraction Law. The Legal Authority uses, amongst others, the impacts described in the Environmental Impact Assessment (EIA) to issue the license and potential implementation measures. Together with the application or the license the initiator has to provide a Monitoring and Evaluation Programme (MEP). To achieve maximum coordination on the scientific and management level, the initiators for extracting beach nourishment sand (Rijkswaterstaat), fill sand (federation of Waterconstructors LaMER) and MEP sand extraction Sand Engine have unified in one MEP.

The scope of this MEP is based on the need to monitor the predicted effects and gaps in knowledge as defined in the EIA, urgencies as addressed by the Committee of EIA and stakeholders, specific demands by the Legal Authority and implementation measures issued for precaution in nature preservation in the license to protect the environment (Table 17.1). The resulting gaps in knowledge and topics of the MEP are summarised below and described subsequently in the next section (17.2):

1) Silt and modelling.
2) Impact of silt and algae on Benthos.
3) Disturbance by transport and above water presence of Trailing Suction Hopper Dredgers (TSHD) for:
    a. Seals
    b. Common Scooter
4) Disturbance of seals by underwater sound.
5) Quick Scan methods for shell banks.
6) Trend analysis on Benthos.
7) Recolonisation of the Zeeland banks.

Table 17.1 Overview of implementation measures issued for precaution in nature preservation (from either Extraction Law or Nature Conservation Law).

Species/ habitat	Type	Precaution measure	Areas
Harbor Seal Grey Seal	distance	Maintain a precaution distance of 1200-1500 m to prevent disturbance on haul-out plates.	Sand banks in N2000 areas: North Sea Coastal zone Waddensea Voordelta Oosterschelde, Westerschelde
Harbor Seal Grey Seal	time	Do not approach haul-out plates in periods of pupping, suckling and moulting (not even at precaution distance).	Sand banks in N2000 areas: North Sea Coastal zone Waddensea Voordelta Oosterschelde, Westerschelde
All groups of birds (all species)	distance	Maintain a precaution distance of 500 m to prevent disturbance.	Everywhere coast along (extracting, transport, nourishing)
Shell banks at extraction sites	Prevention	No extraction of areas with shellbanks	everywhere
Shell banks Nourishment sites	Prevention/ Periode	No nourishment on areas with shell banks from June to April	N2000 area North sea Coastal zone
Habitat H1110	Area closure	Closed areas for fishery to improve shell banks	N2000 area North Sea Coastal zone (VIBEG-areas)
	Distance	Keep a precaution distance for extraction of 100 /900 m to prevent covering of any benthos within the borders of N2000 area North Sea Coastal zone	N2000 area North sea Coastal zone
Common Scooter	Area closure	Closed areas for fishery and other traffic to lessen disturbance	N2000 area North sea Coastal zone (VIBEG-areas)
Project specific			
H1110 and Eider	distance	Use areas with not to high % silt	Near N2000 area Voordelta
Being discussed			
Habitat H1110	period	Not win in the period of December January to prevent impact on algae bloom	Near N2000 areas: North sea Coastal zone Waddensea Voordelta

17.2 Detailing the different topics

This section will detail different topics in the research questions and the first results and applicability.

17.2.1 Silt and modelling

A momentary but large sand extraction at the North Sea can have long term effects, as a large quantity of silt will be deposited in the sea bottom, which may gradually resuspend for several years. When this silt is released back into the system, the turbidity will increase. Due to its limited grain size, silt has a relatively long residence time in the water column. The increase in turbidity hampers the penetration of sunlight, which can negatively influence the effect chain from algae-growth, (shell) fish larvae, shellfish up to birds and large fish. Two knowledge gaps were defined:

1) What is the behaviour of the plume that is generated by the extraction (near field and midfield effect) in order to derive settling rates of silt?

2) What is the exchange coefficient of silt between water and bottom.

Plume behaviour

Direct effects of sand extraction on the suspended sediment concentrations were measured on board two ships that sampled the near-field, which is 300–1000 m up- or downstream of the Trailing Suction Hopper Dredger (TSHD) during dredging cycles and mid-field in a 14.5 by 6 km region just to the North of the location of extraction (south of Texel). Observations were made during three campaigns. No significant differences between near-field and mid-field measurements were found. The result were used to model the presumed plume (Figure 17).

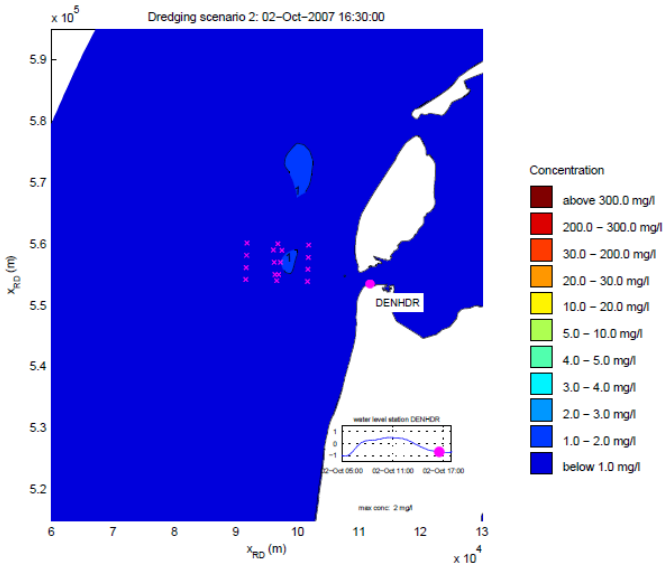

Figure 17. Modelling the plume: example of the modelled concentrations of silt at the surface layer (Grasmeijer & Eleveld. 2010). Purple crosses represent the locations of measurement (Talmon 2007, 2008a,b).

