Report of the Dutch workshop on Cumulative Effects in relation to MSFD/GES and OSPAR/QSR2010 Utrecht, June 11-12, 2008

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Institute for Marine Resources and Ecosystem Studies

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Preface

The current report provides an overview of the background, setup and outcome of the Dutch trial workshop on Cumulative Effects in relation to MSFD/GES and OSPAR/QSR2010. Results are presented as they were generated during the workshop, without additional evaluation, validation or quality control. Only a brief discussion of the results is provided.

Please note that all information in this document must be regarded as unvalidated expert opinions and does not reflect in any way a formal position of the Dutch Authorities.

Summary

Background
The OSPAR QSR2010 is intended to provide an overview of the current state of the marine environment in the OSPAR Area, and is expected to be an important source of information for the Initial Assessment of the MSFD. A number of case studies are foreseen to illustrate the effects of cumulation of pressures in a limited geographic area and to develop and demonstrate a method for doing this. The Dutch EEZ case study will be based on an inventory of ecosystem components, activities and their consequent impacts which may negatively affect the ecosystem components. A matrix comprising all these elements and an indication of the relevance of their interactions has been presented in OSPAR by the United Kingdom.

Objective
The main objective of the workshop was to determine the scoping and effects analysis of the cumulative effects assessment for the Dutch EEZ case study, as well as to provide a preliminary assessment of priorities for the MSFD and GES.

Setup
The workshop was set up as an expert workshop, where all participants were expected (and requested) to provide their knowledge on the issues under discussion. The group of participants was divided into smaller teams to deal with only a segment of the matrix. The teams roughly consisted of 2 or 3 experts and 2 or 3 generalists. In order to facilitate the process in the expert teams, the contents of the OSPAR matrix were transferred to a Microsoft Access database for easy selection and filtering of the matrix' contents.

Conclusions
The main conclusion that can be drawn from the workshop is that it is an excellent way of generating a lot of expert information in a short period of time. It provides a good basis for consistency throughout the generation of information. However, the consistency and certainty of the information generated was hampered by several factors, mainly related to the number of workshop participants (lack of experts, groups too small), a lack of clear definitions and classifications, and time constraints.

1 Background

With respect to the protection of the marine environment, at this moment, several processes are running in parallel. Most important is the objective of the Marine Strategy Framework Directive (MSFD) to arrive at a 'Good Environmental Status' (GES) of the European seas in 2020 and the work being carried out in OSPAR to prepare the Quality Status Report 2010 (QSR2010).

The aim of the MSFD to arrive at a GES is to be achieved by protection and restoration of the European seas and by ensuring sustainable use of the seas. European marine regions need to be established for the purpose of co-operation between member states, using existing regional sea conventions as much as possible. Each member state, therefore, has to draft a national marine strategy that is linked to the marine region(s) in which its EEZ is included. This strategy includes a description of the current state of the marine environment of the region (Initial Assessment), including an analysis of the most important pressures and consequences resulting from (mainly) human activities. Furthermore, member states need to develop a set of objectives and related indicators to assess progress towards GES. This work should be delivered by 2012.

The OSPAR QSR2010 is intended to provide an overview of the current state of the marine environment in the OSPAR Area, and is expected to be an important source of information for the Initial Assessment of the MSFD. Currently, assessments of (trends of) current activities and their impacts and assessments of environmental quality are being drafted. One chapter of the QSR (chapter 11) will present an integrated assessment of the status of the environment on a region-by-region basis. In addition, a number of case studies are foreseen to illustrate the effects of cumulation of pressures in a limited geographic area and to develop and demonstrate a method for doing this. The same method will be used for the 'chapter 11' regional assessments. One of the case studies is the Dutch EEZ.

The Dutch EEZ case study will be based on an inventory of ecosystem components, human activities and their consequent impacts which may negatively affect the ecosystem components (Figure 1). The United Kingdom has presented in OSPAR a matrix comprising all these elements and an indication of the relevance of their interactions (Figure 2). This matrix originally has been designed to identify the main impacts on ecosystem elements in order to focus OSPAR's work in the field of biodiversity. It has, however, been recognised as a helpful tool to assess cumulative effects as well.

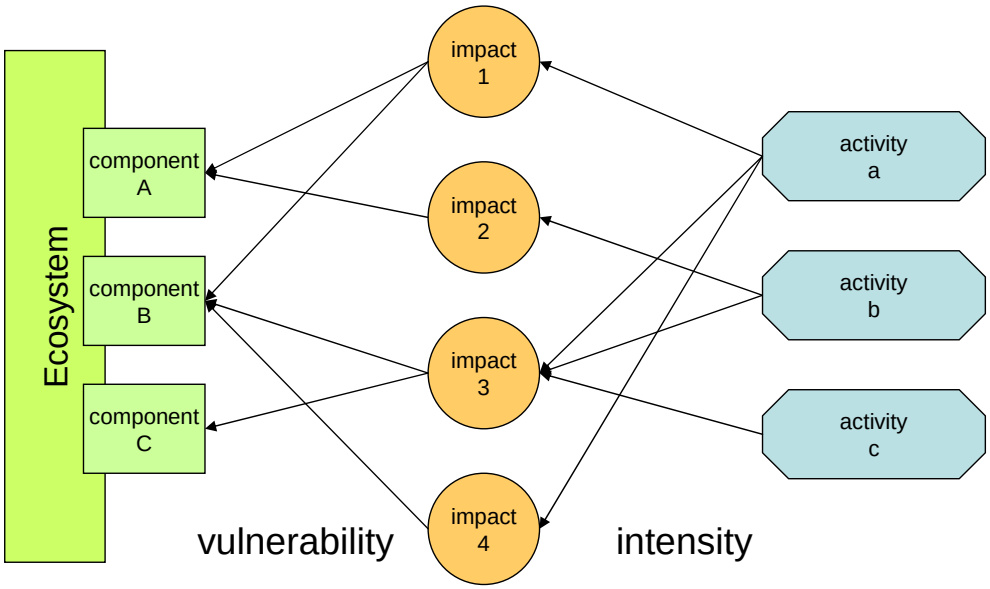


Figure 1. *Schematic presentation of the approach to cumulative effects assessment (CEA), based on the relation between activities, impacts and ecosystem components.*

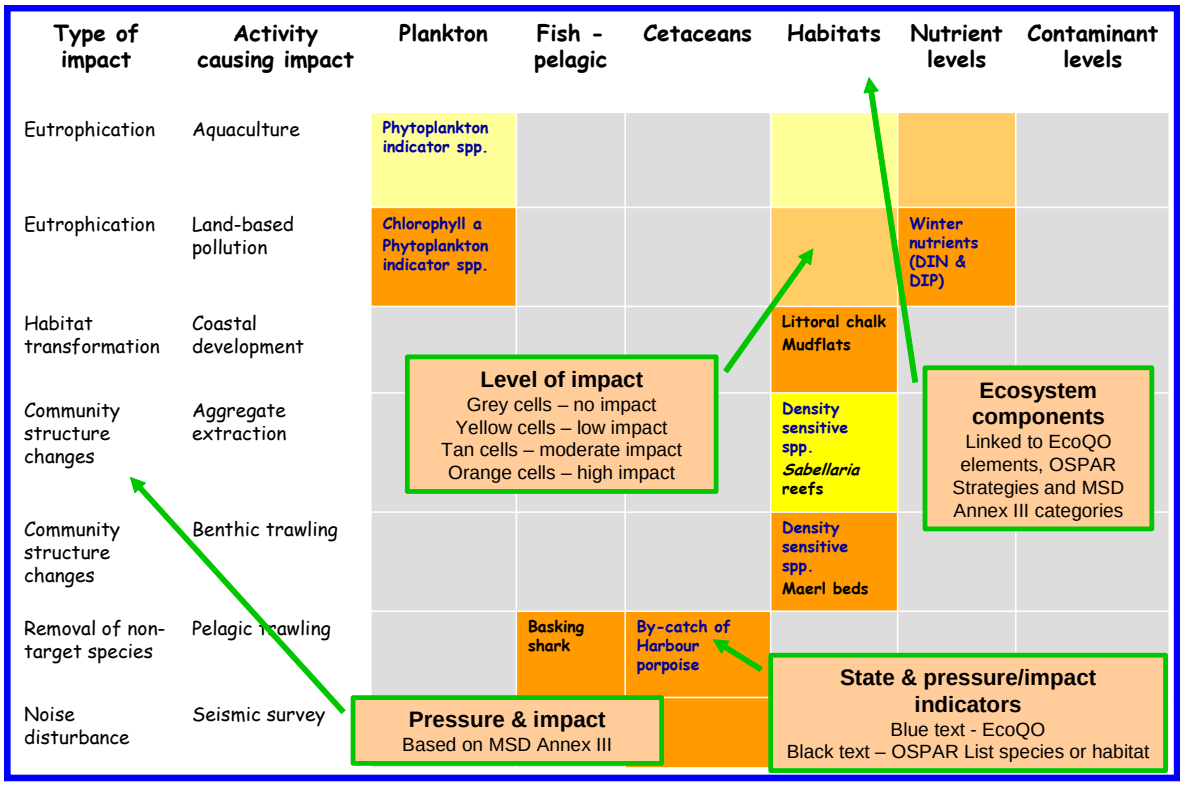


Figure 2. *Schematic presentation of the matrix developed by the United Kingdom to provide an inventory and prioritization of activities, impacts and ecosystem components.*

2 Workshop objectives

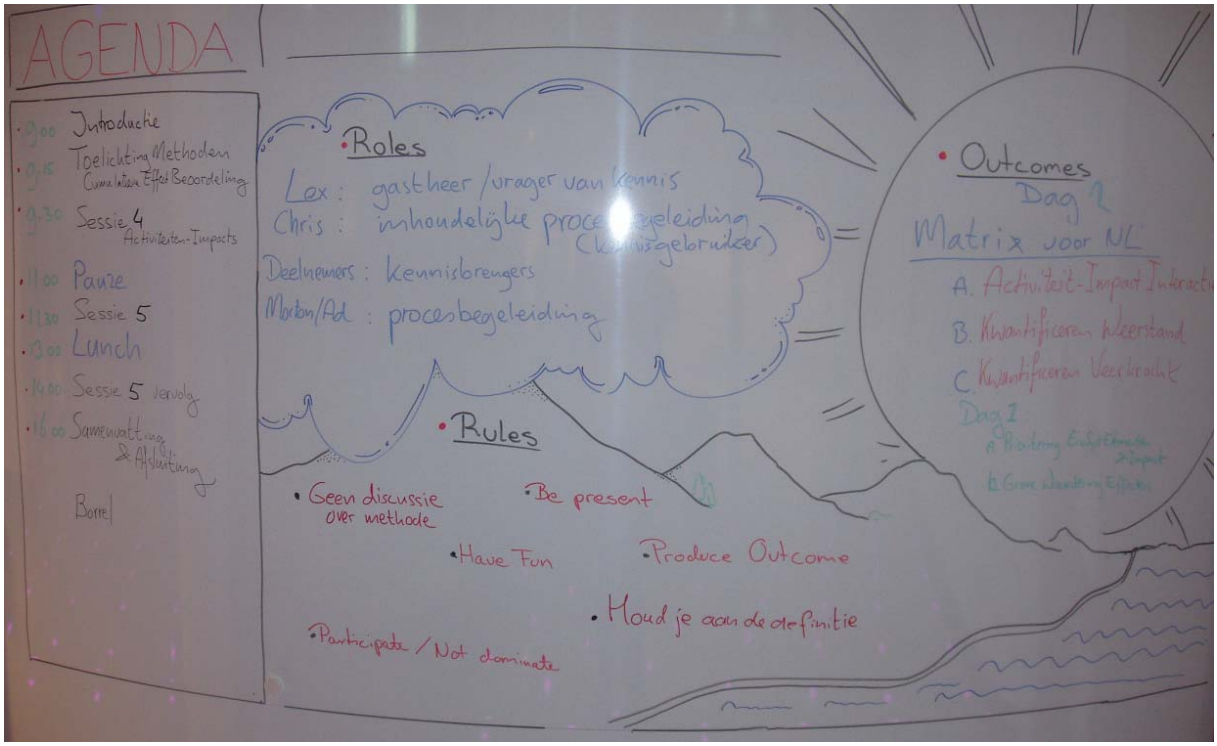
The main objective of the workshop was to determine the scoping and effects analysis of the cumulative effects assessment for the Dutch EEZ case study, as well as to provide a preliminary assessment of priorities for the MSFD and GES. In order to arrive at this objective, the following goals were defined for the workshop:

1. Completion and prioritization of the ecosystem components in the OSPAR matrix;
2. Completion and prioritization of the impacts in the OSPAR matrix;
3. Determine relevant impacts for all activities on the Dutch EEZ with indication of their importance;
4. Provide the expected effect of each impact-ecosystem component interaction;
5. Provide an indication of the resistance and resilience of an ecosystem component for selected* impact-component interaction.

   impact - ecosystem component interactions were selected on the basis of the outcome of goal 4; focussing on interactions with expectations of moderate to high effects.

