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SCICOM STEERING GROUP ON ECOSYSTEM PRESSURES AND IMPACTS

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

20–23 April 2015

Ostend, Belgium

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 Ostend, Belgium, on 20–23 April 2015. Ten participants from six ICES member countries attended the meeting. Contributions were provided from 11 countries whose representatives could not attend.

The objective of WGEXT is to provide a summary of data on marine sediment extraction (ToR A1), marine resource and habitat mapping, changes to the legal regime, and research projects relevant to the assessment of environmental effects (ToR A2). The data on marine sediment extraction will be reported on a yearly basis for OSPAR in an Interim Report. The other items will be addressed in the Final Report of the new ICES 3-year reporting period. In addition, WGEXT previously defined nine other ToRs which WGEXT has identified as important issues to be addressed.

Data reports were reviewed from 17 (of 20) member countries. Although not all of the member countries provided reports, the available data is thought to provide a representative assessment of the overall total of material extracted from the ICES area. We welcome Laura Addington from the Ministry of the Environment, Nature Agency, as the new member of WGEXT from Denmark. This year she was not able to attend the meeting and contribute by correspondence. Contact was also initiated with the new representative from Spain, Marta Martínez-Gil Pardo de Vera. WGEXT looks forward to her contributing by correspondence at the next meeting.

Work has been ongoing on eight of the ToRs (B – J). During 2014, inquiries were sent to member countries for five of the ToRs (B, E, G, H and J), with responses received from several member states. Efforts will continue during 2015 to get responses from the remaining ICES countries. Proposals for ongoing work during 2015 were agreed. WGEXT agreed to meet again in Gdansk, Poland in April 2016.

1 Administrative details

Working Group name

Working group name: Working Group on the Effects of Extraction of Marine Sediments on the Marine Ecosystem (WGEXT)

Year of Appointment

2015

Reporting year within current cycle

2

Chair

Ad Stolk, The Netherlands

Meeting venue

Ostend, Belgium

Meeting dates

20–23 April 2015

2 Terms of Reference

Because of changes in assignments, the WGEXT leads for some of the ToRs have been changed. The Terms of Reference for WGEXT 2013 to 2016 (agreed within the SICOM Steering Group on Human Interactions on Ecosystems Resolutions (SSGHIE 2013)) are:

ToR A. Review of data and developments. *Overall lead from WGEXT: Ad Stolk*

A1. Review data on marine extraction activities including volumes, spatial areas and the collection of geospatial data on extraction locations in the form of shape files for OSPAR. To be produced every year (interim and final reports) and sent to OSPAR.

A2. Review of development in marine resource mapping, legal regime and policy, environmental impact assessment, research and monitoring and the use of ICES Guidelines on marine aggregate extraction. To be produced for the final year three report (2016).

ToR B. Create an ICES aggregate database (linked to the ICES Data Center) comprising all aggregate related data, including scientific research and EIA licensing and monitoring data. *Overall lead from WGEXT: Johan Nyberg*

ToR B is an engaging task. As a result, we expect that they will take over three years to construct. In the first instance, WGEXT wish to create a database which allows users to contact relevant organizations in each country and see what data are available (rather than access the data themselves through the data-base). WGEXT will contact other WGs to look at how they have constructed/formatted their databases:

B1. Year 1 (2013/2014) – creation of a template with data required from each country. *Lead from WGEXT: Johan Nyberg, Ingemar Cato, Marcel Rozemeijer and Henry Bokuniewicz.*

B2. Year 1 (2013/2014) – Check with ICES options for WGEXT database linked to ICES database. *Lead from WGEXT: Johan Nyberg.*

B3. Year 1 (2013/2014) – Create an inventory of other WG contacted with re-gards databases of relevance to WGEXT to allow possible links to be created within the WGEXT database. *Lead from WGEXT: Marcel Rozemeijer.*

B4. Year 2 (2014/2015) – template to be finalized and populated for each country and sent for approval to ICES. *Lead from WGEXT: All members, coordinated by Johan Nyberg.*

ToR C. Incorporate the MSFD into WGEXT. *Overall lead from WGEXT: Ad Stolk*

C1. Years 2 and 3 (2014–2016) - Bringing forward the interpretation of GES descriptors 1, 4, 6, 7 and 11 of WGEXT to the EU. *Lead from WGEXT: Ad Stolk.*

C2. Years 2 and 3 (2014–2016) - Collate the implications of GES descriptors 1, 4, 6, 7 and 11 for marine sediment extraction. *Lead from WGEXT: Ad Stolk (with all members to provide country view)*

C3. Year 3 (2015/2016) - Review the 2003 ICES guidelines on Marine Aggregate Extraction, specifically in relation to the GES descriptors of the MSFD in light of discussions concerning 1 and 2 above. *Lead from WGEXT: Ad Stolk*.

ToR D. Ensure outputs of the WGEXT are accessible by publishing as a group and creating a webpage on the ICES website. *Overall lead from WGEXT: Michel Desprez.*

D1. Years 2 and 3 (2014–2016) Publish outputs from ToR 6a concerning intensity. *Lead from WGEXT: Annelies de Backer and Keith Cooper.*

D2. Years 1 to 3 (2013–2016) Investigate other outputs to publish. *Lead from WGEXT: Michel Desprez.*

D3. Year 1 (2013/2014) Populate webpage on the ICES website. *Lead from WGEXT: Ad Stolk*

D4. Year 3 (2015/16) Develop a proposal and organize a theme session at 2016 ICES Annual Science Conference. *Lead from WGEXT: Ad Stolk and Keith Cooper (plus other members to present)*

ToR E. Discuss the mitigation that takes place across ICES countries and where lessons can be learnt or recommendations taken forward (years 2 and 3, 2014–2016). *Overall lead from WGEXT: Keith Cooper.*

ToR F. Study the implications of the growing interest in deep sea mining for the WGEXT (legislation/environmental/geological). *Overall lead from WGEXT: Bryndis Robertsdottir and Brigitte Lauwaert.*

F1. Years 1 and 2 (2013–2015). Produce summary paper concerning deep sea mining (What is being mined, where this is occurring, techniques being developed, etc). Lead from WGEXT: Bryndis Robertsdottir, Jan van Dalfsen and Rui Quartau.

ToR G. Promote harmonization, where possible, of data across ICES countries. ToR G will involve ICES Data Centre where possible. *Overall lead from WGEXT: Jyrki Hamalainen.*

G1. Year 2 (2014/2015) – Define the interpretation of intensity across ICES countries. *Lead from WGEXT: Annelies de Backer, Keith Cooper and Sander de Jong*

G2. Years 1–3 (2013–2016) – Define where else data can be harmonized with regards to aggregate extraction. *Lead from WGEXT: Jyrki Hamalainen.*

ToR H. Identify the way archaeological, cultural and geomorphological values are taken into account. *Overall lead from WGEXT: Michel Desprez.*

H1. Year 3 (2015/2016) All countries to provide details of how cultural values are taken into account. *Lead from WGEXT: Michel Desprez.*

ToR I. Cumulative assessment guidance and framework for assessment should be developed. It is acknowledged that this work may be being developed within another ICES or OSPAR WG and steps should be taken to investigate and align guidance as appropriate. *Overall lead from WGEXT: Jan van Dalfsen*

I1. Years 1 and 2 (2013 – 2015) WGEXT to collate and review outputs from other WGs for relevance to WGEXT. *Lead from WGEXT: Jan van Dalfsen.*

ToR J. Identify threshold conditions and associated reasoning for EIAs in different countries, discuss whether similar thresholds could apply in other countries (Year 3). *Overall lead from WGEXT: Henry Bokuniewicz.*

3 Summary of work plan

See Chapter 2.

4 List of Outcomes and Achievements in this delivery period

ToR A1

- Data of national aggregate extraction activities in 2014 from 17 countries
- Data on spatial extent of areas licensed for extraction from 7 countries
- Data on actual areas over which extraction occurs from 4 countries

- Geospatila shapefiles information from 8 countries

ToR B

- Aspects defined for database
- Priority to volume and spatial data
- GIS files for licensed and extracted areas are gathered

ToR C

- Decision to concentrate on D1(biodiversity), D4 (foodwebs), D6 (seabed integrity), D7 (hydrographical conditions) and D11 (underwater noise)
- Overview of latest developments in MSFD

ToR D

- Article: Marine aggregate extraction and Marine Strategy Framework Directive; a review of existing research
- Preparing presentations on ASC in 2016

ToR E

- Inventory of mitigation requirements member countries

ToR F

- First information on deep sea mining.
- Discussion about definition

ToR G

- Decision to concentrate on intensity of extraction as function of volume/area/time
- Inventory of available and useful data from member countries

ToR H

- Completion of overview of data from 13 countries

ToR I

- Decision to follow initiatives already underway is instead of formulation new ones

ToR J

- Completion of overview of data from 11 countrie

5 Progress report on ToRs and workplan

5.1 Opening of the meeting

The Working Group on the Effects of Extraction of Marine Sediments on the Marine Ecosystem (WGEXT) was welcomed to Ostend by Hans Polet, Scientific Director of the Institute for Agricultural and Fisheries Research (ILVO; see Annex 7) as well as by WGEXT member Annelies De Backer who had organized the meeting in Ostend. The director welcomed the group and provided an introduction to the institute and the work they undertake. The chair of WGEXT, Ad Stolk, thanked ILVO for hosting the meeting and all countries for providing national reports. The meeting included a tour of ILVO and a fieldtrip to a dredging company and Atlantic Wall.

Henry Bokuniewicz served as the rapporteur. Bryndis Robertsdottir (Iceland), Jan van Dalfsen (The Netherlands), Johan Nyberg (Sweden), Ingemar Cato (Sweden), Maarten de Jong (the Netherlands), Tammy Stamford (United Kingdom), Marcel Rozemeijer (The Netherlands); and Rui Quartau (Portugal) all sent their apologies for being unable to attend. Maarten de Jong informs us that new research is soon to be published; de Jong, M.F., M. J. Baptist, H. J. Lindeboom, and P. Hoekstra, 2015. Relationships between macrozoobenthos and habitat characteristics in an intensively used area of the Dutch coastal zone. ICES Journal of Marine Science, in press.

5.2 Adoption of the agenda

The 2015 annual meeting marks the second year of the three year ICES reporting period. The 2014 Interim Report has been published. The Cooperative Research Report was finished last year. We had expected it to be published by December, 2014, but editorial comments were received in March, 2015. We anticipate the WGEXT Final Report can act as a Cooperative Research Report at the end of three-year ToR reporting period, which would mean that the Cooperative Research Report would not be necessary. The agenda was duly adopted by the WGEXT members in attendance.

5.3 Overview of Terms of Reference

See Chapter 2.

5.4 Term of Reference (A1): Review annual data on marine extraction activities including tonnages, spatial areas and the collection of geospatial data on extraction locations in the form of shapefiles

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 4.1a and 4.1b.

Table 4.1a. Summary Table of National Aggregate Extraction Activities in 2014.

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)
Belgium (OSPAR)	2,260,000	3,560,000	0	0	5,820,000	915,000
Canada	N/d	N/d	N/d	N/d	N/d	N/d
Denmark[2,9] (HELCOM)	1,800,000[9]	100,000[9]	1,100,000[9]	N/d	3,000,000[9]	350,000[9]
Denmark[2,9] (OSPAR)	1,200,000[9]	3,500,000[9]	3,000,000[9]		7,700,000[9]	0[9]
Estonia (HELCOM)	0	0	0	0	0	0
Finland (HELCOM)	0	0	0	0	0	0
France [3] (OSPAR)	2,516,424	N/d[11]	N/d	200,800[12]	2,717,224	0
France (Med)	0	N/d[11]	N/d	0	N/d	0
Germany (HELCOM)	178,261	0	0	0	178,261	0
Germany (OSPAR)	48,633	1,117,908	0	0	1,166,541	0
Greenland and Faroes (OSPAR)	N/d	N/d	N/d	N/d	N/d	N/d
Iceland (OSPAR)	140,170	0	39,270	ca 76,140	ca 255,580	0
Ireland (OSPAR)	0	0	0	0	0	0
Latvia (HELCOM)	N/d	N/d	N/d	N/d	N/d	N/d
Lithuania (HELCOM)	0	0	0	0	0	0
Netherlands4 (OSPAR)	5,594,918	40,407,400	3,394,499	161,458	51,271,582	2,500,000
Norway (OSPAR)	0	0	0	few thousand	few thousand	0
Poland (HELCOM)	1,351,263	457,731	0	0	1,808,994	0
Portugal (OSPAR)	161,226	1,340,000	0	0	1,501,226	0
Spain (OSPAR)	0	1,226,531	0	0	0	0
Spain (MED)	0	1,207,084	0	0	0	0
Spain (Canary Islands)	0	752,250	0	0	0	0

Sweden (OSPAR)	0	0	0	0	0	0
Sweden (HELCOM)	0	83,498	0	0	83,498	0
United Kingdom[6] (OSPAR)	9,294,224	918,140	567,813	0	10,780,177	1,871,586
United States	176,968	3,603,206	0	3,232,538	7,012,706	0

Table 4.1b. Summary Table of National Aggregate Extraction Activities in 2014 (continued).

Country	New Maps/Data available*	New legislation	New Policy	EIA initiated	EIA ongoing	EIA finished	EIA published
Belgium (OSPAR)	Yes[1]	No	Yes	No	No	No	No
Canada	N/d	N/d	N/d	N/d	N/d	N/d	N/d
Denmark[2](HELCOM)	N/d	N/d	N/d	N/d	N/d	N/d	N/d
Denmark[2] (OSPAR)	N/d	N/d	N/d	N/d	N/d	N/d	N/d
Estonia (HELCOM)	N/d	N/d	N/d	N/d	N/d	N/d	N/d
Finland (HELCOM)	Yes	No	No	No	No	No	No
France [3] (OSPAR)	Yes	No	No	Yes	Yes	In part	Yes
France (Med)	Yes	No	No	Yes	Yes	No	No
Germany (HELCOM)	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
Greenland and Faroes (OSPAR)	N/d	N/d	N/d	N/d	N/d	N/d	N/d
Iceland (OSPAR)	No	Yes?	No	No	No	No	No
Ireland (OSPAR)	N/d	N/d	N/d	N/d	N/d	N/d	N/d
Latvia (HELCOM)	N/d	N/d	N/d	N/d	N/d	N/d	N/d
Lithuania (HELCOM)	N/d	N/d	N/d	N/d	N/d	N/d	N/d
Netherlands (OSPAR)	No[1]	No	No	Yes	No	No	Yes
Norway (OSPAR)	N/d	N/d	N/d	N/d	N/d	N/d	N/d
Poland (HELCOM)	Yes	No	No	N/d	N/d	N/d	N/d
Portugal (OSPAR)	No	No	No	No	No	No	No
Spain (OSPAR)	N/d	N/d	N/d	N/d	N/d	N/d	N/d
Spain (MED)	N/d	N/d	N/d	N/d	N/d	N/d	N/d
Spain (Canary Islands)	N/d	N/d	N/d	N/d	N/d	N/d	N/d
Sweden (OSPAR)	No	No	No	Yes	Yes	No	No
Sweden (HELCOM)	No	No	No	Yes	Yes	No	No
United Kingdom[6] (OSPAR)	Yes	No	No	Yes	Yes	Yes	Yes
United States	No	No	No	No	Yes	No	No

Table Definitions and notes:

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 out-side of the country where it was extracted.

*** "maps" refer to resource maps, not extraction area maps**

[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 Conven-tion-areas cannot be added.

[3] For the first time the extraction quantities of France are the actual extracted volumes, not the licensed volumes.

[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 161,458 m_3 of shells as non-aggregate material

[9] The amounts of Denmark are comparable with 2012, however it has not been possible to provide exact figures this year. Therefore the reported figures are the same as 2012. The exact figures will be reported in the Final Report in 2016.

[10] Conversion factor for Poland, due to the deposits extracted, is 1T = 1.75m^3

Iceland: The total volume for A and C is 182,15 m^3, estimated 15% in A and 85% in C. New data are available for the physical properties of marine aggregates from the Kollafjördur extraction area.

[11] No information is available for extraction quantities although sand extraction for beach replenishment is likely to have occurred.

[12] Licensed data (maximum permitted) because extracted data is subject to statistical confidentiality.

WGEXT will again circulate a copy of the WGEXT 2015 interim report to contact points provided by OSPAR in order that the accuracy of the information presented can be assured. Data has never been received to date from Greenland and the Faroes.

Similar to previous years, Table 4.2 provides information on countries with data adjustments.

Table 4.2. Specific matters highlighted in response to OSPAR request for ICES WGEXT to supply national data.

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)
SWEDEN	Delineate activities in the Baltic area (Kattegat) which fall within the boundaries of the OSPAR
DENMARK	As for Sweden

Table 4.3a and 4.3b summarizes information on spatial extent of areas licensed for extraction 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 the actual spatial footprint should be used to assess impacts.

Table 4.3a Spatial extent of areas licensed for extraction.

Country	2006	2007/08	2009	2010	2011	2012	2013	2014
	Licensed Area Km^2							
Belgium	273	273	273	273	319	319	319	
Denmark	N/d	429	430	789	650	700	N/d	
Finland	N/d	N/d	N/d	N/d	N/d	N/d	12	12
France[1]	73.08[2]	72.97/74.97[2]	74.87[2]	67.87[2]	67.87[2]	135.34[2]	168.539[2]	16,544
Iceland	N/d	N/d	20.55	20.50	20.57	20.57	20.55	20.57
Netherlands[5]	453	456/585	564	490	456	439	462	470
Poland	51.10	51.10	51.10	51.10	25.66	25.66	25.66	25.66
Sweden	0	0	0	0	9.70	0	0	9.70
UK	1316	1278	1286	1291	1274	711	739	726

Table 4.3b Actual areas over which extraction occurs.

Country	2006	2007/08	2009	2010	2011	2012	2013	2014
	Area in which extraction activities occur Km^2							
Belgium	N/d	N/d	N/d	N/d	105.7	106.2	113.7	
Denmark	N/d	N/d	N/d	N/d	N/d	N/d	N/d	
Finland	N/d	N/d	N/d	N/d	N/d	N/d	0	0
France[1]	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d
Iceland	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d
Netherlands [5]	47[3]	383/ 35.3[3]	86[3]	86[3]	71[3]	64	86[3]	90
Poland	N/d	N/d	N/d	N/d	N/d	N/d	N/d	N/d
Sweden	0	0	0	0	9.70	0	0	9.70
UK	141[4]	138	124	105	114	97	99	86

Table 4.3a. and 4.3b notes:

[1] French dredging vessels are fitted with EMS but the information is not treated to make area in which extraction activity occur available.

[2] Includes 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 and 2011, 128.14 sand and gravel extraction area and 7.2 non aggregate area in 2012, 162.96 sand and gravel extraction area and 5.579 non aggregate area in 2013, and 162.96 sand and gravel extraction area and 2.48 non aggregate area in 2014.

[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), 23 km^2 (2011) and 45 km^2 (2013)

[4] 90% of material extracted in UK is taken from 46km2 (2003) and 43km2 (2004), 49.2 km2 (2006) 49.95 (2007), and 39.2 km^2 (2013)

[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.