Concluding plume 1

It was concluded that due to the low concentrations plume measurements are not the optimal means to assess settling rates of silt e.g. Talmon (2007, 2008a,b), Grasmeijer & Eleveld (2010).

Concluding plume 2

The behaviour of the plume was described in more detail. Silt in this flow separates into three compartments: a small proportion deposits directly with the fine sand, another small proportion (5–15%) forms a plume and floats away, and the majority remains in the form of a density driven current on the sea floor (Aarninkhof *et al.* 2010, Spearman *et al.* 2011). This will either deposit onto the sea floor at an unknown moment or be resuspended by currents and waves (Figure 17.1). Because of this, direct turbidity resulting from the overflow of the dredger is negligible. The impact of silt discharged with the overflow by hoppers causes a typically far field effect.

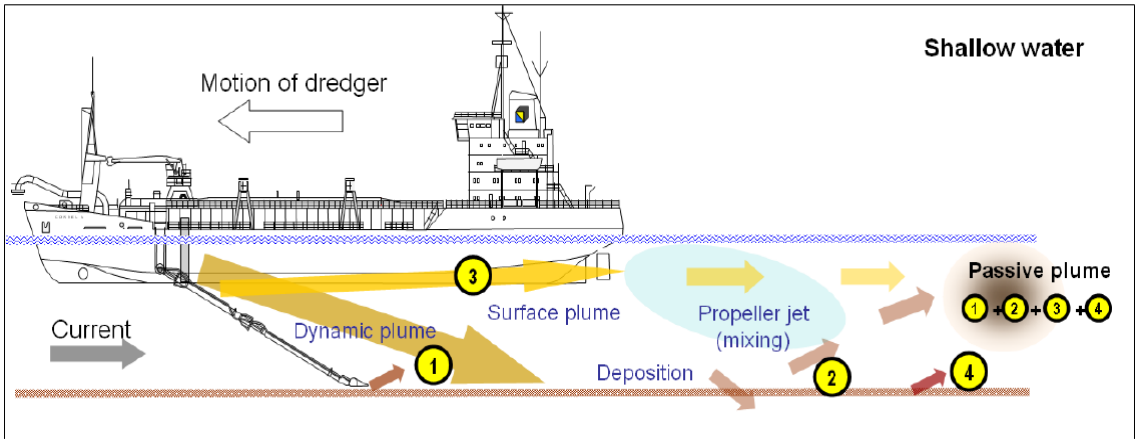

Figure 17.1. The mechanism of overflow and resuspension processes near Trailing Suction Hopper Dredger. "Release of fine sediments occurs from draghead interaction with the sea bed (Process 1), propeller impacts on local sediments (Process 2), formation of the surface plume due to interaction with the boundary layer underneath the vessel (Process 3) and mixing of near-bed density current with ambient waters (Process 4). The combined effect of these four processes yields the passive plume." (Aarninkhof *et al.* 2010, Spearman *et al.* 2011, Grasmeijer & Eleveld, 2010).

Bottom water exchange of silt

A knowledge gap for the modelling of silt is the exchange coefficient of silt between water and bottom It was still uncertain how large this long-term effect is in comparison with the short term effect caused by the instantaneous turbidity just after the sand extraction. The uncertainties in the time-scale at which the bottom-water exchange of silt takes place lead to large uncertainties in the predictions of travel speed and dissipation of a sediment pulse (for instance originating from sand extraction activities). Depending on the type of data used for calibration and validation (bottom based or water column based), relative short (~2, Laane *et al.* 1999) or relative long residence times (~10, van Prooijen *et al.* 2007) were estimated. Two approaches were applied to generate more insight:

- A modelling approach using available measurements on Cadmium (Cd) concentration in the North Sea bed. The metal Cd partitions between the silt- and waterfase. Being transported from the river sources to the marine environment, the partitioning shifts and the Cd will remain bound to silt. This makes the Cd concentration in the bottom a suitable proxy for silt (Laane *et al.* 1999). These data were used to calibrate and validate the water-bed exchange module of the mud transport model. It appeared that the

residence times are on the shorter side and not on the longer side. The estimates were quit comparable to the estimates of Laane *et al.* (1999), based on bed concentrations of Cd, PCBs and other contaminants. The results were applied in the coming EIA of Rijkswaterstaat 2013–2017).

