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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Report C060/08



Institute for Marine Resources and Ecosystem Studies

# Wageningen IMARES

**Location North** 

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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 cooperation 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.

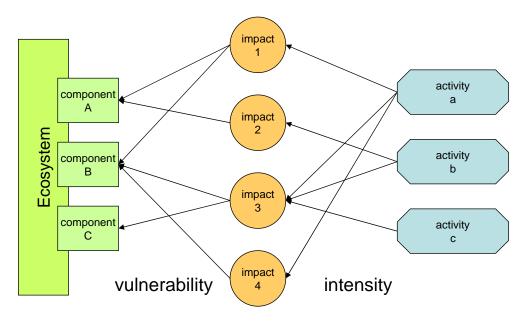


Figure 1. Schematic presentation of the approach to cumulative effects assessment (CEA), based on the relation between activities, impacts and ecosystem components.

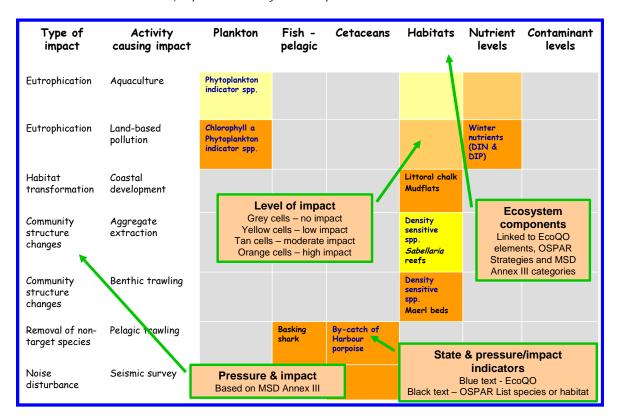


Figure 2. Schematic presentation of the matrix developed by the United Kingdom to provide an inventory and prioritization of activities, impacts and ecosystem components.

### 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.

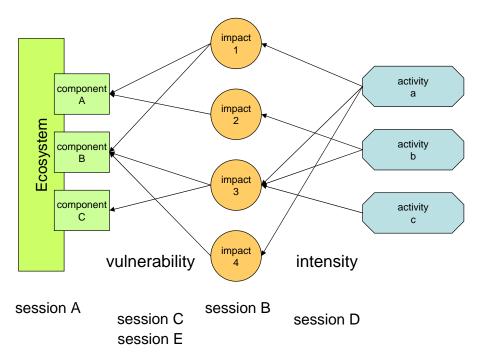


Figure 3. Schematic presentation of the workshop sessions in relation to the CEA approach.

### 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) <sup>1</sup>, 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.

<sup>&</sup>lt;sup>1</sup> 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.

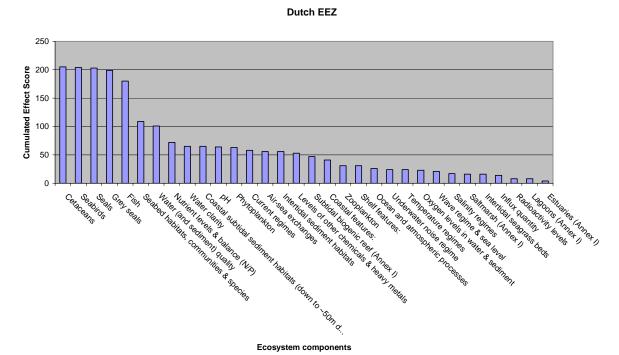


Figure 4. Overview of all ecosystem components ordered by their overall sensitivity for the impacts at the Dutch EEZ. In order to generate this figure; sensitivity classes have been given scores instead of descriptions (none=0; negligible=1; low=2; moderate=4; high=8) and cumulated for each ecosystem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

#### **OSPAR Matrix**

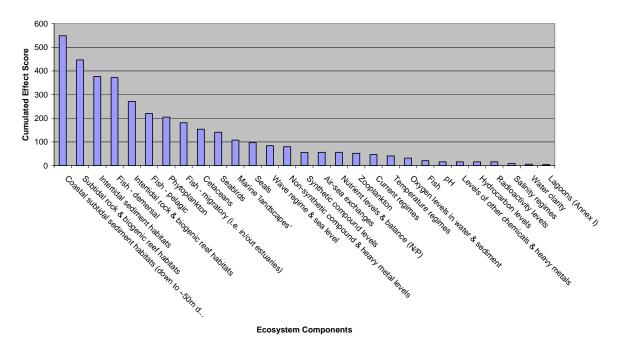


Figure 5. Overview of all ecosystem components ordered by their overall sensitivity for the impacts as scored in the OSPAR Matrix (for comparison with the outcome of the Dutch workshop). In order to generate this figure; sensitivity classes have been given scores instead of descriptions (none=0; negligible=1; 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 'bycatch' 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)