The workshop participants were asked to keep to the following restraining conditions:

- Assume that each impact-ecosystem component interaction may occur, i.e.,
  - Disregard spatial scale
  - Disregard temporal scale
- Do not, at this stage, include indirect effects



3 Workshop setup

The workshop was set up as an expert workshop, where all participants were expected (and requested) to provide their knowledge on the issues under discussion, disregarding their professional position. This was to eliminate -as far as possible- any political or other bias in the workshops' results.

In each of the sessions (see Figure 3 and text below) the group of participants was divided into smaller teams to deal with only a segment of the matrix. The teams roughly consisted of 2 or 3 experts and 2 or 3 generalists. It must be noted, however, that in an optimal situation each team would have comprised 4 to 5 experts and 2 to 3 generalists. However, since the number of expert participants was limited, this was not possible.

The teams were requested to provide their knowledge on the subjects based on their 'intuition', without making use of reference documents or articles. The main reason for this is that otherwise substantially more time would have been required for each of the sessions. Finetuning of the results is foreseen to be done following the expert workshop.

In order to facilitate the process in the expert teams, the contents of the OSPAR matrix (version 7) were transferred to a Microsoft Access database for easy selection and filtering of the matrix' contents. Subsets of the matrix were subsequently provided as editable spreadsheets for the expert teams, so that their input was directly recorded. Directly after each session the spreadsheet contents were compiled and transferred to the database in order to be used in either one of the following sessions.

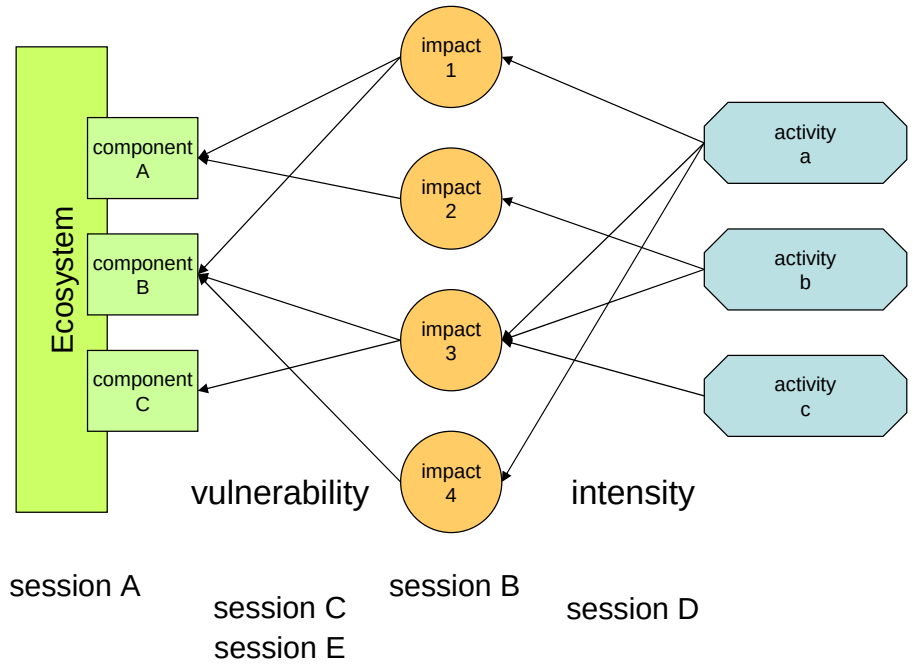


Figure 3. Schematic presentation of the workshop sessions in relation to the CEA approach.

3.1 Day 1

During the first day of the workshop three sessions were run with the expert teams:

A. Prioritization of the ecosystem components
B. Prioritization of the impacts
C. Effects of impacts on ecosystem components

A. Ecosystem components

Each expert team was provided with a number of subsets of ecosystem components from the OSPAR Matrix (see also above) and was requested to indicate the relevance of each ecosystem component for the Dutch EEZ, i.e., whether it is present in such an extent that it is worthwhile including it in the further assessment. If necessary; additional ecosystem components could be added.

The following scale was used to indicate the relevance of ecosystem components:

- None
- Marginal
- Limited
- Considerable
- High

B. Impacts

The expert teams were provided with a subset of impacts from the OSPAR matrix and asked to indicate the relevance of each impact to the Dutch EEZ, i.e., whether it is present in such an extent or intensity that it is worthwhile including it in the further assessment. If necessary, additional impacts could be added.

The following scale was used to indicate the relevance of impacts:

- None
- Marginal
- Limited
- Considerable
- High

C. Effect of impacts on ecosystem components

Comparable to Session A, the expert teams were provided with a matrix based on a subset of ecosystem components and all impacts considered relevant for the Dutch EEZ. For each ecosystem component, they were requested to give an indication of the effect of a possible interaction between the impact and the ecosystem component. Spatial and temporal aspects, as well as the activity from which the impact could originate, were ignored in order to arrive at a generic assessment that can be used in future GIS (and other) analyses.

At this point, the analysis of effects differentiates from the approach followed by the Liverpool University (Robinson *et al.*, 2008) [1], where the effects analysis is based on the intensity of the impact (considering the activity causing it) and the extent and frequency of exposure of the ecosystem component to the impact. In the Dutch approach, these aspects are separated from the generic assessment and dealt with in the second step of the analysis.

[1] Robinson L.A., S. Rogers & C.L.J. Frid (2008): A marine assessment and monitoring framework for application by UKMMAS and OSPAR – Assessment of Pressures.

The following scale was used to indicate the effects:

- None
- Negligible
- Low
- Moderate
- High

3.2 Day 2

During the second day of the workshop two sessions were run with the expert teams:

D. Relevance of impacts per activity
E. Resistance and resilience of ecosystem components for impacts

D. Relevance of impacts per activity

Each expert group was provided with a subset of impacts and was requested to indicate, per activity, the relevance of the impacts as being caused by the activity. It must be noted again, that this is a generic approach, and should not be mistakenly considered to represent the relevance of an impact on the Dutch EEZ. The latter could only represent a –present– situation, while the generic approach is to serve the analysis of potential (future) scenario's.

The following scale was used to indicate the relevance of the impacts per activity, i.e., whether it is present in such an extent or intensity that it is worthwhile including it in the further assessment:

- None
- Negligible
- Low
- Moderate
- High

E. Resistance and resilience of ecosystem components for impacts

This session is in principle very much like session C of day 1. The main difference is that the expected effect of impacts on ecosystem components was now expressed in terms of resistance (potential of a component to withstand the pressure of an impact) and resilience (potential of a component to recover from the effect of exposure to an impact). The expert teams were further asked to provide an indication of their certainty of the indicated resistance and resilience scores.

As the effort required to provide this information was considered relatively high; the results of session C were used to make a selection from the overall Matrix to include only those ecosystem component-impact interactions that were already given the indication of moderate to high effect.

The following scales were used in this session:

Resistance	**Thresholds** *(reduction in biomass or surface area; increase of concentration)*
1 – negligible	<0,1%
2 – low	0,1% - 1%
3 – considerable	1% - 10%
4 – high	>10%

Resilience	**Thresholds**
1 – negligible	Even on the long term (100 yrs+) no significant recovery expected
2 – low	Recovery between 10 and 100(+) years
3 – considerable	Recovery between 2 and 10 years
4 – high	Recovery in less than two years

4 Outcome of the workshop

It was an intensive task for the expert teams to transfer their knowledge into the matrixes. All of their inputs are included in the appendices to this report. It is important to note that this is the raw output of the workshop, without additional review or quality control. We recognize that such a review is necessary before the information can be used in the next step of the cumulative effects assessment case study.

In the paragraphs below, we will briefly elaborate on the results and provide some first comments and suggestions for improvement.

4.1 Day 1

A. Ecosystem components
The selection and prioritization of ecosystem components for the Dutch EEZ can be found in Appendix B of this report. Approximately 2/3 of the ecosystem components (32) of the OSPAR matrix were also considered of high importance for the Dutch EEZ. 15 ecosystem components of the original OSPAR matrix were considered not relevant; mainly because these are related to deep-sea ecosystems or rock-based benthic habitats.

The experts expressed their feeling of inconsistency in the level of detail in the original OSPAR matrix, as it contains many types of habitats, while (for example) only 4 types of fish are distinguished. Further work on the matrix may benefit from a re-evaluation of this balance, as well as the level of detail required. The workshop participants felt that for the approach followed in this workshop a level of detail as used for seabed habitats is not providing any additional value and only generates an incorrect feeling of certainty.

B. Impacts
The selection and prioritization of impacts for the Dutch EEZ can be found in Appendix C of this report. Practically all impacts from the OSPAR matrix were also considered of high importance for the Dutch EEZ.

In general this appeared not to be a very complicated task for the expert teams. Most problems were encountered to interpret the impacts in the Climate Change Theme. In general, the workshop participants would have appreciated to have a good description of each of the impacts (as well as ecosystem components) as this would have prevented a lot of discussion and improved the consistency between the different expert groups.

C. Effects of impacts on ecosystem components
The scoring of the expert teams on the effects of impacts on ecosystem components can be found in Appendix D of this report.

Perhaps the most relevant comment to make with respect to the results of this session is the inconsistency between the expert teams in the definition of effect and the interpretation of the different scales. Seals, cetaceans, fish and seabirds appear to be assessed as most sensitive to the impacts (see Figure 4). Although this may actually be true; it could also be caused by the fact that these ecosystem components have been dealt within the same group of experts.

The experts were asked to provide a generic assessment of the effect that could be caused to the ecosystem component when exposed to the specific impacts. This appeared to be a difficult task, as they had no reference

to the actual intensity, frequency and extent of the impact. In this situation it would have been better to have the expert teams describe the impact-effect relationship for the interaction, instead of providing a generic assessment of the effect.

It was mentioned before that the group of experts actually present at the workshop was limited. This lead to an underrepresentation of experts on specific ecosystem components (e.g., birds and phytoplankton) in the sessions, sometimes hampering a good assessment of the potential effects.

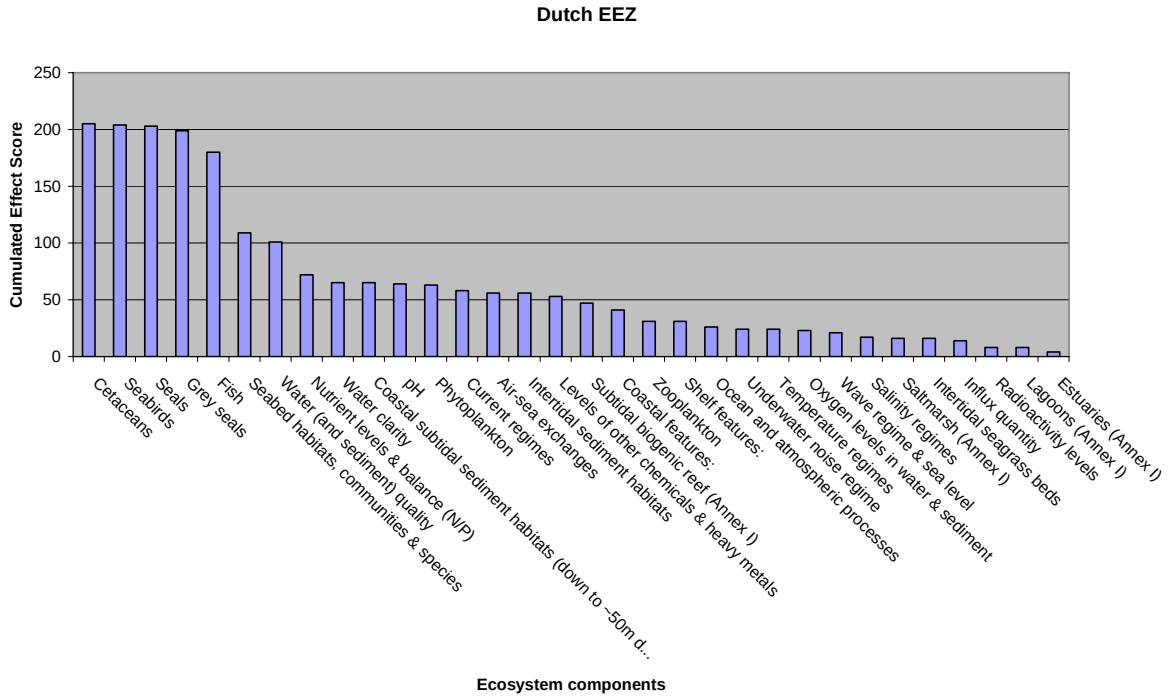


Figure 4. Overview of all ecosystem components ordered by their overall sensitivity for the impacts at the Dutch EEZ. In order to generate this figure; sensitivity classes have been given scores instead of descriptions (none=0; negligible=1; low=2; moderate=4; high=8) and cumulated for each ecosystem component.