- Medusa measurements monitored a radionuclides signal which can be a proxy for the concentration of fines in the sediment (Koopmans *et al.* 2012). Several tracks were done along 3 cross-shore tracks, ranging from 0–9 km off the coast. First results indicate a negative correlation between radionuclides signal in the bed and 2 day average wave height before the moment of measuring (Figure 17.2). In addition, comparing silt profiles in the bed with silt profiles in the water column, the impression is generated that in the water column the fraction of < 35 µm is encountered where the bed contains also the larger fraction up till 63 µm (Koopmans *et al.* 2012).

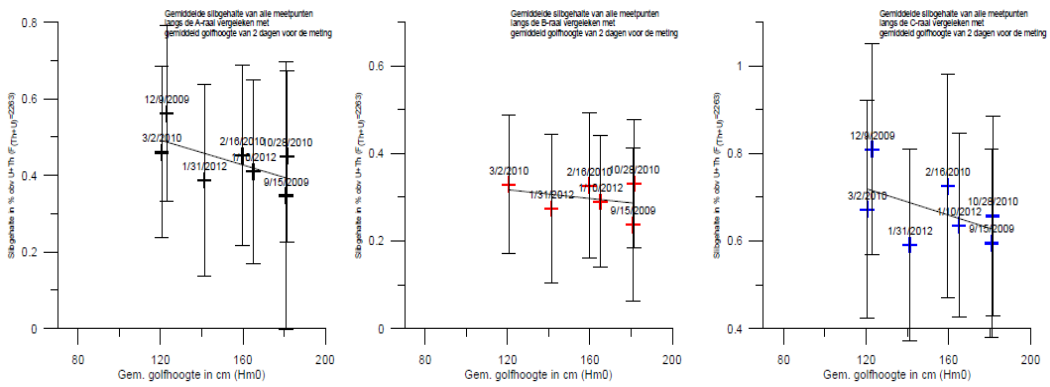

Figure 17.2. A correlation between the average wave height two days before measurements and the average Medusa response on the tracks: The B-track is at ± -20 m. The A- and C-track run from ~-10 meter to -20 m (adaptation of Koopmans *et al.* 2012).

17.2.2 Impact of silt and algae on Benthos

As a direct consequence of extra silt due to sand extraction, light penetration in the water column is reduced over a larger area, which can negatively affect phytoplankton growth. Phytoplankton constitutes the basis of the food web, thus a decreased availability can affect higher trophic levels that live on these microscopic plants, such as filter-feeding shellfish. In addition to a reduced phytoplankton abundance in the water column, the elevated silt concentrations may impede the intake of phytoplankton by shellfish, and potentially give additional stress (i.e. higher energetic cost) to these organisms as they need to excrete silt in the form of pseudo-faeces. Shellfish make up an important component of the coastal food web, for example for shellfish-eating birds such as the Common Scooter in the Dutch Coastal zone. Therefore, insights into potential effects of sand extraction on shellfish populations are desirable for regulating agencies and engineering companies that wish to evaluate whether sand extraction operations are in violation with (inter-)national environmental regulations. The two main questions were addressed according to a series of sub questions:

1) What are the effects of the reduced food conditions on the growth of *E. directus?*

2) When does food limitation occur as a result of these changed conditions?

a) Choose a model animal: Ensis directus.

b) Describe the growth of Ensis directus in the field.

c) Correlate growth with (a)biotic variables.

d) Generate a DEB model (physiological growth model).

e) Interpret actual growth in the field with DEB

f) Integrate DEB model in an online mode in water quality models.

Choose a model animal: *Ensis directus*

Ensis directus is an invasive species which is invading European waters. In 2011 it represented by rough approximation 65% of the shell Biomass in the Dutch coastal zone (Goudswaard *et al.* 2011). In addition it is currently one of the important sources of food for fish (Tulp *et al.* 2010) and the main source of food for the Common Scooter (Leopold *et al.* 2010). Therefore, to assess the potential impact of reduced primary production on shell fish in the Dutch Coastal zone, *E. directus* is an important species (by quantity and by importance).

Describe the growth of Ensis directus in the field

In order to obtain more insight into determinants of growth and feeding behaviour of *E. directus* in natural conditions in the coastal zone, a measurement platform was deployed at 10m water depth off Egmond equipped with a sensor package (turbidity, chlorophyll, T, S, current) and a monitor recording the gape of multiple individuals of two bivalve species (*E. directus, Mytilus edulis*). This location Egmond was chosen because of two reasons: i) silt: it represents a location where the silt budgets and transport to the Waddensea are best measured (most narrow band of silt concentration) ii): Ensis: it is a location where high abundances of Ensis are encountered. The growth and development of a cohort of E. directus since 2009 is given in Figure 17.3 (Witbaard *et al.* 2012). The growth described in DEB values is given in Figure 17.4. Note the 3 fases in growth. Data on Ensis in the North Sea coastal zone of Witbaard *et al.* (2012) show first an increase in gonadal tissue, meat content (AFDW) and then an increase in shell length. In the future the data set will be extended with growth figures of summer 2012 and the glycogen data for both 2011 and 2012.