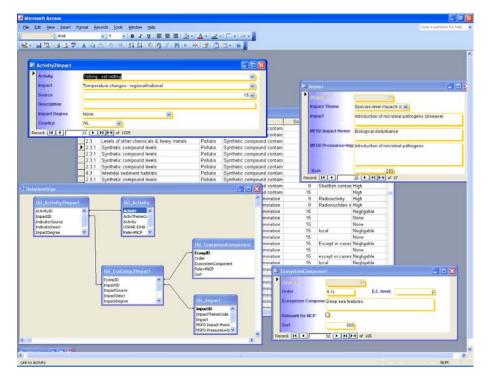


Figure 7. Screenshot of the Microsoft Access database that was developed for transfer of all information from the matrix.

### 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: Moas Kaa

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

	Ecosystem		
Nr	Component	Importance	Remark
	Ocean and		
	atmospheric		
1	processes		
1.1	Air-sea exchanges	high	unclear pressure impact relation
1.2	pН	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
	Wave regime & sea		
1.6	level	high	clear
1.7	Water clarity	high	biological importance
	Water (and sediment)		Quantity importance exchange seabed watercolumn,
2	quality		grain size distribution
	Nutrient levels &		
2.1	balance (N/P)	high	
	Oxygen levels in water		
2.2	& sediment	high	
	Levels of other		
0.0	chemicals & heavy	la : a la	general severe or relative to certain regions, is it still a
2.3	metals	high	real problem
2.4	Radioactivity levels	limited	incidents
2.5	influx quantity	hiah	Dutch coastal sea importance. pressure dredging on
2.5	influx quantity	high	suspended material populations and communities provide different and
3.3	   Fish	   high	complementary information
5.5	Fish - pelagic	Iligii	
3.3.1	populations	high	Distinguish populations: e.g. herring, mackerel
0.0	Fish - demersal		The magnetic population of the magnetic state of the magnetic stat
3.3.2	populations	high	Distinguish populations: e.g. cod, haddock, plaice, sole
		Ī	Many elasmobranch species occurred in the NL EEZ but
	Fish - sharks, skates		disappeared due to fishing. Distinguish different species
3.3.3	& rays	high	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
	Fish - migratory		
3.3.5	(i.e. in/out estuaries)	high	
			populations and communities provide different and
3.3.6	Fish communities	high	complementary information
3.4	Cetaceans		
			minke whale mostly in offshore up until now low numbers
3.4.1	Balleen whales	limited	in NL
3.4.2	Toothed whales	marginal	only strayers
			dolphins and porpoise should be separated because they
2 4 2	Dolphino	high	occupy different habitats, e.g offshore versus
3.4.3	Dolphins	high	inshore/coastal
3.5.1	Harbour Seals	high	harbour and grey seals need to be distinguished because relative importance in NL EEZ
J.J. I	TIAIDUUI SEAIS	Ingri	dolphins and porpoise should be separated because they
			occupy different habitats, e.g offshore versus
3.4.4	porpoises	high	inshore/coastal
			t the second sec