In order to be able to compare the outcome of session C with the relative importance of ecosystem component-impact interactions in the OSPAR Matrix, the same figure has been produced based on this information (Figure 5). Roughly the same ecosystem components have been scored as potentially being affected by the impacts, although there are major differences. The highest scores in the Dutch dataset are given to cetaceans, seabirds and seals, whereas these can be found at position 9-12 in the OSPAR Matrix dataset. Furthermore, 'nutrients levels' and 'levels of other chemicals and heavy metals' have also been scored more sensitive to the impacts in the Dutch Matrix. The OSPAR Matrix contains information on a higher level of differentiation; whereas the Dutch expert teams have often provided their score on the highest level, when groups of ecosystem components have been split into subgroups (e.g., seabed habitats, communities and species). The latter is hampering a good comparison when results are presented as cumulated effects scores; as in some cases the top-level of a group of ecosystem indicators has been given an effect score, while in other cases all subgroups have been given an effect score. This needs to be made consistent in the database before an actual cumulative effects assessment can be done (i.e., the sub-groups need to inherit the score of their top-level).

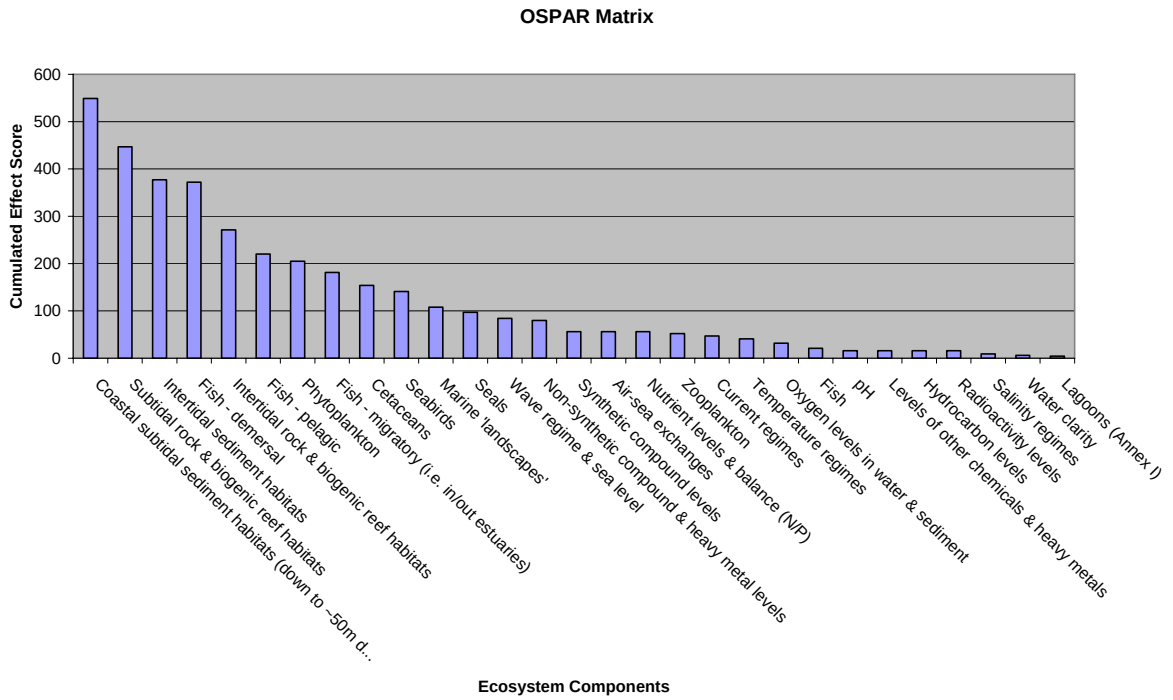


Figure 5. Overview of all ecosystem components ordered by their overall sensitivity for the impacts as scored in the OSPAR Matrix (for comparison with the outcome of the Dutch workshop). In order to generate this figure; sensitivity classes have been given scores instead of descriptions (none=0; negligible=1; low=2; moderate=4; high=8) and cumulated for each ecosystem component.

4.2 Day 2

D. Relevance of impacts per activity

The scoring of the expert teams on the relevance of impacts per activity can be found in Appendix E of this report.

The outcome of this session was most influenced by the lack of good definitions of the impacts. The most obvious is the impact 'removal of non-target species'. Although most expert teams interpreted this impact as 'by-catch' of fisheries activities; in one of the expert teams it was interpreted as the un-intentional physical removal of organisms. Following that interpretation; removal of non-target species is also a relevant impact in activities such as sand and gravel extraction or even land reclamation.

Before further steps in the cumulative effects assessment case study will be taken, a definition of the impacts will be drawn up (and if possible agreed upon on an international level) after which the dataset will be made consistent with that definition.

When comparing the Activity-Impact interactions between the Dutch and the OSPAR Dataset there appear to major differences. These differences are not consistent; for some activities the Dutch dataset contains much more impacts, while for other activities the OSPAR dataset contains more impacts. An example is given in the table below (Table 1).

Table 1. Example (selection of 2 activities from the database) of impacts per activity resulting from the workshop (indicated as NL) and resulting from the OSPAR Matrix (indicated as OSPAR)

Aquaculture	NL	Introduction of microbial pathogens (disease) Introduction or spread of non-indigenous species & translocations (competition) Litter Organic enrichment Siltation rate changes Synthetic compound contamination (inc. pesticides, antifoulants, pharmaceuticals)
	OSPAR	De-oxygenation Habitat change (to another substratum) Habitat structure changes - abrasion & other physical damage Input of nitrogen & phosphorus Introduction of microbial pathogens (disease) Introduction or spread of non-indigenous species & translocations (competition) Litter Non-synthetic compound contamination - Heavy metals, Hydrocarbons (+produced water) Organic enrichment Synthetic compound contamination (inc. pesticides, antifoulants, pharmaceuticals) Visual disturbance (behaviour) Water flow (tidal currents) rate changes - local Wave exposure changes - local
Beach replenishment	NL	Barrier to species movement (behaviour, reproduction) De-oxygenation Emergence regime changes (inc. desiccation) - local Habitat structure changes - abrasion & other physical damage Input of nitrogen & phosphorus Non-synthetic compound contamination - Heavy metals, Hydrocarbons (+produced water) Organic enrichment Removal of non-target species (lethal) Siltation rate changes Underwater noise disturbance (behaviour) Visual disturbance (behaviour) Water flow (tidal currents) rate changes - local Wave exposure changes - local
	OSPAR	Habitat change (to another substratum) Habitat structure changes - abrasion & other physical damage Habitat structure changes - removal of substratum (extraction)

E. Resistance and resilience of ecosystem components for impacts

The scoring of the expert teams on the resistance and resilience of ecosystem components for impacts can be found in Appendix F of this report.

No specific comments can be made on the results of this session as such. The results can, however, be compared with the outcome of session C of the first day in which (generically) the effects of impacts on ecosystem components were assessed. In 8 cases the effects was assessed high in session C, while in this session both resistance and resilience were indicated as 'moderate'. In most of these cases the impact was related to climate change.

This example illustrates the difficulty of a consistent assessment of the effect scores (either directly or through resistance/resilience) and advocates for a good preparation of the workshop (including univocal definitions) and larger size expert teams (app. 8 team members) with good coverage of the required expertise.

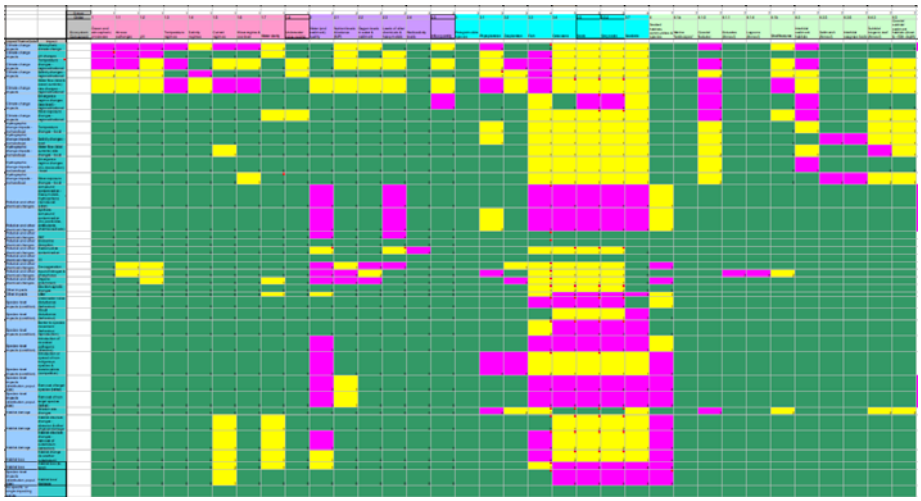


Figure 6. Overview of the matrix based on the outcome of three sessions during the first day of the workshop (prioritization of ecosystem components and impacts and expected effects of the interactions)

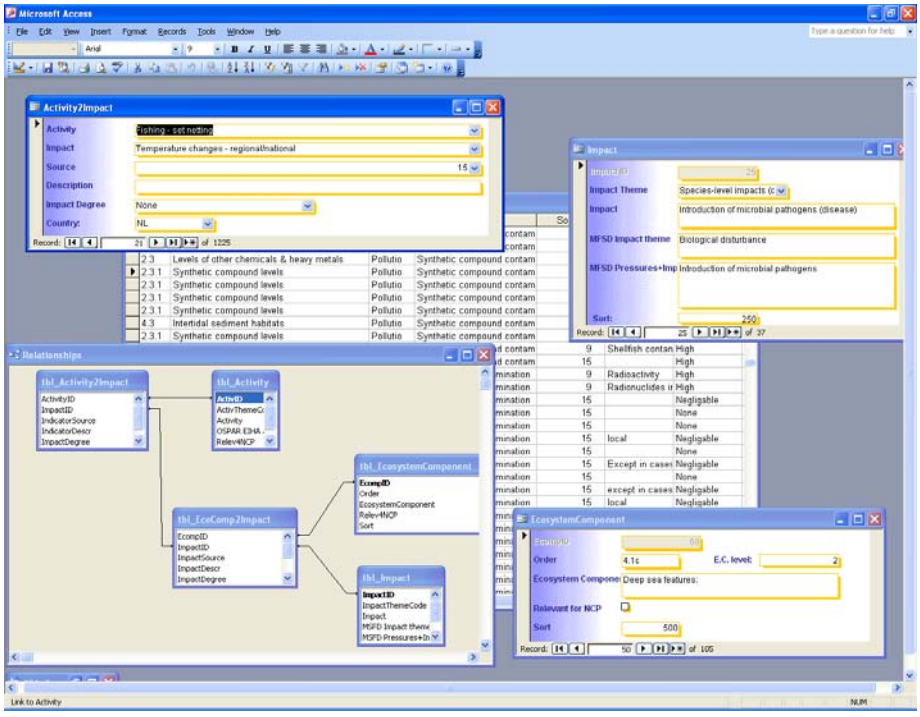


Figure 7. Screenshot of the Microsoft Access database that was developed for transfer of all information from the matrix.

5 Conclusions and recommendations

The main conclusion that can be drawn from the workshop is that it is an excellent way of generating a lot of expert information in a short period of time. Using a workshop, combined with a centralized briefing and facilitation throughout the workshop, provides a good basis for consistency throughout the generation of information.

It must be noted, however, that some factors influenced -in varying extent- the consistency and certainty of the information generated:

- Not all areas of expertise were covered by the experts present in the workshop
- The group of experts varied over the two days, which influenced the continuity
- Expert teams were too small in size; teams should have consisted of 7-9 experts
- Lack of a clear definition of the ecosystem components, impacts and activities
- Lack of a clear reference for the classification of relevance and effect
- Available time was limited, therewith giving the experts the feeling of the need to rush through the sessions
- There was no time for a 'cross-check' of session results by other expert teams (which could have increased consistency)

During the preparation of the workshop, the use of a computer linked 'voting-system' was considered. Although it was decided not to use such a facility, some of the workshop participants suggested that it could have been a valuable approach; provided that it is combined with enough room for discussion. For a next workshop, a combination of the current setup (based on discussion) with a voting system should be considered.

In the table below an overview is given of the main comments given by the workshop participants during the daily evaluation sessions.

Table 2. Comments of the workshop participants from the evaluation session at the end of both workshop days

Scale differences have a considerable influence on the complexity of discussions
Interesting cross-over between marine and freshwater environments
Valuable discussions, little conflicting positions
Not all required expertise was present during the workshop; leading to over- or underattention for certain topics
A clear definition of the ecosystem components, activities and impact in the matrix was lacking and therewith sometimes hampering the discussion
The seemingly endless matrix is workable when dealt with in clear subsets
Matrix contents could have been preliminary filled by the experts 'at home' (office/institutes) for a better discussion in the workshop
Better consistency between subgroups (composition, understanding of criteria and definitions) would have improved the outcome of the workshop
In a stepwise approach, make sure that participants are available throughout the workshop to maintain consistency

6 Future work

The workshop should be regarded as a first step in two processes that will run in parallel. The outcome of session C (effects of impacts on ecosystem components) will be used as a starting point for the identification of indicators to be used in the MSFD process (Initial Assessment and Good Environmental Status). The total set of information will be further used for the case study on Cumulative Effects Assessment (CEA), carried out in the context of OSPAR (ICG-C, BA-6 and Ch11); aiming at presentation in the Quality Status Report 2010.