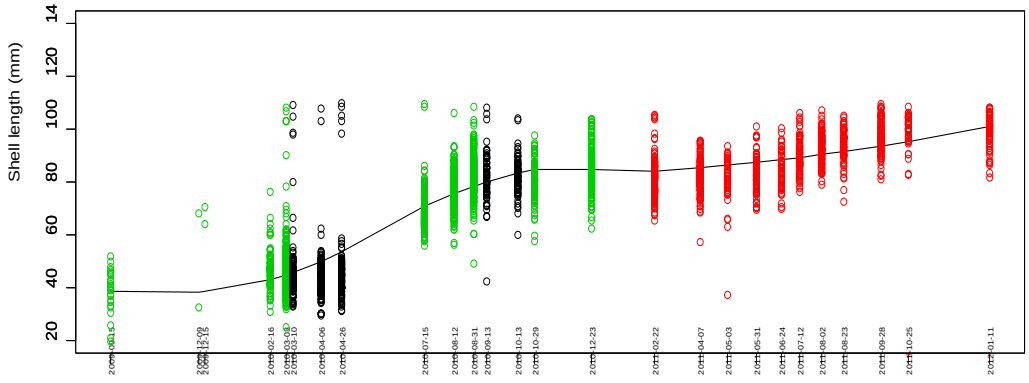

Figure 17.3. The shell length development a cohort of E. directus since 2009.

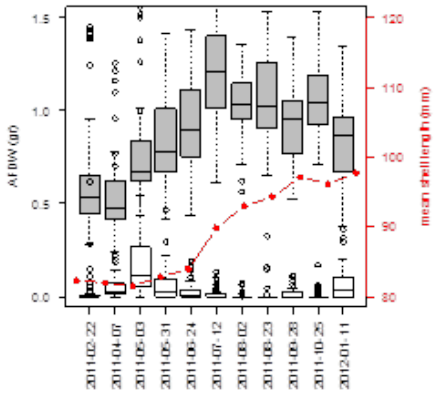

Figure 17.4. The growth of E. directus in 2011 according to DEB related variables: Gonadal tissue, somatic tissue and shell length. The glycogen values are in preparation.

Correlate growth with (a) biotic variables

First preliminary results were generated for the correlations between biotic and abiotic variables and shell growth. Two preliminary analysis were done with Chlorophyl and silt concentrations yielding an optimum curve for chlorophyll (maximum at ~25 µg/l) and declining curve for silt with high growth near 50 mg/l and fairly constant growth for higher values (up to 300 mg/l); (Witbaard *et al.* 2012).

Generate a physiological growth model (DEB model)

A Dynamic Energy Budget (DEB) growth model was generated using several types of data:

- Isotope determinations were used to determine the year-lines in the *Ensis* shell (Cardoso *et al.* 2011).
- Then, with this assurance, length, age and weight values were determined based on field observations (Cardoso *et al.* 2011).
- Using laboratory studies filtration characteristics were determined (suggesting e.g. that *E. directus* is more sensitive to chlorophyll concentrations changes than that of silt (Figure 17.5), Kamermans *et al.* 2011).
- Subsequently the DEB model was determined (Wijsman, 2011, Schellekens, 2012).

Evaluating the approach to generate the model is one of the better approaches with a lot of specifically DEB model dedicated steps. Comparing to other DEB models, the data used were more dedicated to obtain a DEB model than in general.

Application of the DEB model

The Ensis DEB model is applied in the EIA 2013–2017 of Rijkswaterstaat that is currently assessed. In this EIA a chain of models is used: 1) hydraulics; 2) silt; 3) water quality (primary production); 4) DEB model. It is used in an off-line mode. After online waterquality modelling, the DEB response on the chlorofyl signal was calculated and analysed for 6 points in a coast along grid in the Dutch coastal zone. The modelled results yield confidence (Schellekens, 2012). The phenomena observed are in line with what one would expect. It is noted that now these physiological results should be combined with population dynamics. Especially an aspect like mortality that structures the age distributions of the populations, needs to be addressed in order to have a more realistic insight. Further details will be given in the next ICES WGEXT annual report.

The two remaining aspects "Interpret actual growth in the field with DEB" and "Integrate DEB model in an online mode in water quality models" will probably be part of next MEP sand extraction.