[7]Annual report will be available in June.

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.

The last part of the ToR A1 concerns the collection of geospatial data on licensed and extraction locations in the form of shape files. OSPAR is currently working on the OSPAR Data and Information Management Strategy, which will include a web portal and metadata catalogue for all OSPAR data streams. OSPAR urgently requests these data as shapefiles; if exact data is not available, OSPAR asks if approximate shapefiles can be created and sent. Ultimately, they will be aiming to undertake a full cumulative effects assessment which will require pressure layers for all human activities and for that it will be essential to have spatial data.

Countries that have shapefiles during year2 (2014/2015) are listed in Table 4.4. OSPAR countries are asked to provide available shapefiles for 2014 to OSPAR at < Sylvie.Ashe@ospar.org > by 1 October 2015. WGEXT requests that shapefiles are provided annually from all ICES countries including those which are not in OSPAR, to both < Johan.nyberg@sgu.se > and , < ad.stolk@rws.nl > as described in ToR B.

5.5 Terms of Reference B – J: Updates on Progress

The following section provides a narrative of discussions concerning each ToR and outputs from the 2015 meeting.

5.5.1 ToR B: Create an ICES aggregate database comprising all aggregate related data, including scientific research and EIA licensing and monitoring data.

During year 1, WGEXT investigated other databases on aggregates and aggregate extraction and corresponded with members in two EU-financed projects (EMOD-Nnet-Geology and EMODnet-Human activity). WGEXT had previously contacted ICES, and have permission to link with the ICES Database.

The proposed WGEXT metadata table contains (1) Country, (2) Contact person, (3) Total extracted, (4) Construction/Industrial (m3), (5) Beach replenishment (m3), (6) Construction/ fill/land reclamation (m3), (7) Non aggregate (m3), (8) Licensed Area (km2), (9) Area extracted (Km2), (10) Coordinates/shapefile (Y/N), (11) Coordinate system (latitude and longitude: WGS84), (12) Water depth (m), (13) Legislation (Y/N), (14) Licensing Authority, (15) EIA required (Y/N), (16) Monitoring in place (Y/N), (17) Black box/EMS data (Y/N), (18) Mitigation (Y/N), and (19) Comments.

Table 4.4. Geospatial Shapefile information.

COUNTRY	Shapefiles licensed	Shapefiles extracted	Comments
Belgium	Yes	Yes	Licensed areas sent to OSPAR
Canada	No	No	Not an OSPAR country
Denmark	N/d	N/d	Pending Chair request.
Estonia	N/d	N/d	Not an OSPAR country
Finland	Yes	No	Not an OSPAR country
France	Yes	No	
Germany	Yes	Yes	Sent to OSPAR directly
Greenland and Faroes	N/d	N/d	Pending Chair request
Iceland	Yes	No	
Ireland	N/d	N/d	Pending Chair request
Latvia	N/d	N/d	Not an OSPAR country
Lithuania	N/d	N/d	Not an OSPAR country
Netherlands	Yes	Yes	
Norway	No	No	Pending Chair request
Poland	No	No	Not an OSPAR country
Portugal	N/d	N/d	Pending Chair request
Spain	N/d	N/d	Pending Chair request
Sweden	Yes	Yes	
United Kingdom	Yes	Yes	Sent to OSPAR
United States	No	No	Not an OSPAR country

Although many different information fields are useful, the group decided that these data would be very hard to collect from member countries and also difficult to maintain and keep up to date. WGEXT elected to keep the database as concise as possible, using data that is already collected (volume and spatial area tables from current annual reports) and that can be provided in an electronic format.

The proposed template was sent recently to ICES for approval. The ICES working Group on Databases will be asked (by ICES) to review the template, but that is not expected to be done before their meeting in 2016. In the meantime, that is in 2015, WGEXT will go ahead and prepare an EXCEL file of historical extraction volumes compiled from the WGEXT annual reports. Ad Stolk will provide the tabulated data to Henry Bokuniewicz who will try to compile a single EXCEL file. GIS shapefiles of licensed areas for 2014 and extracted areas for 2014 will be requested from all ICES member countries (Table 4.4). WGEXT requests that shapefiles be provided annually by all ICES countries to both < Johan,nyberg@sgu.se > and < ad.stolk@rws.nl > as described in ToR B. We intend to have

WGEXT data incorporated into both EMODnet and the ICES database for public access. It was noted that EMODnet uses international database standard formats.

5.5.2 ToR C: Incorporate the MSFD into WGEXT

During the Annual meeting of 2014 it was decided to focus on the direct effects of marine sediment extraction (on descriptors 6, 7 and 11), but attention will also be placed on descriptors 1 and 4. An inventory was made in several documents about the MSFD on the incorporation of extraction as a human impact factor and in what way it is mentioned.

See for more detail also ToR D and the article mentioned there (Annex 8).

GES Descriptor 1 Biodiversity. In the Template for the review of Decision 2010/477/EU concerning MSFD criteria for assessing good environmental status according to the review technical manual Descriptor 1 (version 4, 08/04/15) pressures are not indicated, but it is mentioned that there are strong links with descriptors that do indicate pressures like D6 and D7.

GES Descriptor 4 Food Webs. In the ICES Special Request Advice (20/03/2015) on the EU request on revisions to MSFD manuals for D3,4 and 6 it is mentioned that only a few EU-countries mention pressures of food web components, in particular fisheries. Extraction is not mentioned.

GES Descriptor 6 Seabed Integrity. In the above mentioned ICES Advice Report for D6 three actions are proposed:

- Develop and test standards for human pressure on benthic habitats.
- Address the role of scale and connectivity in setting boundaries for the sea-floor.
- Assessment of recoverability of sea floor integrity.

Workshops are planned for 2017 and 2018. It is important that WGEXT join the discussions on this subject, especially because in the Advice is stated that the concept of switching to an approach based on functionality and recoverability should not be lost for future work.

This is in line with the opinion of WGEXT formulated in Annual Reports 2011 and 2012: WGEXT suggest that in defining 'adverse' it should be accepted that direct changes to the physical structure of the seabed will result from the extraction of marine sediments. Defining 'adverse' as being no environmental change from the existing (pre-dredge) conditions would, in the opinion of the group, be inappropriate and detrimental to the continued ability of member countries to extract marine sediments from their seabed.

The recommendation to ICES was to bring this forward to the EU.

GES Descriptor 7 Hydrographical Conditions. In the Template for the review of Decision 2010/477/EU concerning MSFD criteria for assessing good environmental status according to the review technical manual Descriptor 7 (version 6.0, 27/03/15) changes of the morphology of the seabed is mentioned as one of the pressures. Sediment extraction will, at least temporally, change the morphology. An important point is the spatial and temporal scale of this change and the scale of its effects. The document also mention the ICES Guidelines on marine sediment extraction (OSPAR Agreement 03/17/1).

GES Descriptor 11 Underwater Noise. In the Template for the review of Decision 2010/477/EU concerning MSFD criteria for assessing good environmental status according to the review technical manual Descriptor 11 (version 7.1, 18/03/15) shipping and dredging are mentioned as pressures.

The attention to underwater sound in relation to dredging and sediment extraction is increasing during the last years. In the UK a report on underwater noise from marine aggregate extraction is published (Robinson *et al.* 2011). The Central Dredging Association (CEDA) pays attention to underwater noise in papers and congresses.

During the reclamation works for the enlargement of the harbour of Rotterdam a monitoring program on underwater sound was executed.

Measuring the noise from a large range of trailer suction hopper dredgers (in power and in volume, 2000 to 22 000 m^3) showed that for all frequencies the noise of dredging and dumping was less than the noise of transit. The conclusion is that, at least in these area and circumstances, sand extraction is contributing to the noise of shipping, but introduces no negative effects from the extraction itself (Heinis, 2013).

References:

Heinis, F. (2013). Effect monitoring for Maasvlakte 2. Underwater sound during construction and the impact on marine mammals and fish. Maasvlakte Project Organisation, World Port Centre, Rotterdam, 39 p.

Robinson, S.P., P.D. Theobald, G. Hayman, L.S. Wang, P.A. Lepper, V. Humphry, S. Mumford (2011). Measurement of underwater noise arising from marine aggregate dredging operations. Report MALSF MEPF 09/P108, Marine Aggregate Levy Sustainability Fund (MALSF).

5.5.3 ToR D: Ensure outputs of the WGEXT are accessible by publishing as a group and creating a webpage on the ICES website

Michel Desprez has taken the lead as the coordinator of ToR D. WGEXT would like to raise the profile of the WG and ensure outputs from the annual meetings are accessible. Michel Desprez is preparing a review article on *Marine Aggregate Extraction and Marine Strategy Framework Directive: A review of existing research*. He intends to have a section and bibliography on each of the GES descriptors 1,4,6,7, and 11. Summary tables will be provided, for example, on potential impacts and species affected. Impacts of sand and gravel extraction might be minimized if, for example, sensitive species could be identified and avoided. Of course, additional mapping would be required. The draft text (Annex 8) will be sent to WGEXT members for advice.

The ICES Annual Science Conference will be held in Latvia in September 2016. We will have a WGEXT session there and several members of WGEXT will present relevant developments in research.

5.5.4 ToR E: Discuss the mitigation that takes place across ICES countries and where lessons can be learned or recommendations taken forward

Keith Cooper has become the WGEXT lead for TOR E. The WGEXT questionnaire included mitigation as might be proscribed in the EIA and specified in the license conditions. WGEXT members were asked to describe mitigation intended to address ecological concerns, interactions with commercial fisheries, historic environment mitigation, and potential interference with navigation. Best management practices and monitoring requirements may be also specified. The questionnaire had been sent to all member countries during the 2014 meeting. WGEXT would like to compile mitigation options and techniques from all ICES countries to investigate the comparability of techniques used, to determine whether they are site specific, or could be applied in multiple countries, as certain countries do not apply mitigation to aggregate extraction. In addition, WGEXT intends to update the 2003 guidelines, should mitigation techniques have moved forward.

In the UK, Netherlands, Belgium and France, operational mitigation requirements will typically be informed by the results of EIA. In the UK for example, dredgers are required to extract all the resource in one licensed zone before moving to the next in order to minimize the spatial extent of any impact. This also minimizes the potential spatial impacts on other marine users, such as fishermen. The EIA process will also determine whether screening is permitted to take place or not, depending on the presence/absence of sensitive receptors, such as features of nature conservation interest. Exclusion zones will be defined to protect existing pipelines, cables etc. and also to mitigate any potential impacts on features of maritime heritage value identified. Exclusion zones may also be used to protect features of nature conservation interest, although the application will be dependent on the features exposure and sensitivity to the dredging pressure. Research over the last 20 years has informed understanding of recovery, post-extraction, and this now underpins many of the impact hypotheses used in the UK EIA process – particularly the importance of maintaining similar seabed condition. This has resulted in a change in emphasis for both operational mitigation and compliance monitoring, which now focuses on the seabed conditions required to enable benthic recovery of dredged areas post-extraction, rather than simply reducing or monitoring impacts. This approach is now being applied by the industry on a regional scale, with each licensee contributing to the monitoring program. In the Netherlands, extraction cannot occur in water less than 20 m deep. This prevents disturbance of *Natura 2000* areas which are all in shallower water. This mitigation also prevents adverse impacts on coastal protection. Pits are dredged in order to minimize the footprint of the extraction site, but the side slopes are also specified. Slopes are intended to be steep enough to minimize the area disturbed, but not so steep that low oxygen conditions develop. The appropriate values had been determined by monitoring studies. The orientation of the pit is also important. It is intended that the sediment type is not changed by the dredging and extractors are typically required to monitor conditions and benthic recolonization.

5.5.5 ToR F: Study the implications of the growing interest in deep sea mining for the WGEXT (legislation/environmental/geological)

The WGEXT coordinators for ToR F could not attend this meeting. Brigitte presented a brief review of the current situation with respect to deep sea mining provided to EIHA 2015 by prof. David Johnson who is a consultant within the MIDAS project (an FP7 European project).

The marine mineral resources from the deep sea are Manganese nodules, Cobalt crusts and massive sulphides. Mn-nodules are expected to be mined by seabed rakes with the product air-lifted to the surface. These areas tend to have a high species diversity, but low biomass. The benthic communities tend to be composed of very long-lived individuals, slow-growing in extremely stable conditions.

Cobalt crusts are ingrown with the substrate and cannot be collected as easily as Mn-nodules. Cobalt crusts are hotspots of biodiversity; they have very diverse species (including corals). They are in complex ecosystems. The potential impacts for mining cobalt crusts are expected to be less because of a smaller area thought to be available for exploitation.

Massive sulphides can be found on (i) active vents with many endemic species, high biomass, low biodiversity, linear distribution and relatively fast regeneration; and on (ii) inacitive vents with high biodiversity, lower biomass and probably more wide-spread distribution. Mining of massive sulfides seems impractical at the moment; the areas are too small, too deep and of low grade.

The large areas of the ocean floor outside of National waters are to be regulated by the International Seabed Authority. The Authority was established in 1994 and composed of representatives from 166 countries. They have regulations for prospecting and exploration, but a code for exploitation is under development.

WGEXT intends to continue to stay abreast of the situation and would be prepared to offer the WGEXT guidelines for marine extractions if and when they might be helpful.

5.5.6 ToR G: Promote harmonization, where possible, of data across ICES countries.

This ToR is mainly dedicated to harmonization of the use of dredging intensity across ICES countries. The questionnaire prepared last year (2014) on how EMS data is collected and processed in the different countries, had been distributed, and the replies have been compiled in the Interim report for 2014. No answer was received from Denmark yet, and therefore it has been provided again to the WGEXT representative from Denmark to complete the overview.

In continuation of the extensive discussion from last year, WGEXT recognized that setting standardized thresholds on the intensity classes "high", "medium" and "low" is not practical. Not only is it susceptible to misinterpretation, but the wide range of different dredging activities among ICES countries makes standardization very complex. WGEXT reaffirmed that the proper measure of intensity is volume/area/time. However, evaluating this parameter is very difficult, and even impossible for many countries. Even in cases where the data is available to calculate this value, its interpretation is confounded by the wide variety of differences among specific extractions. It has to be kept in mind that there are many other (often site-specific) variables, which have to be taken into account when assessing the intensity of extraction, such as the capacity of the dredging vessel, whether screening is done or not, the quality of extracted material, etc. Impacts, for example, can be substantially different for between intense extraction over a short time, and small extractions repeated over a long period even though the volume/area/time over a year may have the same value in both cases. If dredging vessels are of similar size, an experiment with the Belgian data showed that volume/area/time was well correlated (R^2=0.95) to time/area. Larger dredges fill in less time than smaller ones, but the production rate depends on the material being extracted and whether or not screening is done.

Nevertheless, the data to calculate time/area is likely to be more widely available and time/area might be used as a proxy for volume/area/time.

To get more insight on the subject, it was decided that a test study dealing with intensity will be made using available EMS data from Belgium, Netherlands, UK and possibly Denmark and France. Annelies De Backer will attempt to collect and compile these data as time per area. The spatial scale still needs to be decided; it may be 50 by 50 m. "Time" would probably be reported either as the total number of hours or minutes dredged over the course of a (calendar) year. Total volume removed over the course of a year will be included, where such data is available or can be derived. In the U.K., volume data is collected by the Crown Estate but not accessible to the public for legal reasons. Mark Russell will request these data on behalf of ICES WGEXT. If it cannot be provided perhaps the Crown Estate can do the calculation itself and communicate the results to us. In France, also, data would need to be requested from the Ministry of the Environment, but data would have to be assembled from each regional level; this may not be practical. The potential inclusion of data from Denmark will be discussed informally at the EMSAGG meeting in June, 2015. At the same time, an informal discussion will take place about the possibilities of providing data with the Crown Estate and the Dutch authorities.

It was deemed premature to start to explore the harmonization of other data. There seemed to be no new information that urgently requires harmonization at this time, although other information may be needed eventually for the database. Many harmonization issues regarding reported subjects such as volumes, materials, uses, etc. can be avoided by formulating the reporting tables precisely, to facilitate a coherent result. It was as also mentioned that harmonization is closely linked to ToR B Database, as accurate and well harmonized data is essential in building an international database.

5.5.7 ToR H: Identify the way archaeological, cultural and geomorphological values are taken into account by member countries

In response to inquiry last year (2014), information has now been compiled from Belgium, Finland, France, Iceland, the Netherlands, Poland, Portugal, Spain, Sweden, the U.K. and the U.S. We are expecting information to be sent from Denmark and Germany. See Annex 4.

5.5.8 ToR I: Cumulative assessment guidance and framework for assessment should be developed

Unfortunately, the WGEXT leaders for Tor I could not attend this meeting. Cumulative effects of human activities, however, is being studied by other WGs, specifically ICES BEWG and the WGMHM. OSPAR has set up an Inter-sessional Correspondence Group on Cumulative Effects. Adrian Judd (CEFAS) was contacted to discuss progress. Furthermore the issue of cumulative impacts is addressed within studies related to the development of Offshore wind energy in Europe and it is addressed in EU FP7 projects as ODEMM, Knowseas, and COEXIST. Rather than undertaking any new work on cumulative impacts, WGEXT will follow these other initiatives already underway. As conclusions relevant to WGEXT are available, they will be reviewed in order to develop a guidance and framework for extraction.

5.5.9 ToR J: Identify threshold conditions and associated reasoning for EIAs in different countries; discuss whether similar thresholds could apply in other countries.

Certain ICES countries have thresholds determining the need for an EIA. However, many countries do not. WGEXT intend to investigate what thresholds are in place in member countries, by compiling an inventory of thresholds that are currently used, before looking at the applicability of these thresholds for other countries. The ToR is due to be reported in the Final Report (2016), however, work began in 2013.

Reports had been received during 2013 from Finland, France, the Netherlands, Portugal, Sweden, The United Kingdom and the USA; in 2014-2015, additional reports were received from Estonia, Latvia and Spain, and incorporated into this (2015) report (Annex 5). In general, there are provisions for a brief Environmental Assessment in advance of any more extensive EIA. The authority to require an EIA lies with the licensing authority, but recommendations can be provided to the licensing authority from other agencies, such as those responsible for fisheries. In discussion, it was suggested that the regulatory authority as well as the advisory process be identified.

Some countries (Table 5.2) have numerical criteria either in law or policy that trigger EIAs. Others use professional judgment on a case-by-case basis, although of course, the professional experience includes informal, numerical criteria. In some places, like Sweden, France, Latvia, and Belgium, all permits will require an EIA to be undertaken.

Table 5.2. Requirements for EIAs from ICES countries.

	ALWAYS REQUIRED	VOLUME	AREA	DEPTH	PROFESSIONAL JUDGEMENT
Belgium	*				*
Estonia		*	*	*	*
Finland		*	*		
France	*				*
Latvia	*				*
The Netherlands		*	*	*	
Portugal					*
Spain		*	*		
Sweden	*				*
UK		*			*
USA					*

5.6 Presentations given to the WGEXT

Presentations were given to WGEXT by Kris Hostens (ILVO), Gert Van Hoey (ILVO), Marc Roche (FPS-Economy), Vera Van Lancker (OD Nature), Jeroen Vermeersch (Flanders Heritage Agency), Annelies De Backer (ILVO) Laure Simplet (Ifremer), Keith Cooper (Cefas), and Mark Russell (BMAPA). See Annex 7 for abstracts.