Before further processing for CEA case study, the data will be validated. Subsets of the information (as presented in the appendices in this report) will be sent to experts that were not present during the workshop, as well as some that were present in order to provide a crosscheck of generated information. The combined results will be used as the starting point for further analysis.

The main step in the further analysis is to implement the information in a Geographical Information System (GIS) in order to include the spatial distribution of ecosystem components and impacts. In parallel, one or more methods to cumulate effects over ecosystem components will be developed and subsequently implemented in the GIS to produce maps and tables as the final products of the CEA case study.

Justification

Rapport C060/08
Project Number: 199.75015.01

The scientific quality of this report has been peer reviewed by a colleague scientist and the head of the department of Wageningen IMARES.

Approved: N.H.B.M. Kaag
Scientist

Signature: 

Date: September 5, 2008

Approved: Drs. J.H.M. Schobben
Head Department Environment

Signature: 

Date: September 5, 2008

Appendix A. Workshop participants

Name	Affiliation
Absil, Christine	St de Noordzee
Brasseur, Sophie	IMARES
Broeksma, Waldo	RWS/DNZ
Dijkshoorn, Chris	RWS/DNZ
Dijkstra, Ad	RWS/Waterdienst
Duijts, Rik	RWS/DNZ
Enserink, Lisette	RWS/Waterdienst
Grol, Els van	RWS/DNZ
Jak, Robbert	IMARES
Jonker, Ilze	RWS/Waterdienst
Kabuta, Saa	RWS/Waterdienst
Karman, Chris	IMARES
Kremer, Myra	VenW/DGW
Langenberg, Victor	Deltares
Oosterbaan, Lex	RWS/DNZ
Oterdoom, Harm	RWS/Waterdienst
Pedersen, Morten	LEF centre
Piet, Gerjan	IMARES
Rozenmeijer, Marcel	RWS/Waterdienst
Tacoma, Aart	RWS/DNZ
van der Graaf, Sandra	RWS/Waterdienst

Appendix B. Ecosystem components

Nr	Ecosystem Component	Importance	Remark
1	Ocean and atmospheric processes		
1.1	Air-sea exchanges	high	unclear pressure impact relation
1.2	pH	considerable	wetenschappelijk bewijs, regional importance? Why?
1.3	Temperature regimes	high	
1.4	Salinity regimes	high	discussie tov temperatuur
1.5	Current regimes	high	clear
1.6	Wave regime & sea level	high	clear
1.7	Water clarity	high	biological importance
2	Water (and sediment) quality		Quantity importance exchange seabed watercolumn, grain size distribution
2.1	Nutrient levels & balance (N/P)	high	
2.2	Oxygen levels in water & sediment	high	
2.3	Levels of other chemicals & heavy metals	high	general severe or relative to certain regions, is it still a real problem
2.4	Radioactivity levels	limited	incidents
2.5	influx quantity	high	Dutch coastal sea importance. pressure dredging on suspended material
3.3	Fish	high	populations and communities provide different and complementary information
3.3.1	Fish - pelagic populations	high	Distinguish populations: e.g. herring, mackerel
3.3.2	Fish - demersal populations	high	Distinguish populations: e.g. cod, haddock, plaice, sole
3.3.3	Fish - sharks, skates & rays	high	Many elasmobranch species occurred in the NL EEZ but disappeared due to fishing. Distinguish different species as some species are more sensitive than others
3.3.4	Fish - deep sea	none	Deep Sea species do not occur in the NL EEZ
3.3.5	Fish - migratory (i.e. in/out estuaries)	high	
3.3.6	Fish communities	high	populations and communities provide different and complementary information
3.4	Cetaceans		
3.4.1	Balleen whales	limited	minke whale mostly in offshore up until now low numbers in NL
3.4.2	Toothed whales	marginal	only strayers
3.4.3	Dolphins	high	dolphins and porpoise should be separated because they occupy different habitats, e.g offshore versus inshore/coastal
3.5.1	Harbour Seals	high	harbour and grey seals need to be distinguished because relative importance in NL EEZ
3.4.4	porpoises	high	dolphins and porpoise should be separated because they occupy different habitats, e.g offshore versus inshore/coastal

Nr	Ecosystem Component	Importance	Remark
3.5.2	grey seals	high	harbour and grey seals need to be distinguished because relative importance in NL EEZ
3.6	Turtles	none	
3.7	Seabirds	high	Not enough expertise
3.7.1	Seabirds Benthic feeders	high	Distinguish between benthic and pelagic feeders, also local versus migratory birds?
3.7.3	Waders	high	Waders?
3.7.2	Seabirds Pelagic feeders	high	Distinguish between benthic and pelagic feeders, also local versus migratory birds?
3.7.4	Migratory birds	high	
4.3.3	Intertidal mud (Annex I, OSPAR List)	high	
4.3.4	Intertidal mixed sediment (UK BAP)	none	Not present
4.3.5	Saltmarsh (Annex I)	considerable	
4.3.6	Intertidal seagrass beds	limited	
4.4	Subtidal rock & biogenic reef habitats		
4.4.1	Subtidal photic rock (Annex I)	none	
4.4.2	Subtidal aphotic rock (Annex I)	none	
4.4.3	Subtidal biogenic reef (Annex I)	considerable	
4.5	Coastal subtidal sediment habitats (down to ~50m depth)		
4.5.1	Coastal gravel/coarse sediment	high	Cleaver bank, etc
4.5.2	Coastal sand	high	
4.5.3	Coastal mud	high	Oyster grounds, Frisian front
4.5.4	Coastal mixed sediment	none	? Needed or not?
4.5.5	Macrophyte-dominated subtidal sediment	none	
4.6	Shelf seabed habitats (~50-200m)		
4.6.1	Shelf gravel/coarse sediment	none	
4.6.2	Shelf sand	none	
4.6.3	Shelf mud	none	
4.6.4	Shelf mixed sediment	none	
4.7	Deep seabed habitats		
4.7.1	Deep-sea rock (Annex I)	none	
4.7.2	Deep-sea biogenic reef (Annex I)	none	
4.7.3	Deep-sea sediment	none	
4.7.4	Deep-sea vents & seeps	none	

Appendix C. Impacts

Impact Theme Code	Impact	Importance	Remark
Climate change impacts	Atmospheric climate change	high	Changing composition
Climate change impacts	pH changes	high	
Climate change impacts	Temperature changes - regional/national	high	
Climate change impacts	Salinity changes - regional/national	high	depending on level of change, influx from rivers
Climate change impacts	Water flow (tidal & ocean currents) rate changes - regional/national	high	
Climate change impacts	Emergence regime changes (sea level) - regional/national	limited	safety related, possible relation with overall system's productivity
Climate change impacts	Wave exposure changes - regional/national	marginal	
Hydrographic change impacts - inshore/local	Temperature changes - local	limited	Very locally determined, no influence on wider ecosystem, locally important (would influence scoring)
Hydrographic change impacts - inshore/local	Salinity changes - local	limited	Very locally determined, no influence on wider ecosystem, locally important (would influence scoring)
Hydrographic change impacts - inshore/local	Water flow (tidal currents) rate changes - local	marginal	???
Hydrographic change impacts - inshore/local	Emergence regime changes (inc. desiccation) - local	limited	safety related, possible relation with overall system's productivity
Hydrographic change impacts - inshore/local	Wave exposure changes - local	marginal	
Pollution and other chemical changes	Non-synthetic compound contamination - Heavy metals, Hydrocarbons (+produced water)	limited	Under control, long term effects unknown, accidents may have large impact
Pollution and other chemical changes	Synthetic compound contamination (inc. pesticides, antifoulants, pharmaceuticals)	limited	NCS is a sink, specific compounds may have impact
Pollution and other chemical changes	Radionuclide contamination	marginal	
Pollution and other chemical changes	??		
Pollution and other chemical changes	De-oxygenation	limited	May also have some positive impact
Pollution and other chemical changes	Input of nitrogen & phosphorus	considerable	
Pollution and other chemical changes	Organic enrichment	limited	Local effects

Impact Theme Code	Impact	Importance	Remark
Other impacts	Electromagnetic changes	considerable	Potentially important, local scale, effect unknown
Other impacts	Litter	high	Distinguish between types/sources of litter (e.g. netting, micro-plastics)
Species-level impacts (condition)	Underwater noise disturbance (behaviour)	high	Effects largely unknown
Species-level impacts (condition)	Visual disturbance (behaviour)	considerable	
Species-level impacts (condition)	Barrier to species movement (behaviour, reproduction)	high	We considered a shipping lane also a barrier
Species-level impacts (condition)	Introduction of microbial pathogens (disease)	limited	
Species-level impacts (condition)	Introduction or spread of non-indigenous species & translocations (competition)	high	We considered both Intentional and accidental
Species-level impacts (distribution, popul. size)	Removal of target species (lethal)	high	
Species-level impacts (distribution, popul. size)	Removal of non-target species (lethal)	high	
Species-level impacts (distribution, popul. size)	Habitat loss/ damage	high	
Habitat damage	Siltation rate changes	high	Especially in water column
Habitat damage	Habitat structure changes - abrasion & other physical damage		
Habitat damage	Habitat structure changes - removal of substratum (extraction)	limited	Future increase due to adaptation to sea level rise
Habitat loss	Habitat change (to another substratum)	limited	Man-made structures, limited geographic extent
Habitat loss	Habitat loss (to land)	high	Maasvlakte 2, future coastal extension

Appendix D. Sensitivity of ecosystem components per impact

Order	Ecosystem Component	Impact	Effect	Comment
1	Ocean and atmospheric processes	Water flow (tidal & ocean currents) rate changes - regional/national	Low	
1	Ocean and atmospheric processes	Temperature changes - regional/national	High	resilience: not sure
1	Ocean and atmospheric processes	Salinity changes - regional/national	Low	
1	Ocean and atmospheric processes	Atmospheric climate change	High	resilience: considering time scales for recovery
1	Ocean and atmospheric processes	pH changes	High	balance, chemistry, stochiometry
1.1	Air-sea exchanges	Input of nitrogen & phosphorus	Negligible	
1.1	Air-sea exchanges	Temperature changes - regional/national	High	Resilience: not sure
1.1	Air-sea exchanges	De-oxygenation	Negligible	
1.1	Air-sea exchanges	Salinity changes - regional/national	Negligible	
1.1	Air-sea exchanges	Water flow (tidal & ocean currents) rate changes - regional/national	Negligible	
1.1	Air-sea exchanges	pH changes	High	
1.1	Air-sea exchanges	Atmospheric climate change	High	resilience: considering time scales for recovery
1.2	pH	Temperature changes - regional/national	Negligible	
1.2	pH	pH changes	High	Resilience: not relevant
1.2	pH	De-oxygenation	Negligible	
1.2	pH	Atmospheric climate change	High	
1.2	pH	Input of nitrogen & phosphorus	Negligible	
1.2	pH	Water flow (tidal & ocean currents) rate changes - regional/national	Negligible	
1.2	pH	Organic enrichment	Negligible	
1.2	pH	Salinity changes - regional/national	Negligible	
1.3	Temperature regimes	Temperature changes - regional/national	High	resistance: not relevant
1.3	Temperature regimes	Atmospheric climate change	High	
1.3	Temperature regimes	Water flow (tidal & ocean currents) rate changes - regional/national	High	
1.4	Salinity regimes	Water flow (tidal & ocean currents) rate changes - regional/national	Low	

Order	Ecosystem Component	Impact	Effect	Comment
1.4	Salinity regimes	Atmospheric climate change	Negligible	
1.4	Salinity regimes	Salinity changes - regional/national	High	Resistance: not relevant
1.5	Current regimes	Water flow (tidal currents) rate changes - local	Negligible	
1.5	Current regimes	Water flow (tidal & ocean currents) rate changes - regional/national	High	Resistance: not relevant
1.5	Current regimes	Temperature changes - regional/national	Low	
1.5	Current regimes	Habitat structure changes - abrasion & other physical damage	Negligible	
1.5	Current regimes	Atmospheric climate change	High	
1.5	Current regimes	Habitat loss/ damage	Negligible	
1.5	Current regimes	Habitat structure changes - removal of substratum (extraction)	Negligible	
1.5	Current regimes	Habitat loss (to land)	Low	
1.5	Current regimes	Habitat change (to another substratum)	Negligible	
1.6	Wave regime & sea level	Atmospheric climate change	High	
1.6	Wave regime & sea level	Temperature changes - regional/national	Low	
1.6	Wave regime & sea level	Water flow (tidal currents) rate changes - local	Negligible	
1.6	Wave regime & sea level	Water flow (tidal & ocean currents) rate changes - regional/national	Moderate	
1.7	Water clarity	Atmospheric climate change	Low	
1.7	Water clarity	Wave exposure changes - regional/national	Negligible	
1.7	Water clarity	Habitat structure changes - abrasion & other physical damage	Negligible	
1.7	Water clarity	Habitat loss (to land)	Negligible	
1.7	Water clarity	Organic enrichment	Negligible	
1.7	Water clarity	Habitat change (to another substratum)	Negligible	
1.7	Water clarity	pH changes	Negligible	
1.7	Water clarity	Litter	Negligible	
1.7	Water clarity	Habitat structure changes - removal of substratum (extraction)	Negligible	
2	Water (and sediment) quality	Habitat structure changes - removal of substratum (extraction)	Moderate	Resistance: local only
2	Water (and sediment) quality	Litter	Low	
2	Water (and sediment) quality	De-oxygenation	High	
2	Water (and sediment) quality	Introduction or spread of non-indigenous species & translocations (competition)	Moderate	