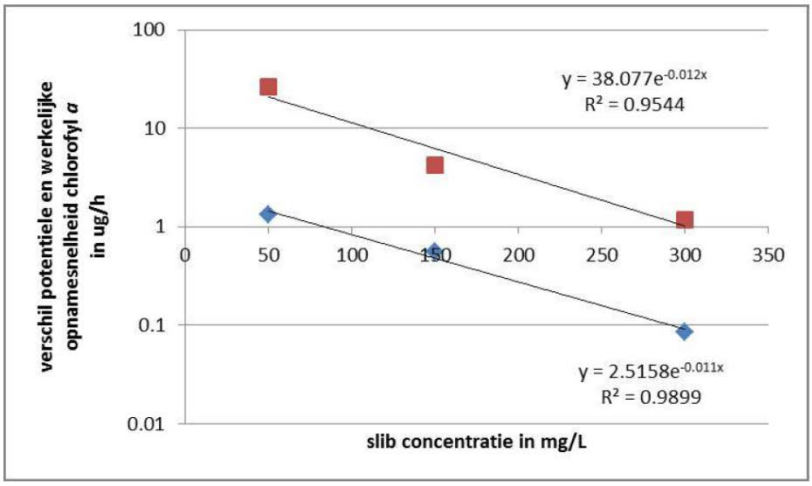

Figure 17.5. Change in the absorption of chlorophyll a by increasing silt concentration of an Ensis individual (total of 15 tested). In red: the difference in absorption speed, chl A concentration of 15 µg / l. In blue: with chl A concentration 6 µg / l (Schellekens 2012).

17.3 Disturbance by transport and above water presence of TSHDs

Passing TSHDs can disturb seals at their haul-outs and Common Scooters which are "obligatory localised" at sites with high densities of shells.

17.3.1 Seals

Attention was focussed the direct behavioural response of Harbour Seals and Grey Seals during haul out. For several locations and types of disturbances, both species seem rather imperturbable. Only when disturbances (e.g. TSHD) come really near and make more noise, reactions are observed (Figure 17.6). However, for TSHDs, habituation can occur (e.g. Didderen *et al.* 2012).

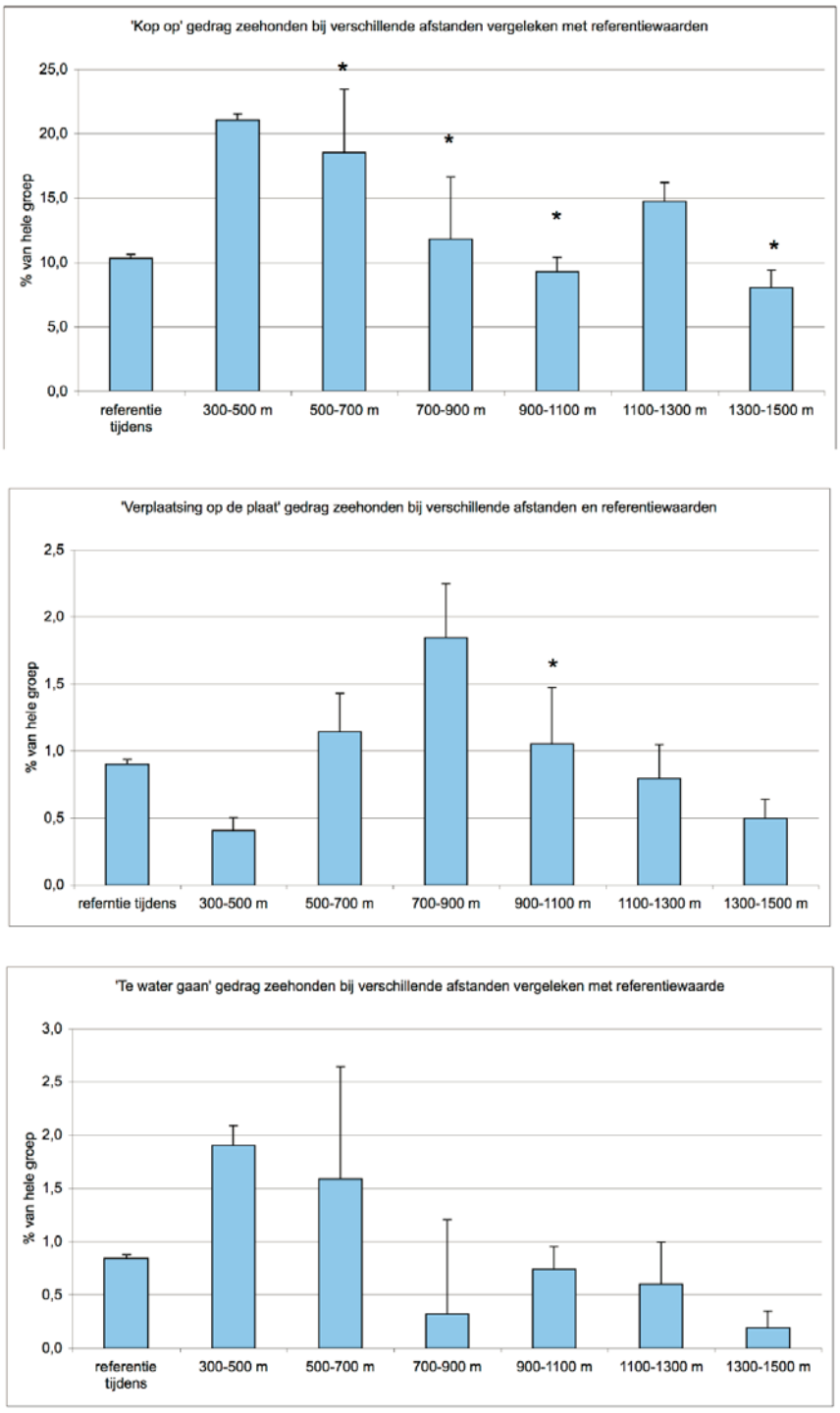

Figure 17.6. The reaction of seals on an approaching TSHD.