5.7 Closure of the Meeting and Adoption of the 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 the Institute for Agricultural and Fisheries Research (ILVO) as well as WGEXT member Annelies De Backer for all her hard work in hosting the meeting and Henry Bokuniewicz for taking up the task of rapporteur.

6 Revisions to the work plan and justification

None.

7 Next meetings

The Working Group on the Effects of Extraction of Marine Sediments on the Marine Ecosystem (WGEXT), chaired by Ad Stolk, will meet again in Gdansk, Poland April, 2016 as guests of the Polish Geological Institute (ul. Kościerska 5, 80-328 Gdańsk). We hope to have the 2017 meeting in the UK; Mark Russell will explore the options.

Annex 1: List of participants

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Annex 2 Recommendations

Recommendations will be formulated in the Final Report in 2016.

Annex 3: WGEXT Agenda Annual Meeting 2015

Mon. 20th April 2015	
09.30 – 09.45	Meet at the Institute for Agricultural and Fisheries Research (ILVO), Ankerstraat 1, Oostende
09.45 – 10.30	Welcome by Hans Polet,, Scientific Director of ILVO
	Welcome by WGEXT Chair
	Apologies for absence
	Terms of reference
	Adoption of Agenda
10.30 – 10.45	Coffee and tea
10.45 – 12.30	Terms of Reference A1a: OSPAR Summary of Extraction Statistics
12.30 – 13.30	Lunch
13.30 – 14.30	Visit ILVO
14.30 – 16.00	Complete Terms of Reference A1a
16.00 – 16.15	Coffee and tea
16.15 - 16.45	Term of Reference J: EIA tresholds
16.45 – 17.30	Term of Reference I: Cumulative assessment
	Aim to complete A1, I and J by the end of day 1
Tues. 21th April 2015	
09.00 – 09.30	Round up on Terms of Reference B - J
09.30 – 10.30	Term of reference B: Database

10.30 – 10.45	Coffee and tea
10.45 – 11.30	Term of Reference E: Mitigation
11.30 – 12.30	Presentations Kris Hostens (ILVO) Gert Van Hoey (ILVO)
12.30 – 13.30	Lunch
13.30 – 18.00	Field visit to Atlantic Wall (Raversijde) and dredging company
19.30 – 21.30	ILVO Dinner
	Aim to complete B and E by the end of day 2
Wed. 22th April 2015	
09.00 – 10.30	Term of Reference G: Intensity, harmonisation
10.30 – 10.45	Coffee
10.45 – 13.00	Presentations Vera Van Lancker (MUMM) Marc Roche (FPS-Economy) Jeroen Vermeersch (Onroerend Erfgoed, Cultural Heritage) Annelies de Backer (ILVO)
13.00 – 14.15	Lunch
14.15 – 15.00	Term of Reference C: MSFD
15.00 – 15.30	Term of Reference D: Publishing outputs WGEXT
15.30 – 16.00	Term of Reference H: Cultural Heritage
16.00 – 16.30	Coffee break

16.30 – 17.00	Term of Reference F: Deep Sea Mining
17.00 – 18.00	Editorial comments on Cooperative Research Report
	Aim to complete C, D, F, G, H and CRR by the end of day 3
Thurs. 23th April 2015	
09.00 – 11.30	Agree initial text of WGEXT Second Interim Report 2015
11.30 – 11.45	Coffee
11.45 – 13.00	Presentations Laure Simplet (Ifremer) Keith Cooper (Cefas) Mark Russell (BMAPA)
13.00 - 14.00	Lunch
	Aim to complete Second Interim Report 2015 by end of day 4

Annex 4: Review of National Marine Aggregate Extraction Activities

A detailed breakdown of each country's sediment extraction dredging activities is provided here.

4.1 Belgium

In Belgium, the sectors of the Belgian Continental Shelf where sand can be extracted are defined and limited by law (royal decree of 1 September 2004; Figure 1).

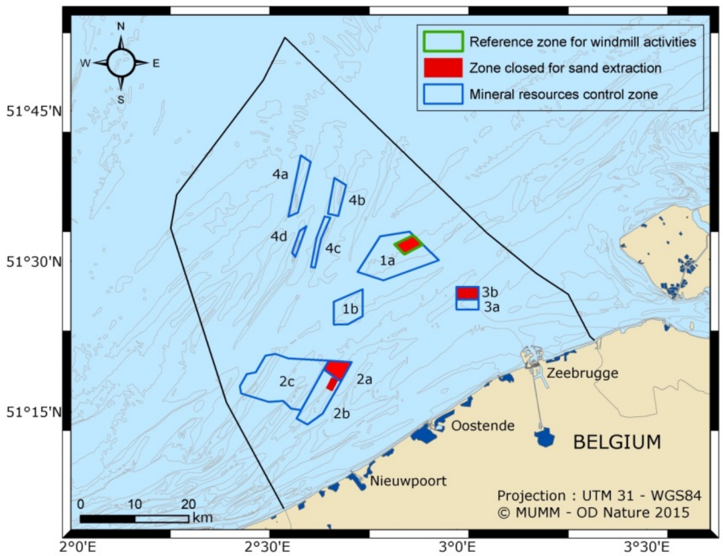


Figure 1. Extraction areas on the Belgian part of the North Sea (as defined by royal decree of 1 September 2004).

By royal decree of 20 March 2014, the Belgian marine spatial plan came into force. Due to this marine spatial plan, the sand and gravel legislation had to be changed. This was done by royal decree of 19 April 2014 which entered into force 12 June 2014. The main changes concern zone 2 which is lying in a habitat area. These changes concern not only the areas which can be extracted (Figure 2), but there is now also a limit to the amount of sand which can be extracted from area 2. The maximum amount that can be extracted during 2014 from zone 2 is 1.663.000 m3. This amount decreases every year (from 2014 till 2019 by 1%, i.e. 17 000m^3 per year). In zone 2 it is also prohibited to extract gravel.

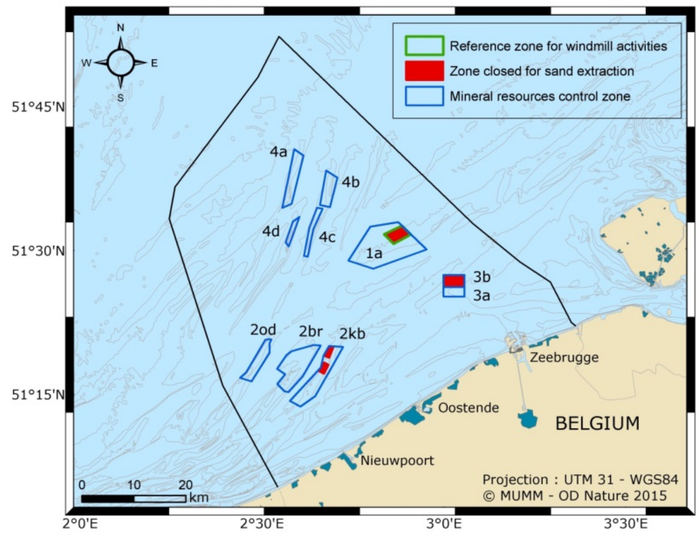


Figure 2. Extraction areas on the Belgian part of the North Sea, from 12th of June 2014 onwards.

In 2014, a total amount of 5,824,043 m³ sand and no gravel was extracted from the Belgian Continental Shelf both by the private sector and the Flemish Region, Coastal Division and Division Maritime Access.

The private sector extracted 2,259,049 m³ sand by 12 private license holders, which 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 3,564,994 m³ sand, which was used solely for beach nourishment and originated mainly from zone 3a and zone 4c. The increase of the total amount extracted in 2014 was mainly due to the increased extraction for beach nourishment. In Table 1, an overview is given of extracted amounts per area.

Table 1. Marine aggregate extraction figures for 2014 from FOD Economie, KMO, Middenstand en Energie. (Includes aggregate extraction for beach nourishment).

Dredging area	Amount (m³)
Thorntonbank (1a)	1,373,000
Gootebank (1b)	0
Kwintebank (2ab)	19,000
Buiten Ratel (2c)	604,000

Oostdyck (2c)	126,000
Sierra Ventana (3a)	1,132,000
Hinderbanken (4c)	2,570,000
TOTAL	**5,820,000**

In 2014, 915,000 m³ of sand for industrial purposes was exported to our neighbouring countries France, UK and the Netherlands (Table 2). The other 1,344,000 m³ of industrial sand was landed in the Belgian coastal harbours of Brugge (including the harbour of Zeebrugge), Oostende and Nieuwpoort.

Table 2. Export of marine aggregates in 2014 from FOD Economie, KMO, Middenstand en Energie.

Landing country	Amount (m³)
France	203,000
UK	46,000
Netherlands	666,000
TOTAL	**915,000**

Sand extraction on the Belgian Continental Shelf started in 1976 and data are available since then (Figure 3). From 2007 onwards the extra quantities extracted by the Flemish Region are included in the graph.

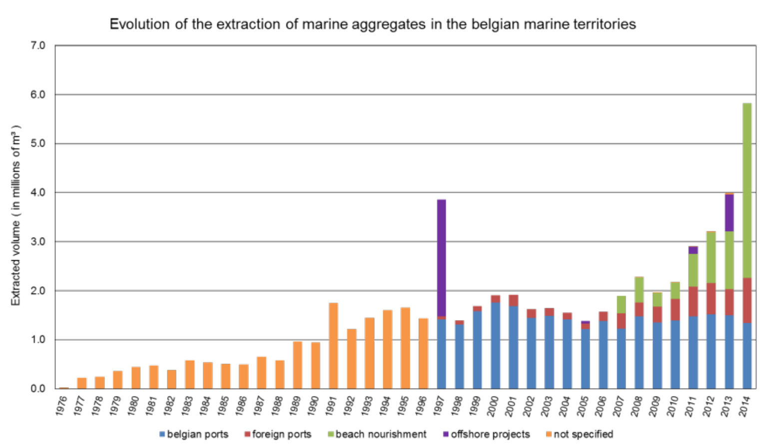


Figure 3: Volumes of sand and gravel extracted from the Belgian Continental Shelf between 1976 and 2014.

4.2 Canada. No report.

4.3 Denmark. No report.

4.4 Estonia. No report.

4.5 Finland

There was no extraction in 2014. A small scale test extraction was planned for the areas of Soratonttu and Itä-Tonttu off Helsinki, but it has not yet been implemented.

Table 1. Historic patterns of marine aggregate extraction (m^3)

YEAR	Amount		YEAR	Amount
2000	0		2008	0
2001	0		2009	0
2002	0		2010	0
2003	0		2011	0
2004	1,600,000		2012	5,800
2005	2,388,000		2013	0
2006	2,196,707		2014	0
2007	0		**Total (1996-2014)**	**6,190,507**

Description of historic extraction activities for 1995–2014

Sand and gravel extraction from Finnish coastal areas between 1995 and 2004 was negligible. The Port of Helsinki extracted 1.6 million m^3 off Helsinki (Gulf of Finland) in 2004, 2.4 million m^3 in 2005 and 2.2 million m^3 in 2006. Since then there has been only a small experimental dredging operation in 2010 and a 5 800 m^3 test extraction in 2012 in the Loviisa area, Eastern Gulf of Finland.

Summary of current licensed areas and forecasts for future exploitation of marine aggregates

There are three licenses issued by the Regional State Administrative Agencies (AVI).

Loviisa: 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 Ltd. However there was a complaint against the decision and the case was under hearing of Administrative Court of Vaasa. The decision on 31 December 2008 was favourable for the extraction. Extraction has not yet started besides a small experimental dredging exercise in May 2010 and another feasibility test exercise of 5800 m^3 in 2012. The license is valid until 30 April 2017.

Soratonttu and Itä-Tonttu (offshore of Helsinki): In 2010 The Regional State Administrative Agency of Southern Finland issued a license to Morenia Ltd. for extracting 5 Mm^3 marine sand and gravel in the Itä-Tonttu and Soratonttu areas off the city of Helsinki. According to the license, the extraction should start within 4 years of issuing the license. The license is valid until 31 August 2020. In 2014 The Regional State Administrative Agency of Southern Finland gave a new decision, extending the starting time for extraction until 20 June 2020.

Yppäri

A license application was sent by Morenia Ltd. 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), the Bay of Bothnia. After the request by the authorities, Morenia Ltd. has conducted additional studies and delivered further information concerning the application in 2012. The work was undertaken and a license was issued for 10 years in 2013. However, there was a complaint against the license decision, but the Administrative Court of Vaasa decided in October not to take up the subject. Thus, the license is now valid.

In the Helsinki metropolitan area there are currently several major tunnel construction sites, e.g. the metro line extension to west of Helsinki and the new railway route to the airport. As a consequence, a lot of crushed rock material from tunnel works has been available in the area, reducing the need for marine aggregates.

Metsähallitus, who administers and manages the state owned areas including natural resources, has sold its affiliated company Morenia Ltd, which was the license holder for the above mentioned marine aggregate areas. All licenses are moved to a new affiliated company called MH-Kivi Ltd.

4.6 France

Reported quantities in 2014 are actual values, whereas in previous reports licensed quantities which would have been overestimates. Also given below are actual extracted volumes from 2010.

Construction industrial aggregate (sand and gravel) extraction figures for 2014:

DREDGING AREA	AMOUNT, m^3
Channel	358,686
Atlantic	2,157,738

Brittany	0

Amount of material extracted for beach replenishment projects in 2014.

France does extract sand for beach replenishment but data is not available because these extractions are in the jurisdiction of the local and regional authority and licenses are not required.

Construction fill/ land reclamation in 2014: No data are available for construction fill or land reclamation in France

Non-aggregate extraction figures for 2014. A maximum, 200 800 m^3 (licensed data) of shelly sand could have been extracted off the coast of Brittany. Maerl extraction was prohibited by the end of 2013.

Exports of marine aggregate in 2014. There were no exports of marine aggregate.

Historic patterns of marine aggregate extraction. The tabulated values in table 1 are actual extracted volumes from 2010.

Table 1.Description of historic extraction activities for 2000-2014.

Year	**Quantities extracted (m^3)**			**Total extracted (m^3)**	**Maximum quantities permitted by Authorities (m^3)**
	Channel	Brittany	Atlantic		
2010	545 881	225 400	2 598 423	3 369 704	6 448 662
2011	592 539	196 393	2 688 844	3 477 776	6 550 746
2012	406 594	175 264	2 750 178	3 332 036	11 320 746
2013	768 999	230 068	2 557 782	3 556 849	10 597 877
2014	358 686	200 800 [1]	2 157 738	2 700 629	12 431 000

[1] Licensed data (maximum permitted) because extracted data is subject to statistical confidentiality

Summary of current license position and forecasts for future exploitation of marine aggregates (Figure1 and Table 1).

Seventeen extraction licenses (165.44 km^2), One research license (53.27 km^2) and one prospection (42 km^2) authorization have been issued by local administration (Préfectures). Thirteen applications (four for exploration, four on actual extraction area for a renewal of license, five on new extraction perimeter) for aggregate extraction are being considered by Economy Ministry. It represented 1364.53 km^2 for research perimeters and 43.654 km^2 for extraction sites, with a potential increase for new licensed area of 37.614 km^2.

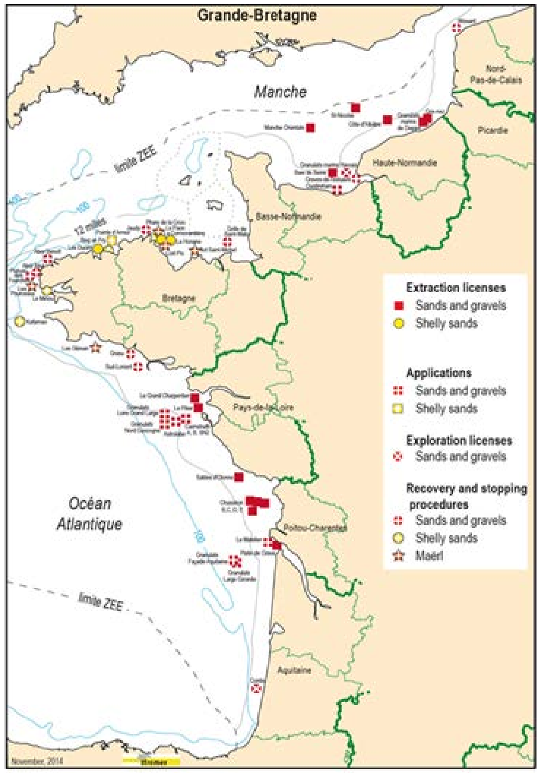


Figure 1.Description of Extraction sites 2014.

	Licensed area				Area in which extraction occurred				
	2010/2011	2012	2013	2014	2010	2011	2012	2013	2014
FRANCE[1]	109.87	230.611	263.8091	260.711	No data[2]	No data[2]	No data[2]	No data[2]	No data[2]

[1] Includes 42 research licenses and 67.87 extraction licenses in 2010/2011, 95.27 research licenses and 135.34 extraction licenses in 2012, 95.27 research licenses and 168.539 extraction licenses in 2013 and 95.27 research licenses and 165.44 extraction licenses in 2014.

[2] French dredging vessels are fitted with EMS. Data is used to verify the respect of the boundaries of the permitted area but is not treated to delivered information on area in which extraction occurred.

Additional Notes and Explanation: Information supplied is used to compile the following table which will represent one of the formal outputs of the WGEXT to OSPAR. In a bid to ensure consistency in the way figures are calculated please refer the following additional explanation of the column headings.

4.7 Germany

Marine aggregate (sand) extraction figures for 2014

OSPAR area	
Replenishment	1117908 m³
Construction	48633 m³
Total	1166541 m³
HELCOM area	
Replenishment	none
Construction	178261 m³
Total	178261 m³

4.8 Greenland and the Faeroes. No report.

4.9 Iceland.

History of extractions in Iceland

Year	Marine Aggregate Extraction, m3	Marine Non-Aggregate Extraction, m3		Total Extraction, m3
	gravel & sand	shell sand	maerl	
2000	1,435,665	147,280	0	1,582,945
2001	1,189,950	133,640	0	1,323,590
2002	861,315	114,250	0	975,565
2003	1,155,485	83,920	0	1,239,405
2004	1,412,430	118,340	0	1,530,770
2005	1,259,157	143,780	13,740	1,416,677
2006	1,253,464	151,460	20,535	1,425,459
2007	1,145,390	158,300	21,666	1,325,356
2008	921,000	134,680	50,445	1,106,125
2009	374,885	69,360	25,435	469,680
2010	125,800	39,760	54,450	220,010
2011	138,700	40,740	ca 56,000	ca 235,440
2012	145,070	12,780	58,800	216,650
2013	182,115	7,100	ca 63,000	ca 252,215
2014	179,440	11,140	ca 65,000	ca 255,580

4.10 Ireland. No report.

4.11 Latvia. No report.

4.12 Lithuania. No extraction was done in 2014.

4.13 The Netherlands.

Marine aggregate (sand) extraction figures for 2014

DREDGING AREA	AMOUNT Mm^3
Euro-/Maas access-channel to Rotterdam	**1,843,127**
IJ-access-channel to Amsterdam	**1,236,188**
Channels Voordelta	**31,638**
Dutch Continental Shelf	**5,594,918**
Dutch Continental Shelf / Maasvlakte 2 project	**3,394,499**
TOTAL	**12,100,370**

Non-aggregate (shell) extraction figures for 2014

DREDGING AREA	MATERIAL	AMOUNT m^3
Wadden Sea	Shells	**0**
Wadden Sea inlets	Shells	**0**
Western Scheldt	Shells	**0**
Voordelta of the North Sea	Shells	**18,720**
North Sea	Shells	**142,738**
TOTAL	Shells	**161,458**

Description of non-aggregate extraction activities in 2014:

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 2014.