Order	Ecosystem Component	Impact	Effect	Comment
2	Water (and sediment) quality	Organic enrichment	High	
2	Water (and sediment) quality	Radionuclide contamination	Negligible	except in cases of accidents
2	Water (and sediment) quality	Input of nitrogen & phosphorus	High	
2	Water (and sediment) quality	Synthetic compound contamination (inc. pesticides, antifoulants, pharmaceuticals)	High	
2	Water (and sediment) quality	Removal of non-target species (lethal)	Moderate	
2	Water (and sediment) quality	PBT	High	
2	Water (and sediment) quality	Habitat change (to another substratum)	Negligible	
2	Water (and sediment) quality	Removal of target species (lethal)	Moderate	
2	Water (and sediment) quality	Non-synthetic compound contamination - Heavy metals, Hydrocarbons (+produced water)	High	
2	Water (and sediment) quality	Habitat loss (to land)	Negligible	
2	Water (and sediment) quality	Introduction of microbial pathogens (disease)	Moderate	
2	Water (and sediment) quality	Water flow (tidal & ocean currents) rate changes - regional/national	Negligible	
2.1	Nutrient levels & balance (N/P)	Removal of target species (lethal)	Negligible	
2.1	Nutrient levels & balance (N/P)	Temperature changes - regional/national	Negligible	
2.1	Nutrient levels & balance (N/P)	Removal of non-target species (lethal)	Negligible	
2.1	Nutrient levels & balance (N/P)	Atmospheric climate change	Negligible	
2.1	Nutrient levels & balance (N/P)	De-oxygenation	Negligible	
2.1	Nutrient levels & balance (N/P)	Input of nitrogen & phosphorus	High	
2.1	Nutrient levels & balance (N/P)	Water flow (tidal & ocean currents) rate changes - regional/national	Negligible	
2.1	Nutrient levels & balance (N/P)	Organic enrichment	High	
2.1	Nutrient levels & balance (N/P)	pH changes	Negligible	
2.2	Oxygen levels in water & sediment	Input of nitrogen & phosphorus	Low	
2.2	Oxygen levels in water & sediment	Organic enrichment	Moderate	
2.2	Oxygen levels in water & sediment	De-oxygenation	High	

Order	Ecosystem Component	Impact	Effect	Comment
2.2	Oxygen levels in water & sediment	Water flow (tidal & ocean currents) rate changes - regional/national	Negligible	
2.2	Oxygen levels in water & sediment	Temperature changes - regional/national	Low	
2.2	Oxygen levels in water & sediment	Atmospheric climate change	Low	
2.3	Levels of other chemicals & heavy metals	De-oxygenation	Moderate	
2.3	Levels of other chemicals & heavy metals	Radionuclide contamination	Negligible	Except in cases of accidents
2.3	Levels of other chemicals & heavy metals	Synthetic compound contamination (inc. pesticides, antifoulants, pharmaceuticals)	High	
2.3	Levels of other chemicals & heavy metals	Non-synthetic compound contamination - Heavy metals, Hydrocarbons (+produced water)	High	
2.3	Levels of other chemicals & heavy metals	Temperature changes - regional/national	Negligible	
2.3	Levels of other chemicals & heavy metals	pH changes	Low	
2.3	Levels of other chemicals & heavy metals	Water flow (tidal & ocean currents) rate changes - regional/national	Negligible	
2.3	Levels of other chemicals & heavy metals	PBT	High	
2.4	Radioactivity levels	Radionuclide contamination	High	
3.1	Phytoplankton	Temperature changes - local	Negligible	
3.1	Phytoplankton	Salinity changes - regional/national	Negligible	unknown
3.1	Phytoplankton	Synthetic compound contamination (inc. pesticides, antifoulants, pharmaceuticals)	Low	
3.1	Phytoplankton	Siltation rate changes	High	
3.1	Phytoplankton	Input of nitrogen & phosphorus	High	
3.1	Phytoplankton	pH changes	Low	
3.1	Phytoplankton	Water flow (tidal & ocean currents) rate changes - regional/national	Moderate	
3.1	Phytoplankton	Introduction or spread of non-indigenous species & translocations (competition)	High	
3.1	Phytoplankton	Atmospheric climate change	High	
3.1	Phytoplankton	Temperature changes - regional/national	Low	
3.1	Phytoplankton	Salinity changes - local	Negligible	
3.2	Zooplankton	Organic enrichment	Moderate	
3.2	Zooplankton	De-oxygenation	Negligible	
3.2	Zooplankton	Temperature changes - regional/national	High	
3.2	Zooplankton	Water flow (tidal & ocean currents) rate changes - regional/national	Low	

Order	Ecosystem Component	Impact	Effect	Comment
3.2	Zooplankton	Introduction or spread of non-indigenous species & translocations (competition)	High	
3.2	Zooplankton	Siltation rate changes	Low	
3.2	Zooplankton	Salinity changes - regional/national	Low	
3.3	Fish	Water flow (tidal currents) rate changes - local	Negligible	
3.3	Fish	Removal of target species (lethal)	High	
3.3	Fish	Introduction of microbial pathogens (disease)	Moderate	
3.3	Fish	Salinity changes - local	Negligible	
3.3	Fish	Emergence regime changes (inc. desiccation) - local	Negligible	
3.3	Fish	Temperature changes - local	Negligible	
3.3	Fish	Habitat change (to another substratum)	Negligible	
3.3	Fish	Introduction or spread of non-indigenous species & translocations (competition)	Low	has yet to occur
3.3	Fish	pH changes	High	
3.3	Fish	Habitat loss (to land)	Negligible	local
3.3	Fish	Wave exposure changes - local	Negligible	
3.3	Fish	Radionuclide contamination	Negligible	
3.3	Fish	De-oxygenation	Low	not often occurs, important if current
3.3	Fish	Wave exposure changes - regional/national	Negligible	
3.3	Fish	Non-synthetic compound contamination - Heavy metals, Hydrocarbons (+produced water)	Moderate	detailed exp. lacks / different compounds, different effects
3.3	Fish	Removal of non-target species (lethal)	High	
3.3	Fish	Salinity changes - regional/national	High	
3.3	Fish	Temperature changes - regional/national	High	
3.3	Fish	Underwater noise disturbance (behaviour)	Moderate	some species are sensitive, no knowledge on ecosystem level
3.3	Fish	Input of nitrogen & phosphorus	Negligible	effects not direct
3.3	Fish	Organic enrichment	Negligible	local
3.3	Fish	Barrier to species movement (behaviour, reproduction)	Low	indirect via changes in current
3.3	Fish	Emergence regime changes (sea level) - regional/national	Negligible	
3.3	Fish	Litter	Low	
3.3	Fish	Electromagnetic changes	Negligible	local, local, though potential problem

Order	Ecosystem Component	Impact	Effect	Comment
3.3	Fish	Water flow (tidal & ocean currents) rate changes - regional/national	High	
3.3	Fish	Synthetic compound contamination (inc. pesticides, antifoulants, pharmaceuticals)	Moderate	
3.3	Fish	Habitat structure changes - removal of substratum (extraction)	High	ex: gravel beds for herring
3.4	Cetaceans	Salinity changes - regional/national	Low	
3.4	Cetaceans	Removal of target species (lethal)	High	
3.4	Cetaceans	Non-synthetic compound contamination - Heavy metals, Hydrocarbons (+produced water)	High	
3.4	Cetaceans	Habitat structure changes - abrasion & other physical damage	Negligible	indirect
3.4	Cetaceans	Water flow (tidal & ocean currents) rate changes - regional/national	Negligible	indirect
3.4	Cetaceans	pH changes	Negligible	
3.4	Cetaceans	Removal of non-target species (lethal)	High	
3.4	Cetaceans	Habitat loss (to land)	High	
3.4	Cetaceans	Wave exposure changes - regional/national	Negligible	
3.4	Cetaceans	Emergence regime changes (inc. desiccation) - local	Negligible	
3.4	Cetaceans	Habitat change (to another substratum)	Low	lack in knowledge in feeding ecology?
3.4	Cetaceans	Water flow (tidal currents) rate changes - local	Negligible	
3.4	Cetaceans	Salinity changes - local	Negligible	
3.4	Cetaceans	Temperature changes - regional/national	Low	
3.4	Cetaceans	Temperature changes - local	Negligible	
3.4	Cetaceans	Wave exposure changes - local	Negligible	
3.4	Cetaceans	Habitat structure changes - removal of substratum (extraction)	Low	lack in knowledge in feeding ecology?
3.4	Cetaceans	Radionuclide contamination	Negligible	local
3.4	Cetaceans	Habitat loss/ damage	High	
3.4	Cetaceans	Atmospheric climate change	Negligible	
3.4	Cetaceans	Electromagnetic changes	Low	unknown
3.4	Cetaceans	De-oxygenation	Negligible	
3.4	Cetaceans	Barrier to species movement (behaviour, reproduction)	Moderate	lack of data
3.4	Cetaceans	Litter	High	

Order	Ecosystem Component	Impact	Effect	Comment
3.4	Cetaceans	Introduction or spread of non-indigenous species & translocations (competition)	Negligible	
3.4	Cetaceans	Underwater noise disturbance (behaviour)	High	no proof on population level
3.4	Cetaceans	Organic enrichment	Negligible	
3.4	Cetaceans	Visual disturbance (behaviour)	Negligible	
3.4	Cetaceans	Introduction of microbial pathogens (disease)	Moderate	
3.4	Cetaceans	Synthetic compound contamination (inc. pesticides, antifoulants, pharmaceuticals)	High	
3.4	Cetaceans	Input of nitrogen & phosphorus	Negligible	
3.5	Seals	Organic enrichment	Negligible	
3.5	Seals	Wave exposure changes - local	Negligible	
3.5	Seals	Temperature changes - local	Negligible	
3.5	Seals	De-oxygenation	Negligible	
3.5	Seals	Water flow (tidal currents) rate changes - local	Negligible	
3.5	Seals	Barrier to species movement (behaviour, reproduction)	High	Delta area "population"
3.5	Seals	Electromagnetic changes	Low	unknown
3.5	Seals	Introduction of microbial pathogens (disease)	Moderate	
3.5	Seals	Habitat structure changes - removal of substratum (extraction)	Low	lack in knowledge in feeding ecology?
3.5	Seals	Emergence regime changes (sea level) - regional/national	High	haul-out possibilities
3.5	Seals	Temperature changes - regional/national	Low	
3.5	Seals	Emergence regime changes (inc. desiccation) - local	Negligible	
3.5	Seals	Wave exposure changes - regional/national	Low	if affecting haulout
3.5	Seals	Salinity changes - local	Negligible	
3.5	Seals	Habitat change (to another substratum)	Low	lack in knowledge in feeding ecology?
3.5	Seals	Radionuclide contamination	Negligible	local
3.5	Seals	Removal of target species (lethal)	High	
3.5	Seals	Atmospheric climate change	Negligible	
3.5	Seals	Visual disturbance (behaviour)	Negligible	
3.5	Seals	Synthetic compound contamination (inc. pesticides, antifoulants, pharmaceuticals)	High	
3.5	Seals	Underwater noise disturbance (behaviour)	High	no proof on population level
3.5	Seals	Introduction or spread of non-indigenous species & translocations (competition)	Negligible	grey seals?