The first pane shows the Behaviour of "head up" (observing).

The second pane demonstrates the movements towards the waterfront of the haul-out. Note the difference in scale (first reaction).

The third pane demonstrates the number of animals actual deciding to enter the water. Note the difference in scale (escape); (Didderen e.a. 2012).

17.3.2 Common Scooter

The Common Scooter is a species which aggregates at locations with large live shell banks. At certain spots, these banks are situated between some locations of extraction and the connected locations of nourishment. Since these birds are very sensitive to disturbance and also obligatory connected to these shell banks, precaution is needed. Regular airplane flights are performed to describe their distribution in the coastal zone, in addition with the presence of other bird species and potential factors of disturbance (e.g. fishing boats). At spots with high numbers of scooters, benthos samples are taken for both quantity and quality of the shells. Remarkably, at some places with some fishery activity also high number of scooters are seen. Hypothesizing, they seem attracted to the high density of shrimps and shells (respectively). Additional measurements are made. At this moment the Dutch coastal waters observe far less Common Scooters than before (~100.000 in the 1990s to ~10.000 nowadays, De Mesel *et al.* 2010a,b). What is the reason? Is this the shift from Spisula to Ensis (change in food quality and quantity) or is this caused by disturbance? In the future a model should be generated evaluating the impact of food availability and quality at several locations (alternative availability) and disturbance. What is the trade-off for Common Scooters? When will they decide to leave the Dutch coastal waters due to either food circumstances or disturbance by TSHDs and other vessels.

17.4 Disturbance of seals by underwater sound

A feasibility study was performed to develop the appropriate method for testing the disturbance dose effect relationship in a controlled environment. It was concluded that a spacious enclosure is needed to accommodate the lower frequencies of the dredging underwatersound. In addition it was shown in another study that TSHD sound is not one of the main problems in terms of environmental pressures. Other sources like pillar driving for windmills and seismic research are more important. This research has been halted till its urgency is evaluated.

17.5 Quick Scan methods for shell banks

Four methods have been tried so far to assess the presence of living shell banks in planned extraction areas:

17.5.1 Medusa

This measure device uses a radiometric signal for silt. In addition an acoustic signal is measured by the medusa device that detects e.g. live and dead shells. In the end the acoustic signal appears to be too unspecified: both live shells and shell debris are measured. More additional boxcores are necessary to control the signal (Koopmans *et al.* 2012).

17.5.2 Side scan sonar

An area was described with van Veen grabes and SSS. The resolution of the SSS was not able to distinguish concentrations of either Ensis (>160 small individuals/m^2) or *Echinocardium cordatum* (>20 individuals/m^2); (Paap, 2011). More extra calibrations are necessary to correlate large scale signals versus actual concentrations and communities of Benthos, although it remains questionable whether this method is good enough to assess density.

17.5.3 Camera

Hauled by a ship, large stretches of bottom can monitored easily and frequently. The images also enable to generate an indicative idea of biological activity. One is also able to distinguish shell banks (Didderen *et al.* 2011). Disadvantages are the fact that clear waters are necessary, not too much wave action and that biomass cannot be assessed and numbers of individuals are less accurate.

17.5.4 Dredge

The regular programme of shell fish surveys uses dredge-methods hauling 100–150 m (sampling 10–15 m^2), it is more precise in species presence than the camera method but less dynamic and flexible (e.g. Goudswaard *et al.* 2011).

17.6 Trend analysis on Benthos

Currently trend analysis on the species levels are performed based on both the boxcore sampling programme of Rijkswaterstaat and dredge sampling programme of Imares. Over the years the importance of *Spisula subtruncata* diminishes enormously whereas E. directus increases enormously. Overall, almost all clusters along the Dutch coast represent the *Abra alba* community (irrespective of the chance from *Spisula* to *Ensis*). First results show that for the boxcore method, species in general lack continues presence in the time lines whereas for the dredge samples they are continuous. Coming period, the boxcore samples will be analysed on more aggregated levels like species diversity and other abstraction levels (De Mesel *et al.* 2010a,b).

17.7 Recolonisation of the Zeeland banks

The Zeeland banks represent an area that has been scarcely monitored. In 2009, 2010 and 2011 more outspread monitoring campaigns have been done in order to assess the natural dynamics of the potential reference areas (showing e.g. a slight overall decline in number of species). Over the years the diversity has a tendency to decline (Figure 17.7). A similar type of movement seems to be visualised in the MDS plots of the samples per year. From red to blue to green the band of year samples moves towards left and up. For the clusters a year to year pattern is less obvious (Figure 17.8). The communities found represent transition between the communities found at the Flemish Banks (related to the Nephtys- and Ophelia communities there) and coastal zone and Southern Bight communities. In 2012 the first year of recolonisation after sand extraction will be monitored (Goudswaard *et al.* 2010, 2012).