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

- the Wadden Sea max. 85 000

  (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 85 000 up to 2014
- the Voordelta 40 000
- the Western Scheldt 40 000
- the rest of the North Sea until a distance of 50 km offshore unlimited.

Exports of marine aggregate in 2014

DESTINATION/(landing)	AMOUNT (m3)*
Belgium	2,500,000
France	10,000

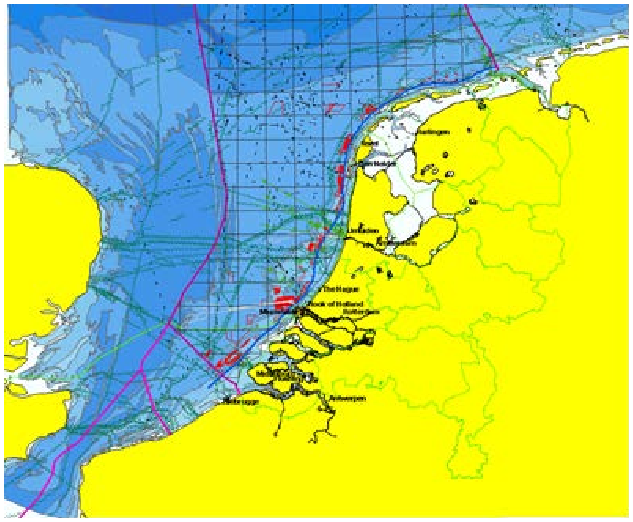
*Approximate figures

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 beach replenishment projects in 2014:

DREDGING AREA	MATERIAL	AMOUNT in Mm^3
Netherlands coast (general)	sand	**5,1**
Katwijk	sand	**1,8**
Weak links North Holland	sand	**33,4**
TOTAL	**sand**	**40,4**

Licensed sand extraction areas 2014



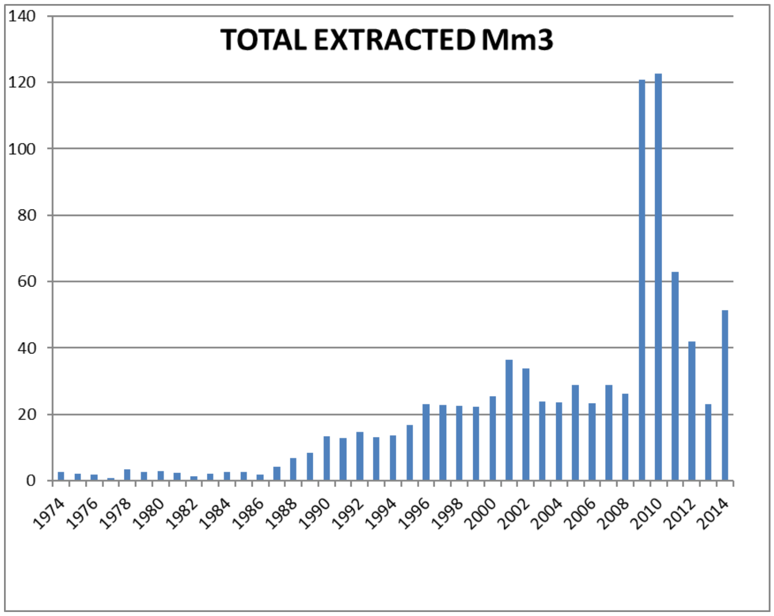
Historic patterns of marine aggregate extraction in Mm3.

Extraction Area	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Euro-/Maas channel	1,23	2,32	0,49	0,65	1,94	1,22	0,06	0,32	0	0,8	1,8
IJ-channel	1,06	4,31	0	0	0	0	0	0,75	0,83	1,5	1,2
Channel Voordelta	-	-	-	-	-	-	-	-	0,05	-	0,03
Dutch Continental Shelf	21,31	22,13	22,88	28,25	24,53	119,59	122,47	68,88	66,89	10,63	8,9
Total extracted	**23,59**	**28,76**	**23,37**	**28,9**	**26,47**	**120,81**	**122,53**	**69,95**	**67,87**	**12,96**	**12,1**

Dutch sand extraction 1974–2014

YEAR	TOTAL EXTRACTED m3		YEAR	TOTAL EXTRACTED m3
1974	2.787.962		1995	16.832.471
1975	2.230.889		1996	23.149.633
1976	1.902.409		1997	22.751.152
1977	757.130		1998	22.506.588

1978	3.353.468		1999	22.396.786
1979	2.709.703		2000	25.419.842
1980	2.864.907		2001	36.445.624
1981	2.372.337		2002	33.834.478
1982	1.456.748		2003	23.887.937
1983	2.252.118		2004	23.589.846
1984	2.666.949		2005	28.757.673
1985	2.724.057		2006	23.366.410
1986	1.955.491		2007	28.790.954
1987	4.346.131		2008	26.360.374
1988	6.954.216		2009	120.700.339
1989	8.426.896		2010	122.532.435
1990	13.356.764		2011	62,948,704
1991	12.769.685		2012	41,899,276
1992	14.795.025		2013	23,167,720
1993	13.019.441		2014	51,271,582
1994	13.554.273			



Licences considered and issued licences Rijkswaterstaat North Sea

Year	Amount		Year	Amount
1998	35		2007	24
1999	30		2008	38
2000	25		2009	23
2001	25		2010	15
2002	42		2011	26
2003	26		2012	10
2004	20		2013	19*
2005	33		2014	20*
2006	33			

* one of the issued licenses is a general permit for beach nourishments in which several extraction areas for the next 5 years are covered in one single permit.

4.14 Norway. No report

4.15 Poland

History of extractions in Poland

Year	Beach Nour-ishment	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	3 500	250 810
1998	88 870	0	88 870
1999	375 860	220 500	596 360
2000	241 000	836 500	1 463 875
2001	100 253	267 750	368 003
2002	365 000	353 500	718 500
2003	438 414	0	438 414
2004	1 042 896	0	1 042 896
2005	1 043 925	0	1 043 925
2006	548 856	0	548 856
2007	977 358	0	977 358
2008	238 948	162 750	401 698
2009	702 590	0	702 590
2010	970 923	0	970 923

2011	531 218	995 750	1 526 968
2012	396 086	488 000	884 086
2013	232 695	507 237	739 932
2014	457 731	1 351 263	1 808 994

4.16 Portugal

History of extractions in Portugal

Year	Construction Aggregate, m^3		Beach Nourishment, m^3	
	Azores archipelago	Madeira archipelago	Administração da região hidrográfica do Tejo[1]	Administração da região hidrográfica do Algarve[2]
1998				1,285,000
1999	6,083			
2000	145,519			
2001	146,791			
2002	115,613	562,353		
2003	176,285	683,521		
2004	197,636	910,179		
2005	159,968	703,620		
2006	181,691	478,473		370,000
2007	141,991	369,008	500,000	
2008	144,647	345,890	1,000,000	
2009	134,021	291,290	1,000,000	
2010	124,132	276,090		1,250,000
2011	126,381	210,720		600,000
2012	69,392	114,360		
2013	50,729	117,980		

2014	45,964	115,262	1,000,000	340,000

[1] Southern central continental shelf.

[2] Southern continental shelf.

There were no extractions reported in the three other districts: Administração da região hidrográfica do Norte (Northern continental shelf), Administração da região hidrográfica do Centro (Central continental shelf), and Administração da região hidrográfica do Alentejo (Southwestern continental shelf)

4.17 Spain

During 2014 two extraction activities from marine sand deposits have been carried out in Spain: one in Guipúzcoa (Cantabrian Coast) and other in Tenerife (Canary Islands).

A total amount of 3.185.865 m^3 of sand was placed on beaches (1.226.531 m^3 in the OSPAR area, 1.207.084 m^3 in the Mediterranean area and 752.250 m^3 in the Canary Islands area). Additionally to the marine sand deposits mentioned above, the sources of these materials have been mainly the dredging activity in harbours with a navigational purpose, the sand redistribution within the beach and, in particular cases, terrestrial quarries.

Figures 1, 2 and 3 show the distribution of the material source in each coastal area.

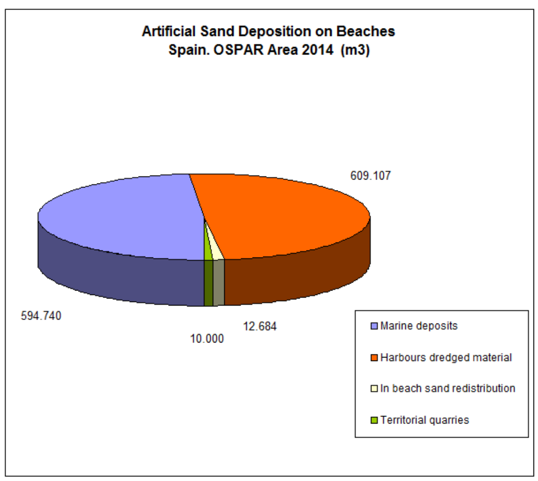


Figure 1

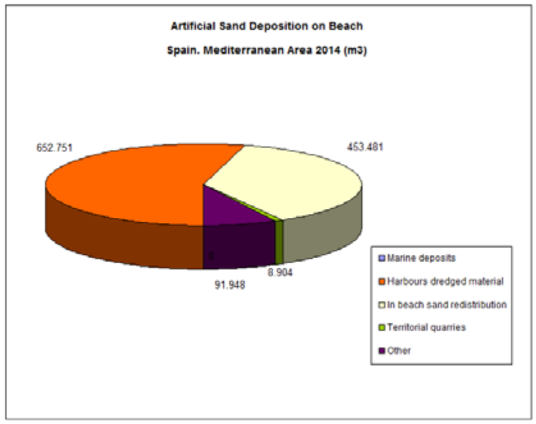


Figure 2

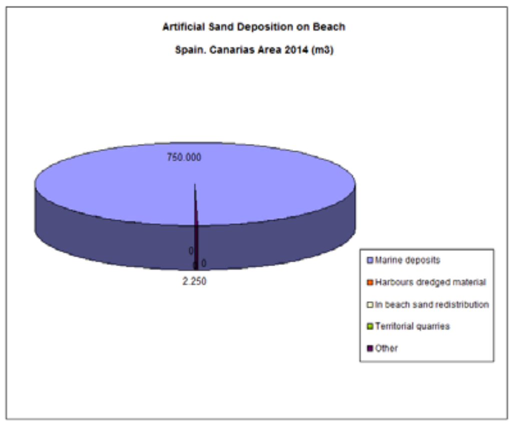


Figure 3

4.18 Sweden. No report.

4.19 United Kingdom

Marine aggregate (sand and gravel) extraction figures for 2014 from The Crown Estate ownership (Includes aggregate and material for beach replenishment and reclamation fill)

Dredging Area	Amount (tonnes)
Humber	2,187,272
East Coast	4,720,088
Thames Estuary	1,632,322
East English Channel	3,862,818

South Coast	3,171,106
South West	1,087,277
North west	520,383
Miscellaneous and rivers	67,018
TOTAL	17,248,284

Extraction tonnage for reclamation fill and beach replenishment were as follows:

Reclamation Fill: 908 501 tonnes

Beach Replenishment: 1 469 024 tonnes

Non-aggregate (e.g. shell, maerl, boulders etc.) extraction figures for 2014: None

Exports of marine aggregate in 2014 from The Crown Estate ownership (tonnage)

Amsterdam	543,370
Antwerp	369,318
Boulogne	8,517
Bruges	99,257
Calais	63,028
Dunkirk	157,494
Fecamp	3,496
Flushing	715,853
Gent	122,342
Harlingen	20,914
Honfleur	16,535
Le Havre	102,487
Ostend	516,446
River Seine Wharves	50,058

Sluiskil	6,432
Zeebrugge	198,991
Total tonnage	**2,994,538**

Amount (tonnage)of material extracted for beach replenishment and reclamation fill projects in 2014 from The Crown Estate ownership

Beach replenishment	
Clacton	479,369
Colwyn Bay	268,959
Deal	2,710
Eastbourne	17,394
Lincshore	620,422
Pevensey	52,609
West Sands, Selsey	27,561
Total tonnage	1,469,024

Reclamation fill	
East Cowes Breakwater	104,725
Felixstowe	561,187
Flushing	242,589
Total tonnage	908,501

Historic patterns of marine aggregate extraction (tonnes) from The Crown Estate ownership. (Figures exclude beach replenishment and reclamation fills) 1998.

Historic patterns of marine aggregate extraction (tonnes) from The Crown Estate Ownership

	1998	1999	2000	2001	2002	2003	2004	2005	2006
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
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
Thames Estuary	862,834	971,960	854,483	909,141	1,291,103	838,185	758,257	696,012	899,852
East English Channel	2,180,099	1,958,476	1,387,450	875,000	1,163,892	1,212,951	457,102	474,553	323,824
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
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
North West	275,590	355,044	316,090	421,068	482,270	470,962	558,398	611,983	608,314
Rivers & Misc.	6,238	6,273	46,120	73,047	78,597	85,153	99,079	124,506	111,687
Yearly Total	**20,471,191**	**20,910,185**	**20,684,340**	**21,151,015**	**20,440,376**	**20,107,368**	**1,767,848**	**19,687,142**	**20,145,414**
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**Total**
Humber	3,184,814	3,154,070	2,524,328	2,622,126	2,175,846	1,451,742	1,528,399	1,566,850	45,383,814
East Coast	7,715,428	6,075,899	5,637,296	5,637,296	5,275,569	3,564,464	4,249,110	4,720,088	120,979,704
Thames Estuary	977,027	1,735,141	405,484	518,881	664,629	1,090,559	737,464	591,766	14,802,770
East English Channel	1,961,035	2,443,367	2,256,919	2,409,476	4,317,153	3,553,379	3,402,686	3,620,229	33,997,621
South Coast	4,752,843	3,934,692	3,492,424	3,430,463	3,917,315	3,629,352	3,397,803	2,966,107	69,483,661
South West	1,769,197	1,470,719	1,019,174	931,151	956,102	1,067,526	1,024,357	1,087,277	23,836,851
North West	633,405	432,889	271,598	307,509	314,098	285,368	378,813	251,424	6,974,823
Rivers & Misc.	109,399	87,787	92,263	39,438	0	0	45,522	67,018	1,072,147
Yearly Total	**21,203,148**	**19,334,564**	**15,699,487**	**15,131,307**	**17,620,712**	**14,642,390**	**14,764,154**	**14,870,759**	**316,531,400**

Summary of current / future licensed area position of marine aggregates within The Crown Estate ownership.

TYPE	STATUS	NUMBER
Production Agreements	Extraction licenses	61
Applications*	New applications	19
Prospecting	Prospecting licenses	3

*Applications excludes current licenses which have a renewal application submitted.

4.20 United States

Marine aggregate (sand and gravel) extraction figures for 2014

DREDGING AREA	AMOUNT
New York Harbor(Ambrose Channel), New Jersey	176,968 m^3
New York Harbor navigation channels	3,397,682 m^3

Description of aggregate extraction activities in 2014: The only active operating for the ex-traction of marine sand to be used for aggregate continues to be that done by a private com-pany, Amboy Aggregates, which removes sand from the seaward section of the main shipping channel into New York harbour (the Ambrose Channel). Amboy Aggregates went out of business in 2014 because their property in South Amboy, New Jersey was sold.

An additional 165,144 cubic meters of sand were dredged from navigation channels in and around New York harbour; this sand as well as other dredged sediment (see table b) was 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.

Non-aggregate (e.g. shell, maerl, boulders, etc.) extraction figures for 2014

DREDGING AREA	**MATERIAL**	**AMOUNT** Cubic Meters
New York Harbor	Mixed clay-rock	744,676
New York Harbor	Mixed sand-mud	2,487,862
New York Harbor	Sand	165,144

Description of non-aggregate extraction activities in 2014. This material was dredged from navigation channels in New York harbor 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 2014: None.

Amount of material extracted for beach replenishment projects in 2014.

DREDGING AREA	MATERIAL	AMOUNT Cubic meters
Assateague Island, MD	Sand	675,985
Rockaway, NY	Sand	2,293,665
Westhampton Dunes, NY	Sand	573,416
Ocean City, MD	Sand	60,140

"Superstorm" Sandy hit the northeast coast of the US on October 29, 2012. Restoration efforts continued in 2014.