Order	Ecosystem Component	Impact	Effect	Comment
3.5	Seals	Non-synthetic compound contamination - Heavy metals, Hydrocarbons (+produced water)	High	
3.5	Seals	Input of nitrogen & phosphorus	Negligible	
3.5	Seals	Litter	High	
3.5	Seals	Salinity changes - regional/national	Low	
3.5	Seals	Removal of non-target species (lethal)	High	
3.5	Seals	Habitat structure changes - abrasion & other physical damage	Low	possibly targetting specific habitats
3.5	Seals	pH changes	Negligible	
3.5	Seals	Water flow (tidal & ocean currents) rate changes - regional/national	Negligible	in extreem cases
3.5	Seals	Habitat loss/ damage	High	
3.5	Seals	Habitat loss (to land)	High	
3.7	Seabirds	Emergence regime changes (sea level) - regional/national	Negligible	
3.7	Seabirds	Temperature changes - local	Negligible	
3.7	Seabirds	Temperature changes - regional/national	Negligible	
3.7	Seabirds	Removal of non-target species (lethal)	High	
3.7	Seabirds	Litter	High	
3.7	Seabirds	Siltation rate changes	Negligible	
3.7	Seabirds	Habitat structure changes - abrasion & other physical damage	Negligible	
3.7	Seabirds	Salinity changes - regional/national	Negligible	
3.7	Seabirds	Atmospheric climate change	Negligible	
3.7	Seabirds	Water flow (tidal & ocean currents) rate changes - regional/national	Negligible	
3.7	Seabirds	Barrier to species movement (behaviour, reproduction)	Moderate	
3.7	Seabirds	Wave exposure changes - regional/national	Negligible	
3.7	Seabirds	Non-synthetic compound contamination - Heavy metals, Hydrocarbons (+produced water)	High	
3.7	Seabirds	Water flow (tidal currents) rate changes - local	Negligible	
3.7	Seabirds	Introduction or spread of non-indigenous species & translocations (competition)	Negligible	
3.7	Seabirds	Habitat change (to another substratum)	Negligible	
3.7	Seabirds	Habitat loss/ damage	High	

Order	Ecosystem Component	Impact	Effect	Comment
3.7	Seabirds	pH changes	Negligible	
3.7	Seabirds	Removal of target species (lethal)	High	
3.7	Seabirds	Salinity changes - local	Negligible	
3.7	Seabirds	Wave exposure changes - local	Negligible	
3.7	Seabirds	Emergence regime changes (inc. desiccation) - local	Negligible	
3.7	Seabirds	Visual disturbance (behaviour)	Moderate	
3.7	Seabirds	Habitat loss (to land)	High	
3.7	Seabirds	Synthetic compound contamination (inc. pesticides, antifoulants, pharmaceuticals)	High	
3.7	Seabirds	Habitat structure changes - removal of substratum (extraction)	Negligible	
3.7	Seabirds	Introduction of microbial pathogens (disease)	Moderate	
4	Seabed habitats, communities & species	De-oxygenation	Moderate	
4	Seabed habitats, communities & species	Habitat structure changes - abrasion & other physical damage	High	
4	Seabed habitats, communities & species	Litter	Negligible	
4	Seabed habitats, communities & species	Introduction or spread of non-indigenous species & translocations (competition)	High	
4	Seabed habitats, communities & species	Removal of target species (lethal)	High	
4	Seabed habitats, communities & species	Habitat loss (to land)	High	
4	Seabed habitats, communities & species	Underwater noise disturbance (behaviour)	Negligible	
4	Seabed habitats, communities & species	Non-synthetic compound contamination - Heavy metals, Hydrocarbons (+produced water)	Negligible	
4	Seabed habitats, communities & species	Synthetic compound contamination (inc. pesticides, antifoulants, pharmaceuticals)	Low	
4	Seabed habitats, communities & species	Removal of non-target species (lethal)	High	
4	Seabed habitats, communities & species	Habitat structure changes - removal of substratum (extraction)	High	
4	Seabed habitats, communities & species	Habitat change (to another substratum)	High	
4	Seabed habitats, communities & species	Habitat loss/ damage	High	Habitat loss is included from different impacts
4	Seabed habitats, communities & species	Introduction of microbial pathogens (disease)	Negligible	
4	Seabed habitats, communities & species	Organic enrichment	High	

Order	Ecosystem Component	Impact	Effect	Comment
4.1.0	Coastal features:	Atmospheric climate change	Moderate	
4.1.0	Coastal features:	Wave exposure changes - regional/national	High	
4.1.0	Coastal features:	Salinity changes - regional/national	Low	
4.1.0	Coastal features:	Temperature changes - local	Low	
4.1.0	Coastal features:	Wave exposure changes - local	Low	
4.1.0	Coastal features:	Salinity changes - local	Negligible	
4.1.0	Coastal features:	Water flow (tidal currents) rate changes - local	Low	
4.1.0	Coastal features:	Emergence regime changes (sea level) - regional/national	High	
4.1.0	Coastal features:	Emergence regime changes (inc. desiccation) - local	Low	
4.1.0	Coastal features:	Temperature changes - regional/national	Moderate	sensitivity decreases with depth
4.1.0	Coastal features:	Water flow (tidal & ocean currents) rate changes - regional/national	Moderate	
4.1.1	Estuaries (Annex I)	Input of nitrogen & phosphorus	Moderate	
4.1.4	Lagoons (Annex I)	Input of nitrogen & phosphorus	High	
4.1b	Shelf features:	Salinity changes - regional/national	Negligible	
4.1b	Shelf features:	Siltation rate changes	Low	
4.1b	Shelf features:	Water flow (tidal & ocean currents) rate changes - regional/national	Moderate	
4.1b	Shelf features:	Atmospheric climate change	Negligible	
4.1b	Shelf features:	Input of nitrogen & phosphorus	Low	
4.1b	Shelf features:	Wave exposure changes - regional/national	Negligible	
4.1b	Shelf features:	Temperature changes - regional/national	Low	
4.3	Intertidal sediment habitats	Temperature changes - regional/national	Moderate	
4.3	Intertidal sediment habitats	Salinity changes - regional/national	Negligible	
4.3	Intertidal sediment habitats	Water flow (tidal currents) rate changes - local	Negligible	
4.3	Intertidal sediment habitats	Atmospheric climate change	Moderate	
4.3	Intertidal sediment habitats	Emergence regime changes (inc. desiccation) - local	Moderate	
4.3	Intertidal sediment habitats	Temperature changes - local	Negligible	
4.3	Intertidal sediment habitats	Wave exposure changes - regional/national	Moderate	
4.3	Intertidal sediment habitats	Emergence regime changes (sea level) - regional/national	High	
4.3	Intertidal sediment habitats	Water flow (tidal & ocean currents) rate changes - regional/national	Negligible	
4.3.5	Saltmarsh (Annex I)	Wave exposure changes - local	High	

Order	Ecosystem Component	Impact	Effect	Comment
4.3.5	Saltmarsh (Annex I)	Salinity changes - local	High	
4.3.6	Intertidal seagrass beds	Wave exposure changes - local	High	
4.3.6	Intertidal seagrass beds	Salinity changes - local	High	
4.4.3	Subtidal biogenic reef (Annex I)	Wave exposure changes - regional/national	Low	
4.4.3	Subtidal biogenic reef (Annex I)	Salinity changes - regional/national	Negligible	
4.4.3	Subtidal biogenic reef (Annex I)	Temperature changes - regional/national	Negligible	
4.4.3	Subtidal biogenic reef (Annex I)	Wave exposure changes - local	Low	
4.4.3	Subtidal biogenic reef (Annex I)	Water flow (tidal currents) rate changes - local	Moderate	
4.4.3	Subtidal biogenic reef (Annex I)	Water flow (tidal & ocean currents) rate changes - regional/national	Negligible	
4.4.3	Subtidal biogenic reef (Annex I)	Salinity changes - local	Negligible	
4.4.3	Subtidal biogenic reef (Annex I)	Temperature changes - local	Negligible	
4.4.3	Subtidal biogenic reef (Annex I)	Siltation rate changes	Low	
4.5	Coastal subtidal sediment habitats (down to ~50m depth)	Salinity changes - local	Negligible	
4.5	Coastal subtidal sediment habitats (down to ~50m depth)	Salinity changes - regional/national	Negligible	
4.5	Coastal subtidal sediment habitats (down to ~50m depth)	Water flow (tidal currents) rate changes - local	Negligible	
4.5	Coastal subtidal sediment habitats (down to ~50m depth)	Siltation rate changes	Low	
4.5	Coastal subtidal sediment habitats (down to ~50m depth)	Wave exposure changes - local	Negligible	
4.5	Coastal subtidal sediment habitats (down to ~50m depth)	Water flow (tidal & ocean currents) rate changes - regional/national	Negligible	
4.5	Coastal subtidal sediment habitats (down to ~50m depth)	Temperature changes - local	Negligible	
4.5	Coastal subtidal sediment habitats (down to ~50m depth)	Wave exposure changes - regional/national	Negligible	
4.5	Coastal subtidal sediment habitats (down to ~50m depth)	Temperature changes - regional/national	Negligible	
1.8	Underwater noise regime	Salinity changes - regional/national	Negligible	
1.8	Underwater noise regime	Wave exposure changes - regional/national	Negligible	
1.8	Underwater noise regime	Temperature changes - regional/national	Negligible	

Order	Ecosystem Component	Impact	Effect	Comment
2.5	Influx quantity	Temperature changes - regional/national	Negligible	
2.5	Influx quantity	Emergence regime changes (sea level) - regional/national	Moderate	
2.5	Influx quantity	Water flow (tidal & ocean currents) rate changes - regional/national	Low	
2.5	Influx quantity	Atmospheric climate change	Low	
3.5.2	Grey seals	De-oxygenation	Negligible	
3.5.2	Grey seals	Removal of target species (lethal)	High	
3.5.2	Grey seals	Radionuclide contamination	Negligible	local
3.5.2	Grey seals	Underwater noise disturbance (behaviour)	High	no proof on population level
3.5.2	Grey seals	Visual disturbance (behaviour)	Negligible	
3.5.2	Grey seals	Introduction or spread of non-indigenous species & translocations (competition)	Negligible	
3.5.2	Grey seals	Litter	High	
3.5.2	Grey seals	Introduction of microbial pathogens (disease)	Moderate	
3.5.2	Grey seals	Synthetic compound contamination (inc. pesticides, antifoulants, pharmaceuticals)	High	
3.5.2	Grey seals	Input of nitrogen & phosphorus	Negligible	
3.5.2	Grey seals	Electromagnetic changes	Low	unknown
3.5.2	Grey seals	Habitat loss/ damage	High	
3.5.2	Grey seals	Organic enrichment	Negligible	
3.5.2	Grey seals	Barrier to species movement (behaviour, reproduction)	Moderate	lack of data
3.5.2	Grey seals	Atmospheric climate change	Negligible	
3.5.2	Grey seals	Salinity changes - local	Negligible	
3.5.2	Grey seals	Salinity changes - regional/national	Low	
3.5.2	Grey seals	Water flow (tidal & ocean currents) rate changes - regional/national	Negligible	in extreem cases
3.5.2	Grey seals	Emergence regime changes (sea level) - regional/national	High	haul-out possibilities pupping
3.5.2	Grey seals	Removal of non-target species (lethal)	High	
3.5.2	Grey seals	Wave exposure changes - regional/national	Low	if affecting haulout
3.5.2	Grey seals	Temperature changes - local	Negligible	
3.5.2	Grey seals	pH changes	Negligible	
3.5.2	Grey seals	Habitat structure changes - removal of substratum (extraction)	Low	lack in knowledge in feeding ecology?
3.5.2	Grey seals	Habitat loss (to land)	High	
3.5.2	Grey seals	Water flow (tidal currents) rate changes - local	Negligible	
3.5.2	Grey seals	Emergence regime changes (inc. desiccation) - local	Negligible	

Order	Ecosystem Component	Impact	Effect	Comment
3.5.2	Grey seals	Habitat change (to another substratum)	Low	lack in knowledge in feeding ecology?
3.5.2	Grey seals	Wave exposure changes - local	Negligible	
3.5.2	Grey seals	Habitat structure changes - abrasion & other physical damage	Low	possibly targeting specific habitats
3.5.2	Grey seals	Non-synthetic compound contamination - Heavy metals, Hydrocarbons (+produced water)	High	
3.5.2	Grey seals	Temperature changes - regional/national	Low	

Appendix E. Importance of impact per activity

Activity	Impact	Relevance	Comment
Energy production - at sea (wind & wave turbines)	Water flow (tidal currents) rate changes - local	Negligible	
Energy production - at sea (wind & wave turbines)	Wave exposure changes - local	Negligible	
Energy production - at sea (wind & wave turbines)	Non-synthetic compound contamination - Heavy metals, Hydrocarbons (+produced water)	Negligible	zinc anodes for corrosion inhibition
Energy production - at sea (wind & wave turbines)	Electromagnetic changes	Negligible	
Energy production - at sea (wind & wave turbines)	Underwater noise disturbance (behaviour)	Moderate	
Energy production - at sea (wind & wave turbines)	Visual disturbance (behaviour)	High	
Energy production - at sea (wind & wave turbines)	Barrier to species movement (behaviour, reproduction)	High	
Energy production - at sea (wind & wave turbines)	Introduction or spread of non-indigenous species & translocations (competition)	Low	
Energy production - at sea (wind & wave turbines)	Habitat change (to another substratum)	High	
Energy production - on land (power stations, inc. nuclear)	Temperature changes - local	Moderate	
Energy production - on land (power stations, inc. nuclear)	Synthetic compound contamination (inc. pesticides, antifoulants, pharmaceuticals)	Negligible	Treatment of cooling water may form organohalogens
Energy production - on land (power stations, inc. nuclear)	PBT	Negligible	Treatment of cooling water may form organohalogens
Energy production - on land (power stations, inc. nuclear)	Radionuclide contamination	Low	
Extraction - maerl	Visual disturbance (behaviour)	Low	
Extraction - navigational dredging (capital, maintenance)	Water flow (tidal currents) rate changes - local	Negligible	
Extraction - navigational dredging (capital, maintenance)	Emergence regime changes (inc. desiccation) - local	Negligible	
Extraction - navigational dredging (capital, maintenance)	Wave exposure changes - local	Negligible	
Extraction - navigational dredging (capital, maintenance)	Non-synthetic compound contamination - Heavy metals, Hydrocarbons (+produced water)	Moderate	respuspension and remobilisation
Extraction - navigational dredging (capital, maintenance)	Synthetic compound contamination (inc. pesticides, antifoulants, pharmaceuticals)	Moderate	resuspension and remobilisation
Extraction - navigational dredging (capital, maintenance)	PBT	Moderate	resuspension and remobilisation