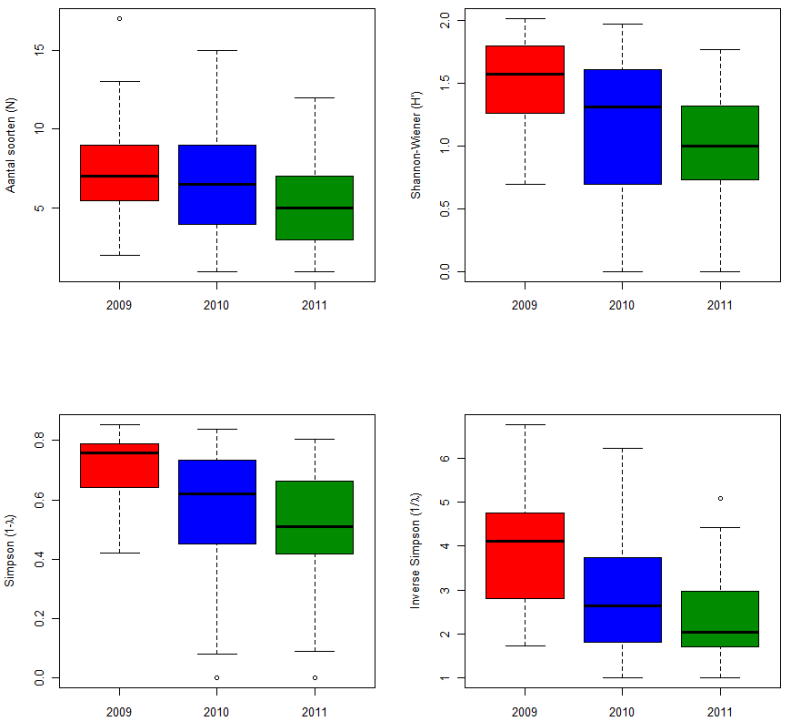

Figure 17.7. Overview Diversity characteristics for the different years of sampling at the Zeeland Banks (Goudswaard *et al*. 2012).

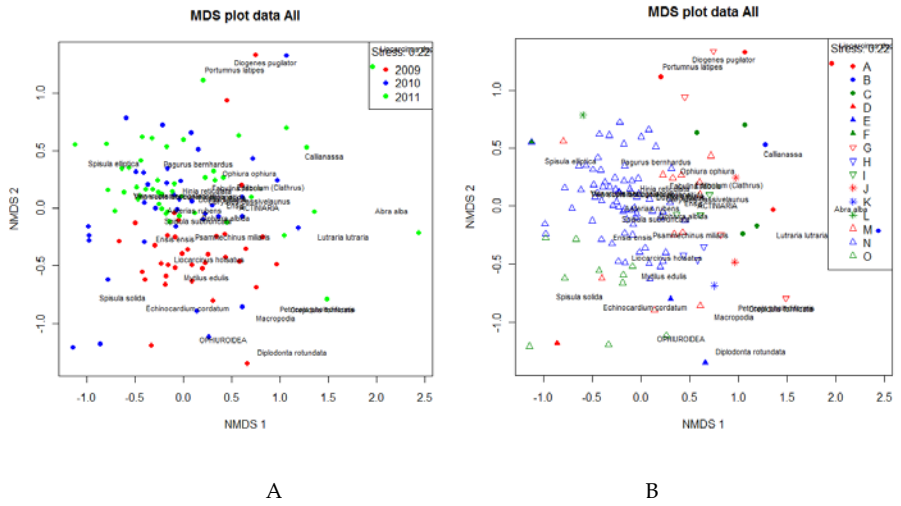

Figure 17.8. (Goudswaard *et al*. 2012)

A: MDS plot of the 2009, 2010, 2011 samples expressed per year.

B: MDS plot of the 2009, 2010, 2011 samples expressed per cluster.

17.8 References

Aarninkhof, S.G.J., J.R. Spearman, A.F.M. de Heer, M. van Koningsveld (2010) Dredging-induced tubidity in a natural context status and future perspective of the TASS program. WODCON conferentie, 09-2010 Shanghai.

Cardoso, J.F.M.F., Nieuwland G., Wijsman J., Witbaard R., Van der Veer H.W. (2011) Validation of a method for age determination in the razor clam Ensis directus, with a review on available data on growth, reproduction and physiology. NIOZ-Report 2011-9: 33 pp.

De Mesel, I., J. Craeymeersch, T. Schellekens, C. van Zweeden, J. Wijsman, M. Leopold, E. Dijkman, K. Cronin (2011a) Kansenkaarten voor schelpdieren op basis van abiotiek en hun relatie tot het voorkomen van zwarte zee-eenden. Imares Rapport C042/11.