Historic patterns of marine aggregate extraction in millions of cubic

Year	Millions of m^3
1990	0.2
1991	0.8
1992	0.8
1993	1.5
1994	1.7
1995	1.4
1996	1.4
1997	1.4
1998	1.3

1999	1.3
2000	1.1
2001	1.3
2002	1.1
2003	1.4
2004	1.6
2005	1.4
2006	1.2
2007	1.2
2008	1.0
2009	0.7
2010	0.8
2011	0.8
2012	0.8
2013	0.8
2014	0.2

Annex 5: ToR H – Archaeological, cultural and geomorphological values

5.1 Belgium

Legislation	Ratification of the UNESCO Convention for protection of UCH (2013)
	Integration of UCH protection into Belgian Marine Spatial Planning (2014)
Included in EIA	Yes
Statutory advisor	Flanders Heritage Agency
Consultancy	MUMM
Type of antiquities	Archaeological structures
	Paleontological remains
Geomorphological features	Buried landscapes and coastlines
Methodology	Geophysical & Remote sensing technology
Guidance note	Under development (SeArch)
Reporting protocol	No
Research & Management projects	SeArch:
	1) Development of an efficient assessment methodology towards sustainable management policy and legal framework
	2) Development of a practical guidance towards stakeholders
	Renard Centre, Univ. Gent: Mapping the archaeological potential of the Belgian Continental Shelf
	1) 3D geo-archaeological preservation models
	2) 2D archaeological potential maps
	3) Identification of key archaeological zones

5.2 Canada. No report.

5.3 Denmark. No report.

5.4 Estonia. No report

5.5 Finland

Legislation	Antiquities Act
Included in EIA	*Yes*
Statutory advisor	Finnish Board of Antiquities' Cultural Environment Protection
Consultancy	Finnish Board of Antiquities' Archaeological Field Services unit
Type of antiquities	Jetties, bridges
	Wrecks > 100 years
Geomorphological features	Eskers
	Ice marginal deposits
Methodology	Geophysical & Remote sensing technology
Guidance note	No
Reporting protocol	No
Research & Management projects	Vrouw Maria Project

5.6 France

Legislation	Law on Preventive Archaeology (2001)
	Ratification of the UNESCO Convention for protection of UCH (2013)
Included in EIA	Yes
Statutory advisor	Department of Submarine Archaeological Research (DRASSM)
Consultancy	No
Type of antiquities	

	Gold torques (Late bronze Age), lead (Celtic tribes of Roman Britain)
	Shipwrecks, canonballs, aircraft remains
Geomorphological features	Palaeo-environments (landscapes)
Methodology	Geophysical & Remote sensing technology (side scan sonar, magnetometer)
Guidance note	No
Reporting protocol	No
Research & Management projects	The Atlas of the Two Seas : from the Channel to the North Sea (Interreg IV)
	(Collaboration between DRASSM/English Heritage/Flemish Heritage Institute)
	The Archaeological Atlas of Martime Cultural Remains of the Atlantic Arc
	National Archaeological Map of the Littoral Zone: Managing Cultural Remains

5.7 Germany No report.

5.8. Greenland and the Faeroes No report.

5.9 Iceland

Legislation	European Convention on the Protection of the Archaeological Heritage (1969)
	World Heritage Convention (1972)
	United Nations Convention on the Law of the Sea (1985)
	Eurpoean Convention on the Protection of Arcaheological Heritage (Valleta 1992)
	The International Convention on Salvage (2002)
	Cultural heritage law of Iceland (2012)
Included in EIA	Yes
Statutory advisor	The Cultural Heritage Agency of Iceland
Consultancy	N/d

Type of antiquities	Archaeological structures
	Shipwrecks, aircraft remains
Geomorphological features	Buried landscapes and coastlines
Methodology	Geophysical & Remote sensing technology
Guidance note	No
Reporting protocol	No
Research & Management projects	**Research Projects (past and present):**
	The Melckmeyt. Dutch wreck in Flatey (1993)
	Kolkuós, medieval harbour (2006)
	The Postship Phønix (2008-?)
	The Vestfirðir surveying (2009-2010)
	A Phd project on submerged archaeological record on the W/NW region, current

5.10 Ireland. No report.

5.11 Latvia. No report.

5.12 Lithuania. No report.

5.13 The Netherlands

Legislation	Monuments Act (1988); Extraction Law
Included in EIA	Yes
Statutory advisor	Netherlands Cultural Heritage Agency (RCE)
Consultancy	Commercial parties approved by RCE
Type of antiquities	Wreck (ships and aircrafts); archeological artefacts
Geomorphological	Paleolandscape
Methodology	Multibeam; Side scan sonar; Coring
Guidance note	KNA Waterbodems (Quality Netherlands Archeology Water bottoms)
	Recognizing archeological finds in aquatic sediments and how to handle them.
Reporting protocol	Yes, available on internet
Research & Management projects	New Indicative Map of Archeological Value

5.14 Norway. No report.

5.15 Poland

Legislation	Act of Protection of Monuments (J.L, 03, No162,1568)
	European Convention on the Protection of Arcaheological Heritage (Valleta 1992)
	Act of Polish sea areas and maritime administration (Journal of Law, 2003, No 6, pos.41)
Included in EIA	Yes
Statutory advisor	State Service for the Protection of Monuments
Consultancy	National Maritime Museum in Gdansk
Type of antiquities	Archaeological structures
	Shipwrecks, aircraft remains
Geomorphological features	Palaeo-environments (landscapes)
Methodology	Geophysical & Remote sensing technology
Guidance note	No
Reporting protocol	
Research & Management projects	**Management Projects (past and present):**
	MACHU (2006-2009)
	Inventorying of archaeological sites of the Gdańsk Gulf (AZP)
	Development of methods of research and photogrammetric documentation of wrecks F53.14 and F 53.31 as part of a project funded by the Ministry of Culture "Inventory wrecks F 53.14 and F 53.31 of the Gulf of Gdansk".

5.16 Portugal

Legislation	UNESCO Convention for protection of UCH (2006)
	European Convention on the Protection of Arcaheological Heritage (1997)
	Decreto-Lei nº 164/97 (Rules on the underwater cultural heritage)
	Decreto-Lei nº 107/2001 (Policy for the protection and enhancement of the cultural heritage)

	Decreto Legislativo Regional nº 27/2004/A (Legal policy of the archaeological heritage management in the Azores archipelago)
Included in EIA	Yes (for volumes > 150,000t.year$^{-1)}$
Statutory advisor	Direção-Geral do Património Cultural (mainland)
Consultancy	Direção Regional da Cultura (Azores archipelago)
Type of antiquities	Archaeological structures
	Prehistoric human artefacts
	Shipwrecks
Geomorphological features	There are no references to this item in the Portuguese legistlation
Methodology	Geophysical & Remote sensing technology
	Diving
Guidance note	No
Reporting protocol	No
Research & Management projects	**Projects of archeological maps ongoing:**
	Carta Arqueológica Subaquática dos Açores
	Carta Arqueológica Subaquática de Cascais
	Carta Arqueológica Subaquática - Baía de Lagos
	Arqueologia Marítima da Ria de Aveiro
	Carta Arqueológica Subaquática do Concelho de Peniche

5.17 Spain

Legislation	Spanish Historical Heritage Act (Law 16/1985)
	Green Paper: Spanish National Plan for the Protection of Underwater Cultural Heritage
Included in EIA	Yes
Statutory advisor	Authorities on Cultural Heritage

Consultancy	Historical Heritage Council
	The National Centre for Underwater Archaeology (ARQUA)
Type of antiquities	Archaeological sites
	Prehistoric artefacts (animal & human remains)
	Shipwrecks
Geomorphological features	Buried landscapes and coastlines
Methodology	Geophysical & Remote sensing technology
	Diving
Guidance note	N/d
Reporting protocol	N/d
Research & Management projects	N/d

5.18 Sweden

Legislation	Cultural Environmental Act (1988:950)
	the Swedish Environmental Code
Included in EIA	Yes
Statutory advisor	National Maritime Museums in Sweden
Consultancy	The Swedish National Heritage Board
Type of antiquities	Archaeological structures
	Prehistoric artefacts (animal & human remains)
	Shipwrecks, canonballs, aircraft remains
Geomorphological features	Eskers
	Ice marginal deposits
Methodology	Geophysical & Remote sensing technology

	Diving
Guidance note	No
Reporting protocol	No
Research & Management projects	N/d

5.19 United Kingdom

Legislation	Protection of Wrecks Act (1973)
	Ancient Monument and Archaeological Areas Act (1979)
	Protection of Military Remains Act (1986)
	European Convention on the Protection of Arcaheological Heritage (Valleta 1992)
	Merchant Shipping Act (1995)
	Marine Policy Statement (2011)
	Annex to the UNESCO Convention for protection of UCH (2013)
Included in EIA	Yes
Statutory advisor	English Heritage
Consultancy	Wessex Archaeology Ltd (BMAPA-Crown Estate)
	Cotswold Archaeology Ltd.
	Martime Archaeology Ltd.
	Sea Change Heritage Consultants Ltd.
	Fjordr Ltd.
Type of antiquities	Prehistoric artefacts (animal remains, humanly worked flints)
	Shipwrecks, aircraft remains
	Palaeo-environments (landscapes)
Geomorphological features	Geophysical & Remote sensing technology

Methodology	2003 (BMAPA-English Heritage)
Guidance note	2005 (BMAPA-English Heritage)
Reporting protocol	Seabed Prehistory (ALSF)
Research & Management projects	Englands Shipping (ALSF)
	Historic Seascapes Character (EH)
	Regional Environmental Assessments
	Regional Environmental Characterisations
	Palaeo-Yare Catchment Assessment (BMAPA)

5.20 United States

Legislation	National Environmental Policy Act
Included in EIA	Yes
Statutory advisor	State Historic Preservation Office
Consultancy	**???**
Type of antiquities	Archaeological sites
	Shipwrecks
Geomorphological features	Former shorelines
Methodology	Geophysical & Remote sensing technology
	Diving
Guidance note	N/d
Reporting protocol	N/d
Research & Management projects	Federal Permit/US Army Corp of Engineers (permitting agency)

Annex 6: ToR J – Review of Decision Criteria for Requiring Environmental Impact Assessments

Belgium: In Belgium, sand and gravel exploitation at sea started in 1976 (29 000m³). Over the past few years, the exploitation increased and now the total amount fluctuates around 3 000 000m³ a year. It is mostly sand that is exploited. This sand is used in the construction sector as draining and stabilization sand or in the concrete industry where it is mixed with other aggregates. For huge infrastructure works, as the construction of a gas pipe line (Zeepipe 1991; Interconnector 1997), there is need for large quantities of sand in a short time. The Flemish Community also increasingly uses the sand for beach supplements and coastal protection.

The law of June 13, 1969 ('Continental Shelf Law') amended by the law of January 20, 1999 ('Protection of the Marine Environment Law') and the law of April 22, 1999 regulates the exploration and exploitation of sand and gravel in certain areas on the Belgian Continental Shelf. Two implementing decrees were published (BS 07.10.04):

Royal Decree (RD) of September 1, 2004 (Belgian Official Journal of 10 October 2004, PDF, 14pp, 118KB) as regards conditions, geographic limits and procedures for granting licences, "Procedure decree".

RD of September 1, 2004 (Belgian Official Journal of 10 October 2004, PDF, 4pp, 46KB) as regards rules for environmental impact assessment.

There are 4 control zones defined, divided in sectors for which a concession can be issued. These were confirmed in the RD of March 20th 2014 which defines and demarcates the maritime spatial plan.

Exceptionally concessions can be issued outside these zones.

The permits for exploiting sand and gravel can be obtained, according to the law, by submitting a concession demand which includes an Environmental Impact Study (EIS). This EIS will be evaluated: MUMM evaluates the acceptability of the activity for the marine environment in an Environmental Impact Assessment (EIA). This EIA forms part of an official advice to the Minister responsible for the marine environment, who will give his advice to the federal Minister of Economy. The advice of the Minister responsible for the marine environment is binding: when the advice is negative, no concession can be issued.

As such, in principle every project has to submit an individual EIA….but the Minister can allow that several (all) permit applications can use the same combined EIS when sand and gravel extraction takes place in the same areas (which it does since we only have 4 zones). Thus every project uses the same two EIS (one for zone 1-3, one for zone 4). These are updated every three years and will be renewed every 10 years.

Canada: No report.

Denmark: No report.

Estonia: In Estonia such decision is made by the Ministry of Environment. Environmental impact is assessed upon applying for development consent or for amending development consent whereby the proposed activity which is the reason for applying for or amending the development consent potentially results in significant environmental impact; if an activity is proposed, which alone or in conjunction with other activities may potentially significantly affect a *Natura* 2000 site. The decision is made on a case-by-case basis exercising professional judgment, but commonly marine extractions exceeding a of volume of 10,000 cubic meters is considered an activity with significant environmental impact as are areas of open-cast mining where the surface of the site exceeds 25 hectares,

Finland: EIA procedure is required practically for all marine aggregate extraction in Finland. According to the EIA act extraction exceeding 25 hectares in area or 200 000 m3 in volume /year automatically requires an EIA. Smaller scale extraction may also require an EIA, if there are "presumable negative impacts on environment".

France: EIAs are required for all extractions of marine aggregate whatever the volume, area or depth of dredging. Marine aggregate extraction comes under the Mining Code and may require three joint permits (Decree of July 6, 2006). These are:

• A mining permit (exclusive research license or concession) is issued by the Ministry in charge of Mines (i.e Ministry of Economy) giving the exclusive research license allowing a deposit and its natural and human environment to be identified. It is granted for a maximum period of 5 years and is renewable twice. The concession is for industrial extraction with a maximum duration of 50 years; this procedure is subject to a public inquiry.

• For sites located in territorial waters, a temporary authorization to occupy the maritime public domain or domain authorization must be granted by the Prefet of the Department only;

• An authorization to open mining works is granted by the Prefet of the Department

The last requires the completion of a pre-licensing impact study assessing the initial state of the environment, the expected environmental impact of extraction and its compatibility with other activities carried out at sea. (Decree n ° 2006-798 of 6 July 2006, as amended on prospecting, research and exploitation of minerals or fossils contained in the seabed in the public domain and metropolitan continental shelf) A Natura 2000 impact study may be required. Exploitation licensing requires environ-mental monitoring with bathymetric, morphological, sedimentary and biological controls during operation. Government services control the movements and activity of the extraction vessel (duration, depth, navigation, etc.) and the volume of material removed.

The content of the Impact Study is described in the Environmental Code (Article R. 122-5) modified by the Decree n° 2011-2019 of 29th December 2011 reforming impact studies. An Impact study must contain:

- A description of the project design and dimensions, including a description of the physical characteristics of the project, the technical requirements of land use during phases of construction and operation and, if appropriate, a description of storage, production and manufacturing operations, such as the nature and quantity of the materials used, as well as estimate the types and amounts of expected residues and emissions and resulting from the operation.

- An analysis of the initial state (baseline survey) zone and environments likely to be affected by the project, including on population, flora and fauna, natural habitats , sites and landscapes, property, ecological continuity as defined by Article L. 371-1 , biological balance, climatic factors , cultural and archaeological heritage, soil, water, air, noise, natural, agricultural, forestry, marine and leisure, as well as the interrelationships between these elements.

- An analysis of the positive and negative effects, direct and indirect, temporary (including during the construction phase) and any permanent environmental impacts as well as short-term, medium-term and long-term impacts. These include the project impacts on and energy consumption, the convenience of the neighbourhood (noise, vibration, odour, and light emissions), hygiene, health, safety, and public health.

An analysis of cumulative effects project with any other projects that have been the subject of an impact document under Article R. 214-6 and a public inquiry, or have been the subject of an impact assessment under this code and for which a notice of the authority administrative jurisdiction of the environmental state has been made public. Excluded are projects subject to an order under section A. 214-6 to R. 214-31 mentioning a time lapsed and those whose authorization decision, approval or implementation lapsed, including the public inquiry is no longer valid as well as those which have been officially abandoned by the petitioner or the client.

- An outline of alternatives to the project that were considered in terms of its impact on the environment or human health.

- The criteria for assessing the compatibility of the project with land use. It may be necessary to provide drawings, diagrams and programs (Article R. 122-17) and to take into account the regional pattern of ecological coherence in the cases mentioned in Article L. 371-3.

• Measures to be taken to avoid or mitigate significant adverse effects of the project on the environment or human health and reduce the effects could not be avoided.

• A description of the methods used to establish the initial state described in 2 and evaluate the project's effects on the environment and, when several methods are available, an explanation of the reasons for the choice made.

• A description of the possible difficulties of a technical or scientific nature, faced by the client for this study.

• The names and precise and comprehensive qualities of the author of the study and impact studies that have contributed to its realization.

Germany: No report

Greenland and the Faeroes: No report.

Iceland: No report.

Ireland: No report.

Latvia: An EIA is always required, but if the mining area is less than 20 hectares, the EIA may be carried out by ranking. Decisions are made by Environmental Protection Department.

Lithuania: No report.

The Netherlands: EIA's are relatively brief statements of potential risks. However, a distinction is made between a regular extraction (< 10 million m^3) and a large scale extraction (>10 million m^3) or deep extraction (> 2 m below sea bed). EIA's, covering the whole range of impacts is required for any project proposing extractions over over10 million cubic meters or covering 500 hectare (5 km^2). This was established in the "Besluit Milieueffectrapportage (Besluit m.e.r.)" decision on the EIA as part of the Law on the Environment, and the updated in the Tweede Regionale Ontgrondingenplan Noordzee (RON2), which was the second regional plan for extraction in the North Sea. Furthermore, the same applies to situations in which several smaller ones that are in each other's vicinity together exceed the 500 hectares. (The website for the EIA commission is http://www.commissiemer.nl/english). The EIA process includes setting boundaries in the Terms of Reference, providing the complete EIA to the EIA commission (M.E.R.) followed by a public notice.

Volume	Area	Depth	Research
<10 million m3	<500 ha	Up to 2 m	Not required
<10 million m3	<500 ha	> 2m	Quantity
> 10 million m3	<500 ha	> 2m	MER (full EIA)
> 10 million m3	> 500 ha	Up to 2 m	MER (full EIA)
> 10 million m3	> 500 ha	> 2m	MER (full EIA)

Norway: No report.

Poland: No report.

Portugal: Until now the only places where marine aggregates have been dredged annually are in the Madeira and Azores archipelago. In Madeira the local authorities have not yet provided information about EIA requirements. In the Azores, given that extraction quantities are very small and localized, until now, no EIA was prior to ex-traction activities.

Spain: An EIA is compulsory if the volumes are in excess of 20,000 cubic meters or if the extraction area is included within the Natura 2000 network or other Marine Protected Areas. For extractions over 100,000 cubic meters in estuaries, and any other dredging activity different to navigational proposes.

Sweden: There has been only one active license at the moment; the first granted in some 15 or 20 years. An EIA was required and all future applications will require an EIA.

Requirements are established in the Continental Shelf Ordinance (1966:315), section 5. A permit to extract sand, gravel or cobbles in an area which in its entirety is situated within public waters of the sea shall be granted by the Geological Survey of Sweden, unless otherwise provided by the last paragraph. An application for such a permit shall contain the particulars needed to assess how the general rules of consideration of Chapter 2 of the Environmental Code will be observed. As provided in Section 3a of the Continental Shelf Act (1966:314), the application shall include an environmental impact assessment. The application documents shall be submitted in at least six copies. When considering an application for a permit, the Survey shall obtain opinions from the Swedish Environmental Protection Agency, the local authority and other authorities concerned. A permit shall be granted for a fixed period, at most ten years, and shall relate to a specific area. The permit shall state to what extent sand, gravel or cobbles may be taken and shall set out such stipulations as are necessary to safeguard to a reasonable extent other interests, such as navigation, fisheries and nature conservation, or as are otherwise called for by the provisions of the United Nations Convention on the Law of the Sea. Attention shall be drawn in the permit to any consideration of the activity that may be required under other legislation. Fees as referred to in Section 4 b, second paragraph, of the Continental Shelf Act shall be payable for the permit, unless the limited extent of the enterprise or some other special reason gives cause to waive them. Such fees shall be determined by the Geological

Survey of Sweden. If the extraction to which the application relates is substantial in scale or could give rise to significant detrimental effects, or in other cases if the Swedish Environmental Protection Agency so requests, the Geological Survey of Sweden shall refer the application to the Government, attaching to it its own opinion. (Ordinance 2007:952)

United Kingdom: There are few MMG.1 criteria although a new Marine Policy statement is pending. All projects (more than 10 000 tonnes) require an EIA, but the value is a guideline. There is a screening tool (short risk assessment) that can be sent to the regulatory authority in each county but usually any proposals for commercial extraction just go right to the EIA, an EIA being routinely required. In some regional areas, the industry has voluntarily done a non-statutory EA to facilitate the process of project-specific EIAs.