Activity	Impact	Relevance	Comment
Extraction - navigational dredging (capital, maintenance)	Endocrine disruption	Moderate	resuspension and remobilisation
Extraction - navigational dredging (capital, maintenance)	De-oxygenation	Negligible	
Extraction - navigational dredging (capital, maintenance)	Input of nitrogen & phosphorus	Moderate	
Extraction - navigational dredging (capital, maintenance)	Organic enrichment	Moderate	
Extraction - navigational dredging (capital, maintenance)	Underwater noise disturbance (behaviour)	Moderate	
Extraction - navigational dredging (capital, maintenance)	Siltation rate changes	Low	
Extraction - navigational dredging (capital, maintenance)	Habitat structure changes - abrasion & other physical damage	Negligible	
Extraction - navigational dredging (capital, maintenance)	Habitat structure changes - removal of substratum (extraction)	Negligible	
Extraction - navigational dredging (capital, maintenance)	Habitat change (to another substratum)	Negligible	
Extraction - oil & gas	Temperature changes - local	Low	
Extraction - oil & gas	Salinity changes - local	Negligible	
Extraction - oil & gas	Emergence regime changes (inc. desiccation) - local	Negligible	Subsidance from gas production may lead to changes
Extraction - oil & gas	Non-synthetic compound contamination - Heavy metals, Hydrocarbons (+produced water)	Moderate	
Extraction - oil & gas	Synthetic compound contamination (inc. pesticides, antifoulants, pharmaceuticals)	Negligible	
Extraction - oil & gas	PBT	Moderate	
Extraction - oil & gas	Endocrine disruption	Negligible	
Extraction - oil & gas	Radionuclide contamination	Negligible	
Extraction - oil & gas	Underwater noise disturbance (behaviour)	Low	
Extraction - oil & gas	Visual disturbance (behaviour)	High	
Extraction - oil & gas	Barrier to species movement (behaviour, reproduction)	Low	
Extraction - oil & gas	Introduction or spread of non-indigenous species & translocations (competition)	Low	
Extraction - oil & gas	Siltation rate changes	Negligible	
Extraction - oil & gas	Habitat structure changes - abrasion & other physical damage	Negligible	

Activity	Impact	Relevance	Comment
Extraction - oil & gas	Habitat structure changes - removal of substratum (extraction)	Negligible	
Extraction - oil & gas	Habitat change (to another substratum)	High	very local
Extraction - sand & gravel	Water flow (tidal currents) rate changes - local	Negligible	
Extraction - sand & gravel	Non-synthetic compound contamination - Heavy metals, Hydrocarbons (+produced water)	Negligible	
Extraction - sand & gravel	De-oxygenation	Negligible	Deep dredging
Extraction - sand & gravel	Input of nitrogen & phosphorus	Negligible	
Extraction - sand & gravel	Organic enrichment	Negligible	
Extraction - sand & gravel	Underwater noise disturbance (behaviour)	Low	
Extraction - sand & gravel	Visual disturbance (behaviour)	Low	
Extraction - sand & gravel	Barrier to species movement (behaviour, reproduction)	Low	
Extraction - sand & gravel	Removal of non-target species (lethal)	High	
Extraction - sand & gravel	Siltation rate changes	High	
Extraction - sand & gravel	Habitat structure changes - abrasion & other physical damage	Moderate	
Extraction - sand & gravel	Habitat structure changes - removal of substratum (extraction)	High	
Extraction - sand & gravel	Habitat change (to another substratum)	Negligible	
Harvesting - seaweed	Water flow (tidal currents) rate changes - local	Negligible	
Harvesting - seaweed	Wave exposure changes - local	Negligible	
Harvesting - seaweed	Organic enrichment	Negligible	
Fishing - benthic trawling	Input of nitrogen & phosphorus	Negligible	
Fishing - benthic trawling	Organic enrichment	Negligible	
Fishing - benthic trawling	Litter	Moderate	lost nets and shipping material
Fishing - benthic trawling	Underwater noise disturbance (behaviour)	Moderate	
Fishing - benthic trawling	Visual disturbance (behaviour)	Low	
Fishing - benthic trawling	Removal of target species (lethal)	High	
Fishing - benthic trawling	Removal of non-target species (lethal)	High	
Fishing - benthic trawling	Siltation rate changes	High	
Fishing - benthic trawling	Habitat structure changes - abrasion & other physical damage	High	
Fishing - benthic trawling	Habitat structure changes - removal of substratum (extraction)	Low	

Activity	Impact	Relevance	Comment
Fishing - hydraulic dredging	Input of nitrogen & phosphorus	Negligible	
Fishing - hydraulic dredging	Organic enrichment	Negligible	
Fishing - hydraulic dredging	Litter	Negligible	
Fishing - hydraulic dredging	Underwater noise disturbance (behaviour)	Moderate	
Fishing - hydraulic dredging	Visual disturbance (behaviour)	Low	
Fishing - hydraulic dredging	Removal of target species (lethal)	High	
Fishing - hydraulic dredging	Removal of non-target species (lethal)	Low	
Fishing - hydraulic dredging	Siltation rate changes	High	
Fishing - hydraulic dredging	Habitat structure changes - abrasion & other physical damage	High	
Fishing - hydraulic dredging	Habitat structure changes - removal of substratum (extraction)	Low	
Fishing - pelagic trawling	Litter	Low	lost nets and shipping material + waste
Fishing - pelagic trawling	Underwater noise disturbance (behaviour)	Moderate	
Fishing - pelagic trawling	Removal of target species (lethal)	High	
Fishing - pelagic trawling	Removal of non-target species (lethal)	Moderate	
Fishing - potting/creeling	Organic enrichment	Negligible	
Fishing - potting/creeling	Litter	Negligible	
Fishing - potting/creeling	Underwater noise disturbance (behaviour)	Negligible	
Fishing - potting/creeling	Removal of target species (lethal)	High	
Fishing - potting/creeling	Removal of non-target species (lethal)	Negligible	
Fishing - recreational	Litter	Negligible	
Fishing - recreational	Underwater noise disturbance (behaviour)	Negligible	
Fishing - recreational	Removal of target species (lethal)	Low	
Fishing - set netting	Litter	Low	lost nets and shipping material
Fishing - set netting	Underwater noise disturbance (behaviour)	Negligible	
Fishing - set netting	Visual disturbance (behaviour)	Moderate	
Fishing - set netting	Barrier to species movement (behaviour, reproduction)	Moderate	
Fishing - set netting	Removal of target species (lethal)	High	
Fishing - set netting	Removal of non-target species (lethal)	Low	
Fishing - shellfish harvesting	Input of nitrogen & phosphorus	Negligible	
Fishing - shellfish harvesting	Organic enrichment	Negligible	
Fishing - shellfish harvesting	Litter	Negligible	

Activity	Impact	Relevance	Comment
Fishing - shellfish harvesting	Underwater noise disturbance (behaviour)	Moderate	
Fishing - shellfish harvesting	Visual disturbance (behaviour)	Low	
Fishing - shellfish harvesting	Removal of target species (lethal)	High	
Fishing - shellfish harvesting	Removal of non-target species (lethal)	Negligible	
Fishing - shellfish harvesting	Siltation rate changes	High	
Fishing - shellfish harvesting	Habitat structure changes - abrasion & other physical damage	High	
Fishing - shellfish harvesting	Habitat structure changes - removal of substratum (extraction)	Low	
Fishing - shellfish harvesting	Habitat change (to another substratum)	High	
Aquaculture	Synthetic compound contamination (inc. pesticides, antifoulants, pharmaceuticals)	Moderate	
Aquaculture	Organic enrichment	Moderate	
Aquaculture	Litter	Negligible	
Aquaculture	Introduction of microbial pathogens (disease)	Moderate	
Aquaculture	Introduction or spread of non-indigenous species & translocations (competition)	Moderate	
Aquaculture	Siltation rate changes	Negligible	
Beach replenishment	Water flow (tidal currents) rate changes - local	Low	
Beach replenishment	Emergence regime changes (inc. desiccation) - local	High	
Beach replenishment	Wave exposure changes - local	High	
Beach replenishment	Non-synthetic compound contamination - Heavy metals, Hydrocarbons (+produced water)	Negligible	
Beach replenishment	De-oxygenation	Negligible	Deep dredging
Beach replenishment	Input of nitrogen & phosphorus	Negligible	
Beach replenishment	Organic enrichment	Negligible	
Beach replenishment	Underwater noise disturbance (behaviour)	Moderate	
Beach replenishment	Visual disturbance (behaviour)	High	
Beach replenishment	Barrier to species movement (behaviour, reproduction)	High	
Beach replenishment	Removal of non-target species (lethal)	High	
Beach replenishment	Siltation rate changes	High	
Beach replenishment	Habitat structure changes - abrasion & other physical damage	High	
Infrastructure - cables & pipelines	Non-synthetic compound contamination - Heavy metals, Hydrocarbons (+produced water)	Negligible	corrosion protection, zinc anodes

Activity	Impact	Relevance	Comment
Infrastructure - cables & pipelines	Electromagnetic changes	High	
Infrastructure - cables & pipelines	Underwater noise disturbance (behaviour)	Low	
Infrastructure - cables & pipelines	Habitat structure changes - abrasion & other physical damage	Low	
Infrastructure - coastal (ports, marinas, leisure facilities)	Water flow (tidal currents) rate changes - local	Negligible	
Infrastructure - coastal (ports, marinas, leisure facilities)	Emergence regime changes (inc. desiccation) - local	Negligible	
Infrastructure - coastal (ports, marinas, leisure facilities)	Wave exposure changes - local	Low	
Infrastructure - coastal (ports, marinas, leisure facilities)	Non-synthetic compound contamination - Heavy metals, Hydrocarbons (+produced water)	Low	
Infrastructure - coastal (ports, marinas, leisure facilities)	Synthetic compound contamination (inc. pesticides, antifoulants, pharmaceuticals)	Low	
Infrastructure - coastal (ports, marinas, leisure facilities)	PBT	Low	
Infrastructure - coastal (ports, marinas, leisure facilities)	Endocrine disruption	Low	
Infrastructure - coastal (ports, marinas, leisure facilities)	Input of nitrogen & phosphorus	Negligible	
Infrastructure - coastal (ports, marinas, leisure facilities)	Organic enrichment	Negligible	
Infrastructure - coastal (ports, marinas, leisure facilities)	Underwater noise disturbance (behaviour)	High	
Infrastructure - coastal (ports, marinas, leisure facilities)	Visual disturbance (behaviour)	High	
Infrastructure - coastal (ports, marinas, leisure facilities)	Barrier to species movement (behaviour, reproduction)	High	
Infrastructure - coastal (ports, marinas, leisure facilities)	Removal of non-target species (lethal)	High	
Infrastructure - coastal (ports, marinas, leisure facilities)	Siltation rate changes	High	local
Infrastructure - coastal (ports, marinas, leisure facilities)	Habitat structure changes - abrasion & other physical damage	High	
Infrastructure - coastal (ports, marinas, leisure facilities)	Habitat structure changes - removal of substratum (extraction)	High	

Activity	Impact	Relevance	Comment
Infrastructure - coastal (ports, marinas, leisure facilities)	Habitat change (to another substratum)	High	
Infrastructure - coastal defence & land claim	Temperature changes - local	Negligible	
Infrastructure - coastal defence & land claim	Salinity changes - local	Negligible	
Infrastructure - coastal defence & land claim	Water flow (tidal currents) rate changes - local	Moderate	
Infrastructure - coastal defence & land claim	Emergence regime changes (inc. desiccation) - local	Low	
Infrastructure - coastal defence & land claim	Wave exposure changes - local	Moderate	
Infrastructure - coastal defence & land claim	Non-synthetic compound contamination - Heavy metals, Hydrocarbons (+produced water)	Negligible	
Infrastructure - coastal defence & land claim	De-oxygenation	Negligible	Deep dredging
Infrastructure - coastal defence & land claim	Input of nitrogen & phosphorus	Negligible	
Infrastructure - coastal defence & land claim	Organic enrichment	Negligible	
Infrastructure - coastal defence & land claim	Underwater noise disturbance (behaviour)	High	
Infrastructure - coastal defence & land claim	Visual disturbance (behaviour)	High	
Infrastructure - coastal defence & land claim	Barrier to species movement (behaviour, reproduction)	High	
Infrastructure - coastal defence & land claim	Removal of non-target species (lethal)	High	
Infrastructure - coastal defence & land claim	Siltation rate changes	High	
Infrastructure - coastal defence & land claim	Habitat structure changes - abrasion & other physical damage	High	
Infrastructure - coastal defence & land claim	Habitat change (to another substratum)	High	
Infrastructure - coastal defence & land claim	Habitat loss (to land)	High	
Infrastructure - offshore (artificial reefs)	Water flow (tidal currents) rate changes - local	Negligible	
Infrastructure - offshore (artificial reefs)	Wave exposure changes - local	Negligible	
Infrastructure - offshore (oil & gas platforms)	Non-synthetic compound contamination - Heavy metals, Hydrocarbons (+produced water)	Negligible	
Infrastructure - offshore (oil & gas platforms)	Underwater noise disturbance (behaviour)	Low	
Infrastructure - offshore (oil & gas platforms)	Visual disturbance (behaviour)	High	
Infrastructure - offshore (oil & gas platforms)	Barrier to species movement (behaviour, reproduction)	Low	
Infrastructure - offshore (oil & gas platforms)	Barrier to species movement (behaviour, reproduction)	High	