De Mesel, I., J. Craeymeersch, T. Schellekens, C. van Zweeden, J. Wijsman, M. Leopold, E. Dijkman, K. Cronin (2011b) BIJLAGEN Kansenkaarten voor schelpdieren op basis van abiotiek en hun relatie tot het voorkomen van zwarte zee-eenden. Imares Rapport C042/11.

Didderen, K., Bouma S., W. Lengkeek (2011) Onderwater videobeelden van de zeebodem ten noorden van Ameland. Een test van een videotechniek als quick scan methode om benthos te Inventariseren. BuWa rapport nr. 11-140.

Didderen, K., Bouma S., W. Lengkeek, (2012). Reacties van zeehonden op baggerschepen. Suppletiewerkzaamheden bij Renesse. Bureau Waardenburg bv., rapportnummer 12-029.

Goudswaard, P.C., V. Escaravage (2010) Een kwalitatieve en kwantitatieve bemonstering van de Zeeuwse Banken in 2009 op de macrofauna gemeenschappen. IMARES Rapport C120/09.

Goudswaard, P.C., V. Escaravage, J. Wijsman (2012) Een kwalitatieve en kwantitatieve bemonstering van de Zeeuwse Banken in 2011 op de macrofauna gemeenschappen met een analyse van voorafgaande jaren. IMARES Rapport in prep.

Goudswaard, P.C., K.J. Perdon, J. Jol, J.J. Kesteloo, C. van Zweeden, K. Troost (2011) Schelpdieren in de Nederlandse kustwateren Bestandsopname 2011. WUR Imares Rapport C094/11.

Grasmeijer, B.T., Eleveld, M.A. 2010. Evaluation of SPM measurements in the North Sea. Research in the framework of the EIA sand extraction North Sea 2008-2012. Report A2273R2r1. Alkyon Hydraulic Consultancy & Research and the Vrije Universiteit Amsterdam.

Kamermans, P., E. Brummelhuis, J. Wijsman (2011) First pioneering laboratory experiments on filtration, respiration and growth of the razor clam (Ensis directus, Conrad). Rapport C115/11.

Koomans, R.L., Kok de, J., Ronde de, J., Rozemeijer, M.J.C. and Vries de, K. 2012. Monitoring silt content in sediments off the Dutch Coast. In: NCK-days 2012 (Ed W.M.a.H. Kranenburg, E.M. and Wijnberg, K.M., eds.), pp. 157-160, Crossing borders in coastal research : jubilee conference proceedings. University of Twente, Department of Water Engineering & Management, Enschede, the Netherlands.

Leopold, M.F, Verdaat H., Spierenburg P. & van Dijk J. (2010). Zee-eendenvoedsel op een recente zandsuppletie bij Noordwijk. IMARES Rapport C021/10, 30 pp.

Laane, R.W.P.M., H.L.A. Sonneveldt, A.J. Van der Weyden, J.P.G. Loch, G. Groeneveld, 1999. Trends in the spatial and temporal distribution of metals (CD, CU, Zn and Pb) and organic compounds (PCBs and PAHs) in Dutch coastal zone sediments from 1981 to 1996: a model case study for Cd and PCBs. Journal of sea research. -Vol. 41, no. 1-2; p. 1-17.

Paap, B. (2011) Benthos kartering met behulp van side scan sonar voor de kust van Noordwijk. Deltares rapport 1203108-000.

Schellekens, T., 2012. Groei en conditie van zwaardschede (Ensis directus, Conrad) voor, tijdens en na geplande zandwinning in 2013-2017. IMARES Rapport in prep.

Spearman, J., A. de Heer, S. Aarninkhof, M. van Koningsveld (2011) Validation of the Tass System for Predicting the Environmental Effects of Trailing Suction Hopper Dredgers. Terra et Aqua 125: 14-22.

Talmon, A.M. (2007) Meetrapport SiltProfilermetingen 22-24 mei 2007 voor de Noord-Hollandse kust. WL | Delft hydraulics rapport Z4426.

Talmon, A.M. (2008a) Meetrapport SiltProfilermetingen Ms Spirit 17 september, 1 en 2 oktober 2007 voorde Noord-Hollandse kust. Deltares rapport Z4481.

Talmon, A.M. (2008b) Meetrapport suspensiemetingen Ms. Zirfaea bij zandwinning 17, 18 en 19 september voor de Noord-Hollandse kust. Deltares rapport Z4521.

van Prooijen, B., Bliek, B. Los, H. Desmit, X. (2007) Winning suppletiezand Noordzee 2008-2012 Slibtransport, nutriëntentransport en primaire productie. Svašek Hydraulics Report BvP/1414/07376C.

Wijsman, J.W.M. (2010) Dynamic Energy Budget (DEB) parameters for Ensis directus. IMARES Report number C116/11.

Witbaard, R., G.C.A. Duineveld & M. Bergman (2012). Progress report on the study into the dynamics and growth of Ensis directus in the near coastal zone of Egmond, in relation to environmental conditions in 2011. NIOZ report 2011-project

18 Annex 9: OSPAR National Contact Points for Sand and Gravel Extraction

List of national contact points for ospar reporting on sand and gravel extraction	
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