United States: For proposed projects, an initial screening is required as an environmental impact assessment (EA) by the permitting agency (usually the US Army Corps of Engineers for dredging permits. This may result in a "Finding of No Significant Impact" (FON-SI). A finding of significant impact is a professional judgment. There is not a quantitative matrix, but general policies for evaluating permit applications are to include consideration of the extent of probable impacts, including cumulative impacts, the public benefits of the project. The judgment is to be based on the relevant issues of conservation, economics, aesthetics, general environmental concerns, impacts on wet-lands, historic values, fish and wildlife values, flood hazards, floodplain values, land use, navigation, shore erosion and accretion, recreation, water supply and conservation, water quality, energy needs, safety, food and fiber production, mineral needs, considerations of property ownership and, in general, the needs and welfare of the people.

Annex 7: OSPAR National Contact Points for Sand and Gravel Extraction

Belgium	Ms Brigitte Lauwaert Management Unit of the North Sea Mathematical Models Gulledelle 100 B-1200 Brussels BELGIUM Tel: 00 32 2 773 2120 Fax: 00 32 2 770 6972 E-mail: B.Lauwaert@mumm.ac.be
Denmark	Laura Addington Danish Forest and Nature Agency Haraldsgade 53 DK-2100 Copenhagen DENMARK Email: lauad@nst.dk
France	M.Laure Simplet Claude Augris IFREMER Département Géosciences Marines Technopôle Brest-Iroise, CS 10070 29280 PLOUZANÉ FRANCE Tel : 00 33 2 98 22 6 425 Email: laure.simplet@ifremer.fr
Germany	Mr Kurt Machetanz Landesamt für Bergbau, Energie und Geologie (LBEG) An der Marktkirche 9 D-38678 Clausthal-Zellerfeld GERMANY Tel: 00 49 5323 7232 50 Fax: 00 49 5323 7232 58 E-mail: kurt.machetanz@lba.niedersachsen.de
Iceland	Mr Helgi Jensson The Environment and Food Agency Sudurlandsbraut 24 IS-108 Reykjavik ICELAND Tel: 00 354 591 2000 Fax: 00 354 591 2020 E-mail: helgi@ust.is
Ireland	Pending
The Netherlands	Mr Sander de Jong Ministry of Infrastructure and the Environment Rijkswaterstaat Sea and Delta P.O. Box 556 3000 AN Rotterdam THE NETHERLANDS Tel: 00 31(0)652562719

	Email: sander.de.jong@rws.nl
Norway	Mr Jomar Ragnhildstveit. Jomar Ragnhildstveit Hordaland County Council Agnes Mowinckelsgt. 5 Pb 7900, 5020 Bergen NORWAY Email: jomar.ragnhildstveit@post.hfk.no Tel: 00 47 55 23 93 08 Fax: 00 47 55 23 93 19
Portugal	Ms Leonor Cabeçadas Institute of Environment Ministry of Environment, Landplanning and Regional Development Rua da Murgueira 9/9A Zambujal Ap. 7585 P-2611-865 Amadora PORTUGAL Tel : 00 351 21 472 1422 Fax : 00 351 21 472 8379 Email : leonor.cabecadas@iambiente.pt
Spain	Fernández Pérez Director General for Coasts Ministry of Environment Pza San Juan de la Cruz, s/n 28003 Madrid SPAIN Tel: 00 34 91 597 6062/6041 Fax: 00 34 91 597 5907
	Mr Jose L. Buceta Miller Division for the Protection of the Sea Directorate General for the Sustainability of teh Coast and the Sea Ministry of Agriculture, Food end Environment za. S. Juan de la Cruz s/n E-28071 Madrid SPAIN Tel: 00 34 91 597 6652 Fax: 00 34 91 597 6902 E-mail: JBuceta@magrama.es
United Kingdom	Phillip Stamp Defra Sustainable Marine Development and Climate Impacts 2D Nobel House, Smith Square, London, SW1P 3JR Tel: 020 7238 4607
	Adrian Judd Cefas Senior Marine Advisor

	Pakefield Road, Lowestoft , Suffolk, NR33 0HT, UK Tel: 01502 562244

Annex 8: Presentations to WGEXT

8.1 Hans Polet (ILVO): Welcome and introduction to ILVO

Members of WGEXT are welcomed warmly to the Institute for Agricultural and Fisheries Research (ILVO). The Institute has responsibilities for all aspects of biological resources. The principal research domain is in Ghent, but the center for fisheries and aquatic production in Ostend carries out ILVO's marine research.

Bioenvironmental research includes monitor the biological quality as well as studies to improve methods and advice to Flemish government, Belgian government, EU, OSPAR, ICES, and others. Chemical Environmental Research engages in monitoring the chemical quality and the development of genetic tools to support monitoring and food quality, product technology and safety. The Belgian fishing fleet is comprised of about 80 vessels. They fish not only in the Belgian part of the North Sea but extended areas to the north and west. Investigators into fisheries biology are engaged in fisheries data collection, stock assessment, and sustainability assessment. Research done on gear technology is focused on improving fishing gear and the development of alternate fishing methods. The Marine Unit of Animal Sciences includes Aquiculture. Investigators in this section are interested in developing aquiculture on land as well as shellfish culture, both on land and offshore and free-fish farming at sea. All this scientific research is made possible by ILVO's offshore team and an array of eight well equipped laboratories on site.

8.2 Gert Van Hoey (ILVO): ICES- Benthos Ecology working group: An overview of the program in the last five years

The Benthic Ecology Working group (BEWG)is focused on (a) Long-term benthic series and climate change (b) Species distribution modelling and mapping (c) Benthos and legislative drivers (c)Benthic biodiversity and ecosystem functioning, (d)Benthic Biodiversity and conservation: to review the role of benthic ecology in relation to MPAs

For the development of an understanding long-term change in the benthos, long-term benthic series and climate change. The BEWG has engaged in Species distribution modelling and mapping: Benthos and legislative drivers: Benthic biodiversity and ecosystem functioning; Benthic Biodiversity and conservation, and a review the role of benthic ecology in relation to MPAs

For an understanding change in the benthos, the BEWG considers regime shifts, seasonality, fine spatial scale variability. One study group is investigating the impacts of climate on benthic processes in the North Sea (SGCBNS). This will continue in future BEWG meetings considering the relation between benthic patterns and changes to climate variables (e.g. NAO index) and environmental conditions (e.g. sediment types) on North Sea benthic communities. An assessment of the fine scale temporal variability in coastal sediment bioturbation will be done as well as an assessment of bioturbation potential as a key ecosystem function on a large spatial scale.

A methods paper was published in 2013 containing all of the coded benthic data sets (~1000 species) for calculating bioturbation potential, referred to as the "BPc indicator". Investigations are to be completed of the performance and applicability of different qualitative and quantitative species distribution modelling methods, e.g. methods validity, limitations, purposes, knowledge gaps. Further development and promotion of the BEWGwill be in collaboration with the Benthic Long-Term Series network (BELTSnet at www.beltsnet.info

To investigate species distribution modelling and mapping, the performance and applicability of different qualitative and quantitative species distribution modelling methods, e.g. methods validity, limitations, purposes, knowledge gaps is being undertaken by a review of benthos distribution modelling and its relevance for marine ecosystem management. Different qualitative and quantitative species distribution modelling methods include assessment of method validity, limitations, purposes, and knowledge gaps. A case study is titled "Towards the quantitative benthic species distribution modeling for ecosystem functioning: linking bioturbation potential with nitrate cycling" Data from Belgian Part of the North Sea, German Bight and Baltic Sea is parameterized as:

$$BPc = [(B / A)^{0.5}]\ [Ri]\ [Mi][A].$$

Where B= biomass, A= abundance, Ri= the sediment "reworking mode" of species. E, epifaunal = 1; S, surficial modifier = 2; UC, DC, upward or downward conveyor = 3; B, biodiffuser = 4; and R, regenerator = 5. Mi is the "mobility" of species: in a fixed tube with 1 representing limited movement; sessile, not in tube = 2; slow movement through sediment = 3 and free movement through burrow system = 4

The effort to research benthos and legislative drivers reports on the use of the position of benthos in the above mentioned directives and the related assessment tools, as well as the demands of some of those benthic indicators, their feasibility and redundancy.

Ethnic indicators and targets for management. The French Benthoval Project is anticipating the contribution of BEWG to investigate the behavior of benthic indicators to quantified pressure gradients, including the ILVO sand extraction dataset of Annelies De Backer. Between 2014 and 2017, the issue of possible variability in expert assessment of benthic species tolerances / sensitivities, as used in several multi-metric indices, will be addressed.

The topic of "myths on indicators" has as its goal to investigate of the importance of species autecology in the development and application of indicators. The issue of possible variability in expert assessment of benthic species tolerances / sensitivities, as used in several multi-metric indices, will be taken up between 2014 and 2017. The development of effective monitoring programs must include consideration of design, harmonization and quality assessments. This topic is being pursued in cooperation with the project "Towards a Joint Monitoring Programme for the North Sea and Celtic Sea". A position paper on benthos monitoring requirements for the North Sea for MSFD purposes is intended to be completed in 2016.

The study of benthic biodiversity and ecosystem functioning has a goal of identifying the links between benthic biodiversity and ecosystem functioning. Literature review on the links between benthic biodiversity and ecosystem functioning will be completed by 2016 to address the following questions:

1. Is there indeed a relationship between the macrobenthos and ecosystem functioning
2. What aspects of macrofauna have generally been investigated (densities, diversity, functional diversity)?
3. What are the ecosystem functions that have been investigated?
4. What was the direction of the eventual response?

Levels of protection (i.e. management measures) being applied within MPAs may not be adequate to protect the species in need of protection, which may put at risk the ecosystem function and traits in specific habitats. The BEWG hopes to:

(1) To identify the links between protected features and their ecological function
(2) To relate the functions of protected marine features to the main pressures that would affect these features (cause-effect analysis)
(3) To consider the effect of not excluding key pressures that affect the designating feature from MPAs (i.e. no take zones).

To identify the links between benthic functions and ecosystem services, a position paper underway will be completed in 2016 providing expert opinion values on the ecosystem services provided by benthic key habitats. The role of benthic ecology needs to be assessed in relation to MPAs.

8.3 Kris Hostens (ILVO): Genetic Tools for Monitoring – From Microbial to Benthic species

ILVO started recently with the development of genetic tools for environmental monitoring. The aim is to optimize, evaluate, implement and integrate these tools for the assessment of ecosystem health. As bacteria are well known sensitive indicators of environmental perturbation, two approaches are presented for the evaluation of bacterial communities on sediment. The polymerase chain reaction denaturing gradient gel electrophoresis (PCR-DGGE) assay is a rapid and easy tool for studying complex environmental microbial communities. This method is based on the evaluation of a genetic fingerprint representing the microbial biodiversity in each sediment sample. Some samples could share 'bands' of the fingerprint (= shared bacterial group) and some 'bands' are specific for one or more samples (= environment specific group). First PCR-DGGE results on the sediments of the Buiten Ratel revealed a clear difference between the bacterial communities of impact and reference sites. The Buiten Ratel is located on Zone 2, the most extracted are on the Belgian Part of the North Sea (BPNS). A metagenomics approach provides information on the bacteria present in a specific environment. In cooperation with the ILVO genomics platform, Next Generation Sequencing, a high throughput sequencing technique is used to unravel the microbial communities on sediment. Metagenomics results on sediments of the BPNS revealed a very high microbial biodiversity, differences between coastal sediments samples and a large group of 'uncultured' or unknown bacteria. Genetic tools could also be implemented for the assessment of benthic biodiversity. A DNA metabarcoding approach is based on high-throughput sequencing of DNA-barcodes (genetic markers) and could provide a faster and more accurate alternative for species identification. The aim is to create a genomic based indicator for benthic biodiversity based on taxonomic profiles of the sampled areas. For this purpose, an intensive collaboration between benthic ecologists and genetic engineers is needed.

8.4 Vera Van Lancker (MUMM): TILES project on Transnational and Integrated Long-term Marine Exploitation Strategies) and the estimation of far field effects of marine aggregate extraction in an offshore sandbank environment

To provide long-term predictions on aggregate resource quantities and qualities, 3D voxel models of the subsurface of the Belgian and southern Netherlands part of the North Sea are built. Primarily, the voxels are constrained by the geology, based on coring and seismic data, but they can also be regarded as volume blocks of any resource-relevant information. The voxels information provides geological boundary conditions to environmental impact models to calculate resource depletion and regeneration under various scenarios of aggregate extraction. For each voxel, mining thresholds are defined, based on impact models and estimated effects on fauna and flora, following Europe's Marine Strategy Framework Directive. The primary geological data entering the voxels are subdued to uncertainty modelling, a necessary step to produce data products with confidence limits and critical for the detection of 'true' seabed changes. All of the information is integrated into a multi-criteria decision support system for easy querying and on-line visualizations.

Partnership: Royal Belgian Institute of Natural Sciences, Operational Directorate Natural Environment; Federal Public Service Economy, SMEs, Self-Employed and Energy, Continental Shelf Service; Ghent University, Dpt. Telecommunications, and Dpt. Geology & Soil Science; and Geological Survey of the Netherlands, TNO. Funding: Belgian Science Policy, BELSPO (2013-2017)

A short presentation is given on hypotheses of far field effects of marine aggregate extraction in an offshore sandbank environment where coarse permeable sands and gravel beds prevail. In this area multiple trailing suction hopper dredgers operate with hopper capacities of up to 12 500 m³. Operations are very intensive, but mostly constrained to Spring and/or Autumn. Concerns were raised on smothering effects in a nearby Habitat Directive Area where ecologically valuable gravel beds occur. Field observations in the gravel areas show a significant increase in sand, as well as a buffering of a fine fraction in the coarse permeable sands surrounding the gravel beds. A multi-step impact hypothesis is proposed in which the abundance of sand and fines could be originating from the intensive dredging activities, but above all remobilization of this material by intensive beam trawling, that further distributes the fines towards the gravel bed areas. Funding:

MOZ4 (Flemish Authorities, Agency Maritime Services and Coast, Coast, contract 211.177), and ZAGRI, a continuous monitoring program, paid from the revenues of marine aggregate extraction activities.

8.5 Marc Roche (FPS-Economy): Sand extraction in the Belgian part of the North Sea: European context and lessons from 11 years of EMS control and bathymetric monitoring

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A thematic cartography of the extracted volumes published in the WGEXT 2010 to 2014 reports illustrates the tremendous differences of the extracted volumes and the trends between EU OSPAR member states. Given the smallness of its coastline length, in relative terms, the volume of sand extracted in the Belgian part of the North Sea is important compared to the relative values of the neighboring countries. In the Belgian part of the North Sea, the extraction of marine sand is strictly supervised by the federal government and is regulated by the law of 13 June 1969. Each licensee is allowed to extract sand from the same shared sectors. The maximum allowed exploitation volume for each licensee is fixed annually. A major feature of the Belgian legislation is to limit the extraction vertically to a depth of 5m below a reference area established from multibeam echosounder (MBES) data recorded between 2000 and 2003. The legal control of sand extraction is organised in two ways: supervision of the activity itself and monitoring of the impact of the extraction on the marine environment. A register system is used to control the extracted volumes: the captain of each active dredger is obliged to fill in a register sheet for each trip. For each licensee, the part of his fee related to the extracted volume is calculated from the amounts declared in these register sheets.

The useful legal reserve evolution analysis from 1977 to 2014 demonstrates that the initial sand reserve of 954 106 m^3 decline to 655 106 m3 is mainly due to external contingencies (space reduction of the extraction sectors, 299 106 m3) rather than the extraction itself (59 106 m3).

The monitoring of the impact of the extraction on the marine environment is based on data from the Electronic Monitoring System (EMS) compelling on board each dredging vessel (complete EMS records are available since 2003) and regular bathymetric surveys with MBES. EMS data allow to evaluating and mapping the extracted volume for any surface and for any timeframe. The most extracted areas are surveyed several times each year. In addition to this local approach, regular surveying of a large number of straight parallel lines along and across the sandbanks and the channels provides valuable information on the global evolution of the bathymetry and allows a comparison between the extracted and non-extracted areas. According to the strong linear correlation observed between the extracted volumes and the depth evolution of the seafloor, most of the bathymetric variation observed in the extraction areas can be explained by the extraction itself. Monitoring results highlight the unsustainable nature of the marine sand extraction and suggest its local impact. Several projects are ongoing to improve the sustainable management of the sand extraction. One project focuses on the definition of an optimal reference surface based on geological data. A better use of EMS data integrating the actual position of the suction pipe head is also under consideration.

8.6 Jeroen Vermeersch (Flanders Heritage Agency): The SeArch Project and the legislation regarding underwater cultural heritage (UCH) in Belgium

Jeroen Vermeersch, Marnix Pieters and Sven Van Haelst

Within *the IWT-SBO PROJECT 120003 SeArch project – Archaeological Heritage in the North Sea* (2013-2016) the Flanders Heritage Agency, with other scientific partners, develops an efficient assessment methodology and approach towards a sustainable management policy and legal framework in Belgium.

The implementation in 2014 of the UNESCO Convention on the Protection of Cultural Heritage Underwater of 2001 resulted into a new situation towards cultural heritage in the Belgian North Sea. Finds older than 100 years old within the BCS/EEZ can be protected under the new Law on the Protection of Cultural Heritage Underwater. Furthermore, UCH in the territorial sea can be protected without any age limitation. In this case Belgium goes a step further than provided within the UNESCO convention of 2001. It hereby makes it possible to protect the many ship- and other wrecks related to both world wars. As a result of a royal decree finds have to be reported to the receiver of cultural heritage (www.vondsteninzee.be).

Besides the implementation of a the new legislation on cultural heritage in the Belgian North Sea, the SeArch Project (www.sea-arch.be) wants to develop an efficient survey methodology to evaluate this heritage. These methods will be made available to various stakeholders. In close collaboration with these partners the project wants to work towards a pro-active approach in regard to the UCH resulting in a better protection of that heritage.

Further information regarding the projects can be obtained from the following websites:

SeArch project: www.sea-arch.be

Receiver of Underwater Cultural Heritage: www.vondsteninzee.be

Database maritime archaeology: www.maritieme-archeologie.

8.7 Annelies de Backer (ILVO): Structural and functional biological assessment of aggregate dredging intensity on the Belgian part of the North Sea

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Marine aggregate dredging in the Belgian part of the North Sea (BPNS) is restricted to four dedicated concession zones. Within these zones, there are areas under different dredging pressure, but with the advantage that these are situated within a similar habitat (cfr. similar sediment characteristics). As such, this study assessed how different degrees of dredging pressure executed on a similar sandy habitat affect the benthic ecosystem. Possible responses of the macrobenthos on the dredging pressure were evaluated based on both structural (species number, species composition, abundance and biomass) and functional (e.g. bioturbation potential, BTA) characteristics of the benthic ecosystem. The structural changes in benthic characteristics were summarized by the benthic indicator BEQI.