Activity	Impact	Relevance	Comment
Infrastructure - offshore (oil & gas platforms)	Introduction or spread of non-indigenous species & translocations (competition)	Low	
Infrastructure - offshore (oil & gas platforms)	Siltation rate changes	Negligible	
Infrastructure - offshore (oil & gas platforms)	Habitat structure changes - abrasion & other physical damage	Negligible	
Infrastructure - offshore (oil & gas platforms)	Habitat structure changes - removal of substratum (extraction)	Negligible	
Infrastructure - offshore (oil & gas platforms)	Habitat change (to another substratum)	High	very local
Infrastructure - offshore (wind turbines)	Water flow (tidal currents) rate changes - local	Negligible	
Infrastructure - offshore (wind turbines)	Wave exposure changes - local	Negligible	
Infrastructure - offshore (wind turbines)	Non-synthetic compound contamination - Heavy metals, Hydrocarbons (+produced water)	Negligible	
Infrastructure - offshore (wind turbines)	Electromagnetic changes	Negligible	
Infrastructure - offshore (wind turbines)	Underwater noise disturbance (behaviour)	Moderate	
Infrastructure - offshore (wind turbines)	Visual disturbance (behaviour)	High	
Infrastructure - offshore (wind turbines)	Introduction or spread of non-indigenous species & translocations (competition)	Low	
Infrastructure - offshore (wind turbines)	Habitat change (to another substratum)	High	
Tourism & recreation	Non-synthetic compound contamination - Heavy metals, Hydrocarbons (+produced water)	Negligible	
Tourism & recreation	Synthetic compound contamination (inc. pesticides, antifoulants, pharmaceuticals)	Negligible	
Tourism & recreation	Organic enrichment	Negligible	
Tourism & recreation	Litter	High	
Tourism & recreation	Habitat structure changes - abrasion & other physical damage	Negligible	
Seismic survey (military, exploration, construction)	Underwater noise disturbance (behaviour)	High	if it explodes = 4
Seismic survey (military, exploration, construction)	Removal of non-target species (lethal)	High	
Shipping	Non-synthetic compound contamination - Heavy metals, Hydrocarbons (+produced water)	Moderate	
Shipping	Synthetic compound contamination (inc. pesticides, antifoulants, pharmaceuticals)	Low	
Shipping	PBT	Low	
Shipping	Endocrine disruption	Low	

Activity	Impact	Relevance	Comment
Shipping	Input of nitrogen & phosphorus	Negligible	Especially ferries and cruise ships
Shipping	Organic enrichment	Negligible	Especially ferries and cruise ships
Shipping	Litter	High	
Shipping	Underwater noise disturbance (behaviour)	High	
Shipping	Visual disturbance (behaviour)	Moderate	
Shipping	Introduction of microbial pathogens (disease)	Moderate	
Shipping	Introduction or spread of non-indigenous species & translocations (competition)	High	
Shipping	Habitat structure changes - abrasion & other physical damage	Negligible	
Pollution - air-based sources (inc. greenhouse gases)	Non-synthetic compound contamination - Heavy metals, Hydrocarbons (+produced water)	Moderate	
Pollution - air-based sources (inc. greenhouse gases)	PBT	Moderate	PAHs
Pollution - air-based sources (inc. greenhouse gases)	Input of nitrogen & phosphorus	Moderate	
Pollution - air-based sources (inc. greenhouse gases)	Organic enrichment	Negligible	
Pollution - land-based sources	Temperature changes - local	Negligible	
Pollution - land-based sources	Salinity changes - local	Negligible	
Pollution - land-based sources	Non-synthetic compound contamination - Heavy metals, Hydrocarbons (+produced water)	High	
Pollution - land-based sources	Synthetic compound contamination (inc. pesticides, antifoulants, pharmaceuticals)	Moderate	
Pollution - land-based sources	PBT	Moderate	
Pollution - land-based sources	Endocrine disruption	Moderate	
Pollution - land-based sources	Input of nitrogen & phosphorus	High	
Pollution - land-based sources	Organic enrichment	Moderate	
Pollution - land-based sources	Visual disturbance (behaviour)	Negligible	
Pollution - land-based sources	Introduction of microbial pathogens (disease)	Negligible	
Pollution - sewerage	Temperature changes - local	Negligible	
Pollution - sewerage	Salinity changes - local	Negligible	
Pollution - sewerage	Non-synthetic compound contamination - Heavy metals, Hydrocarbons (+produced water)	Low	

Activity	Impact	Relevance	Comment
Pollution - sewerage	Synthetic compound contamination (inc. pesticides, antifoulants, pharmaceuticals)	Low	
Pollution - sewerage	PBT	Low	
Pollution - sewerage	Endocrine disruption	Low	
Pollution - sewerage	Visual disturbance (behaviour)	Negligible	
Pollution - sewerage	Introduction of microbial pathogens (disease)	Low	
Pollution - sewerage	Siltation rate changes	Low	
Waste disposal - fish waste (land-based processing; processing vessels)	Organic enrichment	Low	
Waste disposal - munitions (chemical & conventional)	Non-synthetic compound contamination - Heavy metals, Hydrocarbons (+produced water)	Negligible	
Waste disposal - munitions (chemical & conventional)	Synthetic compound contamination (inc. pesticides, antifoulants, pharmaceuticals)	Negligible	
Waste disposal - navigational dredging (capital, maintenance)	Water flow (tidal currents) rate changes - local	Negligible	
Waste disposal - navigational dredging (capital, maintenance)	Emergence regime changes (inc. desiccation) - local	Negligible	
Waste disposal - navigational dredging (capital, maintenance)	Wave exposure changes - local	Negligible	
Waste disposal - navigational dredging (capital, maintenance)	Non-synthetic compound contamination - Heavy metals, Hydrocarbons (+produced water)	Moderate	
Waste disposal - navigational dredging (capital, maintenance)	Synthetic compound contamination (inc. pesticides, antifoulants, pharmaceuticals)	Moderate	resuspension and remobilisation
Waste disposal - navigational dredging (capital, maintenance)	Synthetic compound contamination (inc. pesticides, antifoulants, pharmaceuticals)	Moderate	resuspension and remobilisation
Waste disposal - navigational dredging (capital, maintenance)	PBT	Moderate	resuspension and remobilisation
Waste disposal - navigational dredging (capital, maintenance)	Endocrine disruption	Moderate	resuspension and remobilisation
Waste disposal - navigational dredging (capital, maintenance)	De-oxygenation	Negligible	
Waste disposal - navigational dredging (capital, maintenance)	Input of nitrogen & phosphorus	Moderate	
Waste disposal - navigational dredging (capital, maintenance)	Organic enrichment	Moderate	
Waste disposal - navigational dredging (capital, maintenance)	Visual disturbance (behaviour)	Low	

Activity	Impact	Relevance	Comment
Waste disposal - navigational dredging (capital, maintenance)	Barrier to species movement (behaviour, reproduction)	Negligible	
Waste disposal - navigational dredging (capital, maintenance)	Removal of non-target species (lethal)	Moderate	
Waste disposal - navigational dredging (capital, maintenance)	Siltation rate changes	High	
Waste disposal - navigational dredging (capital, maintenance)	Habitat structure changes - abrasion & other physical damage	High	
Waste disposal - navigational dredging (capital, maintenance)	Habitat change (to another substratum)	Negligible	

Appendix F. Resistance and Resilience

NB. For remarks made by the workshop participants; please refer to the relevant combination of Ecosystem component – Impact in Appendix D.

Ecosystem Component	Impact	Resistance	Resilience
Saltmarsh (Annex I)	Wave exposure changes - local	negligible	low
Subtidal biogenic reef (Annex I)	Water flow (tidal currents) rate changes - local	low	low
Intertidal seagrass beds	Salinity changes - local	none	negligible
	Wave exposure changes - local	negligible	none
Water (and sediment) quality	De-oxygenation	negligible	considerable
	Input of nitrogen & phosphorus	negligible	low
	Organic enrichment	negligible	low
	Introduction of microbial pathogens (disease)	negligible	high
	Introduction or spread of non-indigenous species & translocations (competition)	considerable	low
	Removal of target species (lethal)	considerable	low
	Removal of non-target species (lethal)	high	high
	Habitat structure changes - removal of substratum (extraction)	negligible	considerable
Nutrient levels & balance (N/P)	Input of nitrogen & phosphorus	negligible	low
	Organic enrichment	negligible	considerable
Oxygen levels in water & sediment	De-oxygenation	negligible	high
	Organic enrichment	negligible	considerable
Levels of other chemicals & heavy metals	Non-synthetic compound contamination - Heavy metals, Hydrocarbons (+produced water)	negligible	low
	Synthetic compound contamination (inc. pesticides, antifoulants, pharmaceuticals)	negligible	low
	De-oxygenation	negligible	high
Ocean and atmospheric processes	Atmospheric climate change	considerable	considerable
Phytoplankton	Atmospheric climate change	none	high
Fish	pH changes	low	low
	Temperature changes - regional/national	low	low
	Salinity changes - regional/national	low	low
	Water flow (tidal & ocean currents) rate changes - regional/national	negligible	low

Ecosystem Component	Impact	Resistance	Resilience
	Non-synthetic compound contamination - Heavy metals, Hydrocarbons (+produced water)	low	low
	Synthetic compound contamination (inc. pesticides, antifoulants, pharmaceuticals)	negligible	low
	Underwater noise disturbance (behaviour)	none	considerable
	Introduction of microbial pathogens (disease)	considerable	considerable
	Removal of target species (lethal)	none	low
	Removal of non-target species (lethal)	none	low
	Habitat structure changes - abrasion & other physical damage	low	low
	Habitat structure changes - removal of substratum (extraction)	low	low
Ocean and atmospheric processes	pH changes	considerable	considerable
	Temperature changes - regional/national	negligible	none
Air-sea exchanges	Atmospheric climate change	considerable	considerable
	pH changes	considerable	considerable
	Temperature changes - regional/national	negligible	considerable
pH	Atmospheric climate change	considerable	low
Temperature regimes	Atmospheric climate change	low	low
	Water flow (tidal & ocean currents) rate changes - regional/national	negligible	high
Current regimes	Atmospheric climate change	considerable	low
Wave regime & sea level	Atmospheric climate change	considerable	low
	Water flow (tidal & ocean currents) rate changes - regional/national	negligible	high
Water (and sediment) quality	Non-synthetic compound contamination - Heavy metals, Hydrocarbons (+produced water)	negligible	low
	Synthetic compound contamination (inc. pesticides, antifoulants, pharmaceuticals)	negligible	low
	PBT	negligible	negligible
Levels of other chemicals & heavy metals	PBT	negligible	negligible
Seabed habitats, communities & species	De-oxygenation	none	low
	Organic enrichment	considerable	considerable
	Introduction or spread of non-indigenous species & translocations (competition)	considerable	negligible

Ecosystem Component	Impact	Resistance	Resilience
	Removal of target species (lethal)	none	considerable
	Removal of non-target species (lethal)	none	considerable
	Siltation rate changes	considerable	considerable
	Habitat structure changes - abrasion & other physical damage	none	low
	Habitat structure changes - removal of substratum (extraction)	none	low
	Habitat change (to another substratum)	none	none
	Habitat loss (to land)	none	none
Coastal features:	pH changes	none	none
	Temperature changes - regional/national	considerable	considerable
	Water flow (tidal & ocean currents) rate changes - regional/national	considerable	considerable
	Wave exposure changes - regional/national	considerable	considerable
Shelf features	Water flow (tidal & ocean currents) rate changes - regional/national	negligible	considerable
Intertidal sediment habitats	Atmospheric climate change	considerable	considerable
	Temperature changes - regional/national	considerable	considerable
	Salinity changes - regional/national	considerable	considerable
	Emergence regime changes (sea level) - regional/national	considerable	considerable
	Wave exposure changes - regional/national	considerable	considerable
	Emergence regime changes (inc. desiccation) - local	none	negligible
Saltmarsh (Annex I)	Salinity changes - local	low	considerable