The most obvious impact of dredging on the benthic community was observed in the most intensely used area (high dredging intensity and frequency) with significant changes in the structural benthic characteristics, and a moderate to poor score for the benthic indicator BEQI. For the benthic functional characteristics, no impact of dredging was measured in any of the areas. Furthermore, the heart-urchin (*Echinocardium cordatum*) was observed to be the most sensitive species to dredging, because it reduced substantially in numbers or even disappeared in all impacted areas.

Our results suggest that the current benthic sandy ecosystem of the BPNS is resilient enough to buffer aggregate dredging when performed at low or at high, but infrequent intensities. However, when dredging focuses on a small surface area, and when it is performed at high and frequent intensities, changes in sediments result in clear biological changes.

8.8 Laure Simplet (Ifremer): The Marine Aggregate Working Group (GTGM): toward the elaboration of a sustainable management plan.

In 2010, when formulating and implementing the French aggregates and quarry materials sustainable management strategy, a working group dedicated to marine aggregate had been created. In its conclusions (2012), it proposed 4 actions to fulfil national strategic objectives:

- Define relevant criteria for marine aggregate exploitation integrating environmental and socio-economic issues;

- Establish arrangements for the identification, at scale of French administrative regions, of the needs in marine aggregates;

- Build and develop tools (guidelines, cartographic features, decision-support tools);

- Propose concerted approach modalities to reconcile extracting activities with the different other users.

Alongside these reflections, Ministry of environment (MEDDE) carried out actions to better understand marine environment and characterize pressures and impacts of human activities (identification of the resources in the French coastal regions, works related to MSFD such as initial assessment of the quality of marine waters...).

In 2014, in order to achieve the aggregates and quarry materials sustainable management strategy through the implementation of the 4 above actions, the Water and Biodiversity Direction (DEB) of the Ministry of Environment (MEDDE) set up the "Marine Aggregate Working Group (GTGM)".

This Working Group is a place for debate, consultation and conciliation of all the stakeholders involved in the examination of mining title for marine aggregates extraction and is in charge to prepare and complete a methodological guide by the autumn of 2015.

This methodological guide will provide framework for the elaboration of sustainable management plans (PGDGM) at marine basin scale under jurisdiction of the French Interregional Directorates for the Sea (DIRM).

These PGDGM, aim to provide information and key elements to all operators in sea-related activities (industrial operators, sea users, NGO, citizens, government services). They won't replace existing legislation but will define recommendations to accompany its application and will contain:

- Situational analysis (identified resources and deposits, areas to prospect, geo-referenced inventory of mining titles, material flow, production capacity targets);

- Identification of "sore points" and challenges (ecological sensitivity, use conflict, cumulative impact, lake of knowledge);

- Recommendation for standardised management rules (EIA's content, harmonised exploitation modalities, common guidelines for monitoring during and after extraction takes place, concertation procedure for project acceptance);

- Cartographic materials (licenses, materials flows, deposits, uses of the sea, environmental sensitivity,...).

8.9 Keith Cooper (CEFAS): Marine aggregate dredging: recognising unacceptable change in seabed condition

The UK marine aggregate dredging industry is presently switching to a more objective, regional approach to seabed monitoring. This Regional Seabed Monitoring Plan (RSMP) approach includes 3 elements:

1. *Monitoring of sediment composition within the footprint of dredging effect.* Operators of UK extraction sites are required, through a license condition, to leave the seabed in a similar physical condition after the cessation of dredging. This requirement is intended to promote recovery, and the return of a similar faunal community after dredging. Whilst this policy is consistent with the principles of sustainable development, the ambiguity associated with the term 'similar' can be problematic for both developer and regulator. For example, developers have no clear definition of what is acceptable or not in terms of changes in sediment composition, and the regulator is forced to make subjective assessments as to the acceptability of changes that may occur. If the condition is to achieve its purpose of mitigating adverse environmental impacts then it has to be enforceable, and this requires it to be specific and measurable.

A solution to this problem comes from the use of existing benthic datasets. These datasets can provide a detailed understanding of the distribution of faunal communities, and the range of physical conditions (i.e. sediment composition) naturally found in association with different groups. In theory, as long as the composition of sediments within an impacted area remains within the appropriate range, as defined by the initial pre-dredge state and comparable conditions in the wider region, then a return of the original benthic assemblage should be possible following the cessation of dredging. Having established the condition for acceptable change in sediment composition, this would become a focus for the developer lead monitoring, and final post-dredge assessment of seabed status.

2. *Monitoring of benthic macrofauna within the wider region.* Within each dredging region, a network of benthic monitoring stations (sediment and fauna) will be established in areas outside the impact of dredging. These stations will serve a number of purposes:

a) To allow the broad scale seabed characterisation to be kept up-to-date, reducing the need for additional characterisation surveys in support of new licence area applications.

b) Analysis of temporal trends will help identify if the capacity of the environment to cope with dredging, and other anthropogenic pressures in the region is exceeded.

c) Distinguish long-term trends (e.g. climate driven) from dredging impacts?

d) The time-series data would also provide a check on the health of surrounding faunal assemblages. This is important as these areas will have an important role, through provision of individuals and larvae, in the eventual recolonization of impacted dredging areas.

e) With careful positioning such stations can also provide reassurance that dredging effects are not extending beyond the modelled secondary impact zone.

f) The data could also usefully contribute to wider UK monitoring obligations (e.g. Marine Strategy Framework Directive). Asking the aggregate industry to contribute, indirectly, to such initiatives has some logic given that their activities, in combination with other anthropogenic pressures, may have a bearing on the status of the UK seas.

3**.** *Dedicated research sites.* Within each dredging region, a dedicated study site would be used to answer important questions concerning the effects of dredging (e.g. size of secondary impact zone, time required for physical and biological recovery). The results from this work will be used as a proxy for all similar extraction sites in a region. Once questions have been answered the work will cease, with results published in the peer-review literature. Focusing effort and resources on a single site, rather than spreading effort across multiple sites (as is presently the case in most UK dredging regions), is likely to provide a more robust understanding of dredging effects. The need to have a dedicated study site, and what question(s) need to be addressed will depend on what work has previously been undertaken in the region.

Adoption of the RSMP approach is expected to offer a range of benefits for both the marine aggregates industry and the regulator. For the industry, the approach will reduce the complexity and costs of monitoring. Cost savings will result from the collection of fewer biological samples, and also from the regional approach taken to sampling. For the regulator, the use of acceptable change limits, combined with a regional approach to monitoring, will allow for more effective environmental protection.

8.10 Mark Russell (BMAPA): Cumulative impact assessment of Atlantic herring (*Clupea harengus*) spawning habitat potential

In 2013 the UK marine aggregate extraction industry commissioned an assessment of effect-exposure pathways of dredging activity with locations of seabed showing the potential to support Atlantic herring *Clupea harengus* spawning. The assessment used a top-down spatial analysis of the Downs and Banks populations over a high resolution seabed surface sediment map (BGS SBS v3) based on the Folk (1954) classification.

An extensive literature review identified sediment particle size distribution associated with known spawning beds (Bowers, 1980; de Groot, 1980, 1986; Aneer, 1989; Morrison *et al*., 1991; Maravellias *et al*., 2000; Mills *et al.*, 2003; Geffen, 2009; ICES, 2012). A classification of 'preferred' habitat (gravel and sandy gravel) and 'marginal' habitat (gravelly Sand) was developed and mapped.

Additional data, indicative of herring spawning events/beds, were sourced and mapped e.g. International Herring Larvae Survey, and VMS data related to herring fisheries. The data were ranked, for their spawning ground representativity in an extensive confidence assessment.

The location of, and overall potential for, spawning habitat, were mapped using the multiple data layers. These 'heat' maps indicated areas of seabed with low, medium and high confidence for supporting potential spawning locations.

The reports are available to be downloaded from: http://www.marine-aggregate-rea.info/documents

Equivalent regional assessments have also been undertaken to define the extent of potential sandeel (habitat, and to consider potential cumulative effects. These are available from the same website.

Annex 9: Draft "Marine Aggregate Extraction and Marine Strategy Framework Directive: A review of existing research"

By Michel Deprez

Introduction

Global biodiversity is threatened by human activities which are increasingly impacting marine ecosystem (Halpern *et al.*, 2008). These impacts are usually cumulative and can lead to degrading habitats and ecosystem functionality (Ban *et al.*, 2010).

Understanding relationships between human pressures and ecosystems is the second major challenge identified by Borja (2014) for future research within the field of marine ecosystem ecology.

This review provides information on research aspects related to direct and indirect impacts of marine aggregate extraction, and in connection with criteria for good environmental status relevant to several descriptors of the MSFD: biological diversity, marine food webs, sea-floor integrity, hydrographical conditions and underwater noise.

This review also aims to highlight gaps to expand on the current knowledge.

Descriptor 1: Biological diversity is maintained. The quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climate conditions. Assessment is required at several ecological levels: ecosystems, habitats and species.

Species, Populations & Habitats.

Understanding the entire ecosystem requires the study of all **biodiversity components**, from the genetic structure of populations, to species, habitats and ecosystem integrity (Borja, 2014).

The marine sediments -searched by the extraction industry- correspond to sand and gravel bottoms which represent only a fraction of the high diversity of habitats and marine life (variety of bottom types, habitats of common interest, rare and endangered species).

- Sandy bottoms, with low diversity in microhabitats, particularly mobile banks of coarse sand searched for extraction, are typically poor in species and biomass. But these easily accessible invertebrate populations (annelids, beds of bivalves, crustaceans, echinoderms...) can represent an important food source for many fish (sea-bass) and birds (terns, cormorants, ducks, mad ...). On the other side, most flatfish species of commercial interest develop and reproduce in fine and silt sand without interest for extraction.

- Gravelly bottoms are the most diversified among the marine habitats. This knowledge resulted in many studies related to the commercial extraction of marine aggregates (Seiderer and Newell, 1999; Cooper *et al.*, 2007).

The deep gravel habitats are more diverse than those closer to the coast, with a diverse and abundant epifauna with sponges, tunicates, bryozoans, hydroids and polychaetes. Biogenic reefs under threat and of high heritage value are associated with these gravels.

More than 48 species of fish in the north-east Atlantic area are associated with sandy gravel bottoms for spawning (herring, black bream, sole ...); about forty others are associated with these habitats (rays, dogfish, plaice, sand eels, sharks ...). Due to the high productivity, coastal gravel bottoms actually are important feeding areas for diving birds (Anatidae, Alcidae).

In general, the biodiversity of the seabed tends to increase with the size and heterogeneity of the sediment (microhabitat) and with the stability of the substrate. The fauna of sand bottoms is mainly limited to buried species, while the larger size of gravel allows settling and provides shelter for many sessile and mobile organisms. Potential impacts of marine aggregate extraction on key habitats and species of the European Directive Natura 2000 are summarized in the following table (Posford Duvivier Environment, 2001).

Table 1: Potential impacts of marine aggregate extraction on key habitats and species of the European Directive Natura 2000 (S = Short Term, M = Mean term L = Long term; in Posford Duvivier Environment, 2001).

Potential Impact	Habitats (Ann. I)	Species (Ann. II)	
	Sand Banks	Fish	Mammals
Benthos and substrate loss	ML	SM	SM
Increase of turbidity	S	S	S
Change of sediment	ML	ML	
Change of hydrodynamics and sediment transport	ML		
Chemical disruption	S	S	SL
Disruption of behavior		S	S

The sensitivity measures the degree of the response to stress using indicators (species, communities, habitats). The level of pressure on habitats and species will be different depending on the nature of the impact related to extraction. The following table details the impact level on the different habitats and species identified in the major international conventions that regulate the management of the activities and the protection of the marine ecosystem.

Table 2: Sensitivity of key-species and habitats (identified by international conventions) to various levels of impact of marine aggregate extraction (E=Extraction/T=Turbidity/D=Deposition).

Sensitivity to extraction		***Pressure Levels***				
Indicators of impact		High	Mean	Low	Negligible	Positive
OSPAR species	Cod	T	D			E (zoning)
	Rays			E / T	D	
OSPAR habitats	Sabellaria reefs	E			T	D
	Maerl banks	E / T / D				
	Hard substrates with Modiolus	E / D		T		
ICES habitats	Spawning areas	E / T / D				
	Nurseries	E / D			T	
	Shell beds	E	D		T	
NATURA 2000	1110.2 (gravelly sands)		E / T / D			
	1110.3 (medium sands)			E / T	D	

The identification of sensitive habitats implies ambitious mapping programmes of biological characteristics of marine habitats at regional scales, much bigger than research permits and extraction areas. Because of the high biodiversity of gravel habitats, it would be desirable to add some of these habitats to the list of the European Directive.

The Working Group for Marine Habitat Mapping (ICES, 2008) points out the importance of this objective in the selection process of extraction areas to protect benthic threatened communities and to allow a good resources management. The most endangered species/habitats are maërl beds (high structural diversity) and spawning areas (fundamental functional diversity) which have specific protection measures (OSPAR, Natura 2000). Although biogenic reefs are globally considered as highly sensitive (OSPAR habitats), an example of reversibility of the reduction process of biodiversity has been demonstrated on extraction sites (Cooper *et al.*, 2007; Pierce *et al.*, 2007, 2014) with the return of the tubeworm *Sabellaria spinulosa* (key species of the Habitats Directive and the OSPAR list of endangered species), observed from the early stages of recolonization, encouraged by the deposit of sand overflow.

For benthos, the loss of biodiversity associated with the extraction is local and the duration varies according to the extraction modalities and sites:

- it is important and sustainable in coarse bottoms where intensive extraction takes place (cumulative effects);
- it is naturally compensated by the increase in diversity of benthic communities related to the diversification of habitats in the case of extensive extractions (<50% of the total site area); despite a larger spatial extent, the diversification of habitats is reflected by an increase in diversity of benthic communities (Hewill *et al.*, 2008), thus counterbalancing the loss of 60% for the number of species generally observed within dredging sites (Newell *et al.*, 1998; Desprez, 2000; Newell *et al.*, 2002; Boyd and Rees, 2003; ICES, 2009; Krause *et al.* 2009; Desprez *et al.*, 2014); at a local scale, an increase in the number of EUNIS habitats and associated communities was observed in the English Channel (Desprez *et al.,* 2014) with several new structural and functional habitats in a geographical context of coarse shelly sands with *Amphioxus* (EUNIS Habitat A5.135):
- the extraction perimeter is characterized by the presence of pebble crests with opportunistic epifauna (EUNIS Habitat A5.121);
- the surrounding deposition area is characterized by fine mobile sands with sparse endofauna (EUNIS Habitat A5.231);
- the former extraction site (recolonisation area) is characterized by heterogeneous sediments (EUNIS Habitat A5.131).
- the return to the initial biodiversity can be artificially accelerated by creating a heterogeneous substrate with the seeding of shells or gravel (Cooper *et al.* 2007c).

The study of the ecological function of biodiversity is very recent but has been recognized to have fundamental implications for predicting the consequences of biodiversity loss. Species in an ecosystem can be functionally equivalent, meaning that they play the same role. As such, these functionally equivalent species can be grouped together as functional types (i.e., guilds, trophic groups, structural groups, ecological groups, traits). Theoretically, a higher number of functional group types will provide higher functional biodiversity organization to the system, and thus, contribute to more stable and resilient ecosystems (Borja, 2014).

Indicators

Ware *et al.*, (2009) provided options for aggregate indicators based on impacts to the physical and biological environment, including the percentage of silt/sand and gravel and benthic indices such as diversity and biomass (Van Hoey *et al.*, 2010). Other indicators such as biological traits of benthic community (Bremner *et al.*, 2006, 2008), habitat heterogeneity (Hewill *et al.*, 2008) and functional diversity (Törnroos *et al.*, 2014) have also been proposed. Functional indices may provide a more detailed assessment of the benthic communities than structural ones, but the overall outcome is broadly similar for both types of indices; this suggests measurement of functional indices may be unnecessary for routine monitoring purposes, although they may have value in revealing more specific aspects of change in a system (Culhane *et al.*, 2014).

The Simpson, Shannon and Richness indices are useful indicators of changes in biodiversity (Barry *et al.*, 2013). Metrics which are closely associated with species number and density of individuals scored highest in terms of sensitivity in relation to aggregate extraction impacts and such observations largely support similar findings in the literature relating to a variety of activities that typically result in physical impacts on the seafloor and its associated fauna (Ware *et al.*, 2009). A Benthic Ecosystem Quality Index (BEQI) was developed by Van Hoey *et al.*, (2007) for the monitoring of windfarms, maintenance dredging deposits and aggregate extraction on the Belgian Continental Shelf (De Backer *et al.*, 2014). However, while some indicators are used to a certain extent already, there is further work to be done for indicators to be used as method to assess the physical impacts of aggregate extraction (Fitch *et al.*, 2014).

The relative lack of sensitivity of traditional indices AMBI and ITI may be attributed to their dependence on species responses to organic enrichment, an impact not routinely associated with aggregate extraction activities (Boyd *et al.*, 2002), rather than physical perturbation.

Conclusion

With respect to descriptor (1) WGEXT recognises that extraction of marine aggregates can potentially be a serious threat to biodiversity when exploitation projects affect gravelly areas either of small size or under-representated in the geographical area (loss of habitat), and/or when functional impacts can affect sensible and threatened species (e.g. through loss of spawning areas).

ICES Guidelines (2003).... aim to prevent any harmful effect on these habitats of prime importance.

According to a decreasing gradient of impact of anthropic pressures on biodiversity in the English Channel-North Sea area (Browning, 2002):

- a class of maximal impact is including fishing activity (threatened species, destruction of protected biotopes) ;
- a class of higher medium impact is including many types of pollution ;

- a class of lower medium impact is including marine aggregate extraction and deposition of harbour maintenance sediments ;
- the class of minimal impact is not including any activity considered in this synthesis.

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Descriptor 4: All elements of the marine food webs, to the extent that they are known, occur at normal abundance and diversity and levels capable of ensuring the long-term abundance of the species and the retention of their full reproductive capacity.

This descriptor concerns important functional aspects such as energy flows and the structure of food webs (size and abundance).

Only a large scale continuous extraction activity may cause a persistent turbidity plume which can:

- reduce the primary production of phytoplankton;
- disrupt the feeding and respiration of zooplankton;
- cause avoidance behaviour in visual predatory fish, such as mackerel and turbot. For herring and cod, critical levels were demonstrated at very low silt concentrations (3 mg/l);
- cause mortality of larvae of herring and cod at slightly higher levels (20 mg/l), while eggs can tolerate concentrations >100 mg/l (Westerberg *et al.* 1996).

A direct consequence of increased turbidity from aggregate extraction is the reduction of light penetration into the water column, which can negatively affect phytoplankton growth. Phytoplankton constitutes the basis of the food web, thus a decreased availability can affect higher trophic levels. In addition to a reduced phytoplankton abundance in the water column, elevated silt concentrations may impede the intake of phytoplankton by shellfish, and potentially cause additional stress (i.e. higher energetic costs) to these organisms as they need to excrete silt in the form of pseudo-faeces.

Functionally, the qualitative and quantitative depletion of benthic communities may affect the higher trophic levels (e.g. fish & birds), as the increase in extraction surface in a given geographical area leads to the loss of habitat and potential food web (Birklund & Wijsman, 2005).

Shellfish make up an important component of the coastal food web, for example for shellfish-eating birds such the common scoter as well as demersal fish (Kaiser *et al.*, 2006, Tulp *et al.*, 2010). As such, the impacts of aggregate extraction on shellfish species are being investigated in the Netherlands; the American clam (*Ensis directus*) was taken as a model organism because of its high dominance in biomass in the Dutch coastal zone.

There have been few direct studies on changes in fish populations due to marine aggregate extraction. A study by Boyd *et al.*, (2001) compared the commercial fish landings for fish caught in an aggregate zone, to those obtained from ports distant to dredging. A localised decline in catches in Dover sole was observed, and the study considered that this may be a result of the reduced abundance of prey items within the extraction area as Dover'sole derive much of their food from benthic species.

In the Eastern Channel Region, the majority of fish species have shown marked reductions in abundance since the start of aggregate extraction and draghead entrainment was identified as a possible cause (Drabble, 2012).

In the Baie de Seine, fish monitoring between 2007 and 2011 showed a strong negative impact of aggregate extraction on fish presence, both for the number of species (-50%), for abundance and biomass (-92%). Such a strong impact was not observed in Dieppe (respectively +50%, -35% and +5%) and could be explained by the difference in extraction intensity, low in Dieppe (<1h/ha/year), but medium to high (4 to 10h/ha/year) in the Baie de Seine (Desprez *et al*., 2014).

Several fish species are more or less closely related to the bottom by their way of feeding (many fish species such as plaice, sole, dab, gurnard, red mullet, haddock, whiting and cod, feed primarily on benthic organisms, like bivalves, worms, crustaceans and sea urchins);

A study by Pearce (2008) investigated the importance of benthic communities within marine aggregate areas as a food resource for higher trophic levels. The study noted that the alterations to the benthos due to dredging were likely to cause alterations to the diet of demersal fish, which may be unfavourable. However, given the natural levels of trophic adaptability observed, a change in dietary composition may not be damaging to the fish population as the majority of species studied are likely to switch prey sources, providing sufficient biomass is available to support them.

Stelzenmüller *et al.*, (2010) investigated the vulnerability of 11 species of fish and shellfish to aggregate extraction. The authors calculated a Sensitivity Index (SI) for each species and modelled their distribution around the UK. These species were likely to be affected by aggregate extraction and had either commercial (target fish communities include the flatfish sole, thornback ray and plaice, the gadoids cod and whiting, and the bivalve mollusc queen scallop (*Aequipecten opercularis*)) or conservational importance.

Pelagic fish?

Predicting the disturbance of mobile species is particularly difficult as there are few studies that have directly investigated disturbance in relation to marine aggregate extraction, or suggested that significant impact will occur. Mobile species are also more likely to be influenced by other impacts or anthropogenic activities outside of a licence area, again making direct predictions between marine aggregate extraction and mobile species difficult. A study by Kenny *et al*., (2010) looked at the long term trends of the ecological status of the east coast aggregate producing region, which included consideration of fish stocks. This study noted that long term trends appear to be dominated by wider factors that govern trends at the North Sea scale, as declining fish stocks were observed in both the North Sea and east coast aggregate producing region.

Cook and Burton (2010) reviewed the potential impacts of aggregate extraction on seabirds. One direct effect was the issue of increased turbidity, and to what extent this affects a bird's ability to see prey. Vision for foraging is important for a number of species of seabirds, including terns, the common guillemot and the northern gannet. However, for the most part, material falls out of suspension relatively quickly (mostly within 500 m), meaning this increased turbidity is short term and within a limited area.

In a review of impacts of marine dredging activities on marine mammals, Todd *et al*., (2014) conclude that sediment plumes are generally localized, and marine mammals reside often in turbid waters, so significant impacts from turbidity are improbable. However, entrainment, habitat degradation, noise, contaminant remobilization, suspended sediments, and sedimentation can affect benthic, epibenthic, and infaunal communities, which may impact marine mammals indirectly through changes to prey.

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Descriptor 6: Sea-floor integrity is at a level that ensures that the structure and functions of the ecosystems are safeguarded and benthic ecosystems, in particular, are not adversely affected.

1. Physical damage, having regard to substrate characteristics
2. Condition of benthic community

The physical impact of the extraction is site-specific and linked to many factors such as the hydrodynamics, the sediment grain size, the dredging method and intensity.

- The action of extracting aggregate alters the topography with creation of isolated furrows (dredge tracks) in extensive sites (Cooper *et al.*, 2005; Le Bot *et al.*, 2010) up to durable depressions of several meters deep after several years of localised extractions (Degrendele *et al.,* 2010).

- Removal of aggregate can lead to a change in the seabed substrate, by removing surficial layers of sediment to leave a new substrate exposure of coarser sediments (Cooper *et al.*, 2007; Le Bot *et al.*, 2010) or by altering the particle size distribution as a result of intensive deposition from overflow (Boyd *et al.*, 2005; Cooper *et al.*, 2007; Krause *et al.*, 2010; Barrio- Frojan *et al.*, 2011; Wan Hussin *et al.*, 2012).

- Extraction generally results in an increased variability in terms of particle size composition within both high and low dredging intensity sites (Cooper *et al.*, 2007).

As the distribution of marine organisms and communities is strongly related to hydrodynamic, morphological and sediment parameters (McLusky and EIliott, 2004; Baptist *et al.*, 2006; Degraer *et al.*, 2008; Pesch *et al.*, 2008), any physical changes in the sea bed will lead to a response in the composition of its natural benthic assemblages. This will affect the habitat quality in a wider area, the transport of fish larvae and the abundance of food for fish, birds and mammals.

The direct removal of surface aggregate sediments and associated fauna results in an immediate and local loss of the benthic fauna in the order of 60% for the number of species and 80-90% for the abundance and biomass (Newell *et al.*, 1998; Desprez, 2000; Newell *et al.*, 2002; Boyd and Rees, 2003; ICES, 2009; Krause *et al.* 2010; Desprez *et al.*, 2014). This may range from almost total defaunation (Simonini *et al.*, 2007) to a more subtle and less significant change (e.g. van Dalfsen *et al.*, 2000; Robinson *et al.*, 2005).

Extensive dredging will have the less pronounced impact without functional consequences (e.g. no reduction in biomass) on the higher trophic levels (Bonvicini *et al.* 1985; Desprez *et al.*, 2014). In sandy areas of the North Sea and the Baltic Sea, the effects of sand extraction only became evident when the annual extractions affected 50 % of the licensed area, causing a drop in biomass values (Birklund and Wijsman, 2005).

The cumulative impact, in time and/or space, of multiple extractions results in a continuous disruption of benthic communities, which are reduced to their simplest form (few tolerant species, reduced abundance and minimal biomass due to the elimination of long living bivalves and echinoderms) (Newell *et al.,* 2002; Boyd and Rees, 2003; Cooper, 2005; Robinson *et al.,* 2005; Cooper *et al.,* 2007; Barrio-Frojan *et al.,* 2008).

Are there limits beyond which the capacity of impacted habitats to recover is compromised? After many years of sustained dredging in North Sea, it is encouraging to see that even when one of the measured variables departs significantly from an equitable state, the effect does not persist from one year to the next; the potential for short-term partial recovery of the assemblage has not been compromised, at least in terms of abundance and species richness (Barrio-Frojan *et al.,* 2008). The exact values of acceptable limits for disturbance caused by dredging have yet to be developed, as well as any possible modes of intervention to remedy any critical damage caused.

Differences in impact and subsequent recovery also depend on local hydrodynamics, sediment characteristics, as well as on the nature and type of stress to which the community is adapted in its natural environment (ICES, 2009). In the sandy bottoms of the North Sea, small-scale disturbances in seabed morphology and sediment composition result in limited effects on the benthic community (van Dalfsen *et al.*, 2000), but large scale and deep sand extractions result in a net increase of the fraction of very fines in the sediment and of white furrow shell (*Abra alba*) biomass (de Jong *et al.*, 2014).

In gravelly areas, the impact is higher as a consequence of the heterogeneity and the stability of the sediment which favour more diversified and abundant communities (Seiderer and Newell, 1999; Cooper *et al.*, 2007).

Table3: Risk analysis of marine aggregate extractions for the main types of seabeds exploited on the French littoral (Poseidon matrix).

Risk Analysis		Habitats Sensitivity		
Impact Indicator			NATURA 1110.2	NATURA 1110.3
Dredging Intensity	Recovery rate	Sandy gravels with epifauna	Gravelly sands with *Amphioxus*	Medium sands with *Ophelia*
High	> 10 years	High	High	Medium
Medium	1-10 years	High	Medium	Low
Low	< 1 year	Medium	Low	Negligible ???

The main indirect impact of dredging is linked to the deposition of sediment from the overflow or screening plume, which can cause smothering / damage to sensitive benthic receptors. Extensions of deposits have been calculated for spring tides conditions in the English Channel: 800m for sand and 6.5km for silt (Duclos *et al.*, 2013).

The majority of studies (Desprez, 2000; Newell *et al.*, 2002; Boyd and Rees, 2003; Cooper *et al.*, 2007 and Desprez *et al.*, 2010) suggest that adverse biological change is constrained to the 100m – 200m from the dredge area, even where sedimentary change has been detected at greater distances up to 2 km from the dredge site in the direction of and after remobilisation by strong local tidal currents (Robinson *et al.*, 2005; Cooper *et al.*, 2007; Desprez *et al.*, 2010).

Several types of effects have been observed depending on the intensity of the oversanding and the nature of the bottom:

- On gravelly bottoms, the elimination of the benthic fauna can be almost complete, identical to that observed in the dredged area (ICES, 2009; Desprez *et al.*, 2010), the original communities being unable to withstand a big deposition of fine sands. Due to the permanent extraction activities and remobilization in areas under strong hydrodynamic conditions, the original stable bottom is replaced by a continuously remobilized substrate (Newell *et al.*, 2002, 2004; Robinson *et al.*, 2005; Desprez *et al.*, 2010). Beyond a few hundred meters from the extraction site, there is a rapid increase in the number of species and abundance consistent with the low dispersion of overflowing sediments. Boyd and Rees (2003) also showed that the faunal composition changed gradually with the distance from the extraction site. This is mainly due to the fact that the distribution of species is correlated with the sedimentary characteristics of the deposition area (medium to fine sand);

- A transition from a sandy-gravelly bottom with a diverse epifauna to a sandy bottom with a less diverse infauna can occur as a result of overflow (Boyd *et al.*, 2005; ICES, 2009; Desprez *et al.*, 2010).
- On sandy bottoms, the benthic fauna is less affected in the deposition area than in the extraction site (Newell *et al.,* 2002). The benthic species which are less sensitive to overflow deposits are those able to move rapidly through the sediment and free-swimming epifaunal species (crabs, shrimps…);
- The species richness, abundance and biomass can increase in overflow areas, when sediment deposition is limited and the available food is increased through organic enrichment (Newell *et al.,* 1999, 2002; Desprez *et al.,* 2010).

Generally, the creation of sediment plume has the potential to adversely impact benthic organisms through an increase in sediment induced scour, smothering and through damage and blockage to respiratory and feeding organs (Tillin *et al.*, 2011). Effects of suspended sediments and sedimentation are species-specific, but invertebrates, eggs, and larvae are most vulnerable.

Studies such as Last *et al.*, (2011) investigated the impacts of increased SPM and smothering on a number of benthic species of commercial or conservational importance under a range of environmental and depositional conditions. Two test conditions of SPM were tested (high SPM, equivalent of near dredge conditions and low SPM, equivalent of wider secondary impact conditions). All species survived the higher SPM conditions. The ross worm (*Sabellaria spinulosa*) was highly tolerant to short term burial (< 32 days) and its growth rate showed significantly higher tube growth under high SPM conditions.

Szostek *et al.*, (2014) showed that elevated SPM had no short-term effects on survival of the king scallop (*Pecten maximus*), but observed a reduction in growth rate; this species appeared more tolerant of burial and elevated levels of SPM than the queen scallop (*Aequipecten opercularis*).

Biogenic reefs

Chaetopterus beds (Rees *et al.*, 2005)

Biotopes Eastern Channel (CEFAS, 2007)

Sabellaria reefs & Mytilus beds (Cooper *et al.*, 2007; Pearce *et al.*, 2013)

Indicators biogenic reefs (JNCC, 2014)

Lanice meadows...

Presence of particularly sensitive or tolerant species should inform on the condition of the benthic community. However, Zettler *et al.*, (2013) recently demonstrated that the use of static indicator species, in which species are expected to have a similar sensitivity or tolerance to either natural or human-induced stressors, does not account for possible shifts in tolerance along natural environmental gradients and between biogeographic regions. Their indicative value may therefore be considered at least questionable. The following points should be carefully considered when applying static indicator based quality indices: (1) species tolerances and preferences may change along environmental gradients and between different biogeographic regions, (2) as environment modifies species autecology, there is a need to adjust indicator species lists along major environmental gradients and (3) there is a risk of including sibling or cryptic species in calculating the index value of a species.

Conclusion

With respect to descriptor (6) WGEXT recognises that direct changes to the function and structure of ecosystems, particularly physical parameters, will occur as a result of the extraction of marine sediments. The exploitation of marine aggregates should preferably take place in naturally unstable bottoms (coarse sand dunes), where benthic communities are poor (<5 g/m²), adapted to regular bottom disturbance, and able to rapidly recolonize exploited sites (Cooper *et al.*, 2007).

However, the group are content that in the context of appropriate consent regimes which provide for rigorous environmental assessment and evaluation of each proposal to extract sediment, these impacts may be considered to be within environmentally acceptable limits and therefore not adverse. These assessments should take account of the 2003 "ICES Guidelines for the Management of Marine Sediment Extraction", as adopted by OSPAR, which provide for the adoption of appropriate extraction site locations, and implementation of mitigation and monitoring programmes.

To enable sustainable use of marine resources (Birchenough *et al.*, 2010), there is a clear need for enforcing management measures such as:

- seasonal closures for specific areas (i.e. during recruitment seasons),
- rotation of dredging intensity to allow recolonisation and recovery of macrobenthos,
- exploratory restoration techniques in areas where the seabed has been impoverished as a result of extraction activities.

Studies are needed for a deeper knowledge of recovery processes in structure and function through time (Borja *et al.*, 2010). WGEXT suggest that in defining "adverse" it should be accepted that direct changes to the physical structure of the seabed will result from the extraction of marine sediments. Defining "adverse" as being no environmental change from existing (pre-dredge) conditions would, in the opinion of the group, be inappropriate and detrimental to the continued ability of member countries to extract marine sediments from their seabed.

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Descriptor 7: Permanent alteration of hydrographical conditions does not adversely affect marine ecosystems.

Changes in seabed morphology and associated hydrodynamic effects have the potential to affect adjacent coastlines (Kortekaas *et al.,* 2010). If dredging is undertaken within the area of sediment movement known as the 'active beach profile' then material can become trapped within depressions caused by dredging, preventing it from moving back onshore during calmer conditions (Brampton and Evans, 1998).

In the North Sea, below the 25 m depth contour, no impacts were observed on wave regime, sediment transport or stability of the coastline. Further offshore, the removal of sediment during marine aggregate extraction may impact sediment transport pathways that replenish the coastline.

Phillips (2008) investigated South Wales areas where critical beach loss has been associated with dredging activities; five years of beach monitoring did not find a qualitative or quantitative link between marine aggregate dredging and beach erosion; natural changes, such as changing wind direction and increased easterly storms were most significant in affecting beach formation processes.

The removal of a significant thickness of sediment can cause a localised drop in current strength associated with the increase in water depth. This reduced strength of the bottom current can cause the deposition of fine sediments within the dredged depressions from overflow discharges (Duclos *et al.*, 2013; Krause *et al.*, 2010) or from natural sediment transport (Desprez, 2000; Cooper *et al.*, 2007 and Le Bot *et al.*, 2010). For the seaward harbour extension of the Port of Rotterdam, large-scale sand extractions down to 20m below the seabed, generated an increase of the fraction of fine muddy sands in the troughs and deepest areas of the extraction site (de Jong *et al.*, 2014)... no information on effects on current pattern !?!?

Conclusion

In general and in relative terms, the dimensions of dredged pits are so small that the deepened area has little influence on the macroscale current pattern. Furthermore, it was concluded that, in most cases, the current pattern would only be changed in the direct vicinity of the dredged area.

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Descriptor 11: Introduction of energy, including underwater noise, is at levels that do not adversely affect the marine environment.

Sound is utilized by many marine organisms to sense the environment around them and find prey. Consequently, an increase in anthropogenic low-frequency noise, such as that produced by dredging, has the potential to cause adverse effects. The extent to which effects disseminate through the foodweb to marine mammals is unknown, but speculated effects are given, based on available data.

Extensive variability exists between hearing sensitivity of fish species, but in general, they are sensitive to low frequencies (Popper and Fay, 2011), which puts them at risk from dredging noise. No study has looked at dredging noise specifically, but avoidance of low-frequency vessel noise by some fish species has been reported (de Robertis and Handegard, 2013) and Handegard *et al.*, (2003) noted vertical and horizontal avoidance by cod (*Gadus morhua*) of a bottom-trawling vessel. Dredging noise is unlikely to result in direct mortality, or permanent hearing damage of fish, but long-term exposure could theoretically affect fitness of some individuals.

Responses to particle motion of low-frequency sound have also been recorded in cephalopods (Mooney *et al.*, 2010), which can form an important part of the diet of some marine mammals. Low-frequency noise in the 1 Hz–10 kHzband altered cephalopod breathing rhythms and movement.

Dredging has the potential to impact marine mammals, but effects are species and location-specific, varying also with dredging equipment type. In general, evidence suggests that if management procedures are implemented, effects are most likely to be masking and short-term behavioural alterations and changes to prey availability (Todd *et al.*, 2015). Exclusion of prey from foraging areas has potential to impact marine mammals negatively, but extent to which this occurs depends on the significance of the feeding ground, ability to switch prey species, and availability of alternative foraging areas. The level of effect is therefore species- and context-dependent.

The sound level radiated by a dredger undertaking full dredging activities is in line with the one expected for a cargo shipping travelling at moderate speed (and Robinson *et al.*, 2011). However, extracting gravel does cause additional noise impact (Dreschler *et al.*, 2009 and Robinson *et al.*, 2011). In the UK, underwater noise from aggregate extraction has been largely discounted as a significant impact. Similarly, in the Netherlands, the noise levels from dredgers were not in the top seven major underwater sound sources (Ainslie *et al.*, 2009).

Conclusion

With respect to descriptor (11) WGEXT recognises that extraction of marine sediment does generate underwater noise, however the impacts of this on the marine ecosystem are currently being investigated (ICES, 2011).

References D11

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General conclusion

A method for assessing the vulnerability of marine ecosystems to various anthropogenic threats by impact categories has been proposed by Halpern *et al.*, (2008); by decreasing order of perturbation, invasive species, pollution, management, toxic blooms, demersal fisheries and the phenomena of hypoxia have a higher impact than extraction of marine aggregates.