	Ecosystem			
Nr	Component	Importance	Remark	
			harbour and grey seals need to be distinguished because	
3.5.2	grey seals	high	relative importance in NL EEZ	
3.6	Turtles	none		
3.7	Seabirds	high	Not enough expertise	
	Seabirds Benthic		Distinguish between benthic and pelagic feeders, also	
3.7.1	feeders	high	local versus migratory birds?	
3.7.3	Waders	high	Waders?	
	Seabirds Pelagic		Distinguish between benthic and pelagic feeders, also	
3.7.2	feeders	high	local versus migratory birds?	
3.7.4	Migratory birds	high		
	Intertidal mud (Annex			
4.3.3	I, OSPAR List)	high		
404	Intertidal mixed			
4.3.4	sediment (UK BAP)	none	Not present	
4.3.5	Saltmarsh (Annex I)	considerable		
400	Intertidal seagrass	1		
4.3.6	beds	limited	<u></u>	
4.4	Subtidal rock & biogenic reef habitats			
4.4	Subtidal photic rock			
4.4.1	(Annex I)	none		
7.7.1	Subtidal aphotic rock	I HOHE		
4.4.2	(Annex I)	none		
1. 1.2	Subtidal biogenic reef	110110		
4.4.3	(Annex I)	considerable		
	Coastal subtidal			
	sediment habitats			
4.5	(down to ~50m depth)			
	Coastal gravel/coarse			
4.5.1	sediment	high	Cleaver bank, etc	
4.5.2	Coastal sand	high		
4.5.3	Coastal mud	high	Oyster grounds, Frisian front	
	Coastal mixed			
4.5.4	sediment	none	? Needed or not?	
	Macrophyte-			
4 5 5	dominated subtidal			
4.5.5	Shalf asshed habitate	none		
16	Shelf seabed habitats			
4.6	(~50-200m) Shelf gravel/coarse	<u> </u>		
4.6.1	sediment	none		
4.6.2	Shelf sand	1		
		none		
4.6.3	Shelf mud	none		
4.6.4	Shelf mixed sediment	none		
4.7	Deep seabed habitats	<u> </u>	The state of the s	
171	Deep-sea rock (Annex	none		
4.7.1	I) Deep-sea biogenic	none		
4.7.2	reef (Annex I)	none		
4.7.2	Deep-sea sediment	none		
4.7.3	Deep-sea sediment  Deep-sea vents &	none		
4.7.4	seeps	none		
4.7.4	ანნსა	I HOHE		

## Appendix C. Impacts

Impact Theme			
Code	Impact	Importance	Remark
Climate change			
impacts	Atmospheric climate change	high	Changing composition
Climate change			gg copccc.
impacts	pH changes	high	
Climate change	Temperature changes -	1.1.9.1	
impacts	regional/national	high	
Climate change	Salinity changes -	ingii	depending on level of change,
impacts	regional/national	high	influx from rivers
Impaoto	Water flow (tidal & ocean	ingn	I IIII III III III III III III III III
Climate change	currents) rate changes -		
impacts	regional/national	high	
Climate change	Emergence regime changes	Tilgii	safety related, possible relation
impacts	(sea level) - regional/national	limited	with overall system's productivity
Climate change	Wave exposure changes -	iiiiiiica	With Overall system's productivity
impacts	regional/national	marginal	
Ппрасіз	1egional/national	Illargillar	Very locally determined, no
Hydrographic			influence on wider ecosystem,
change impacts -			locally important (would influence
inshore/local	Temperature changes - local	limited	scoring)
IIISHOLE/IOCAI	Temperature changes - local	IIIIIIIIIII	Very locally determined, no
Hydrographic			influence on wider ecosystem,
change impacts -			locally important (would influence
inshore/local	Salinity changes - local	limited	scoring)
Hydrographic	Samily changes - local	IIIIIIIIIII	scoring)
change impacts -	Water flow (tidal currents) rate		
inshore/local	changes - local	marginal	???
Hydrographic	Changes - local	Illaryillar	
change impacts -	Emergence regime changes		safety related, possible relation
inshore/local	(inc. desiccation) - local	limited	with overall system's productivity
Hydrographic	(IIIC. desiccation) - local	IIIIIIIIIIII	with overall system's productivity
change impacts -			
inshore/local	Wave exposure changes - local	marginal	
IIISHOIE/IOCAI	Non-synthetic compound	Illaryillar	
	contamination - Heavy metals,		Under control, long term effects
Pollution and other	Hydrocarbons (+produced		unknown, accidents may have
chemical changes	water)	limited	large impact
Chemical changes	Synthetic compound	illillitea	large impact
Pollution and other	contamination (inc. pesticides,		NCS is a sink, specific
chemical changes	antifoulants, pharmaceuticals)	limited	compounds may have impact
Pollution and other	artificularits, priarmaceuticais)	IIIIIIIIIII	compounds may have impact
chemical changes	Radionuclide contamination	marginal	
Pollution and other	Nautonucliue contamination	marginal	
chemical changes	??		
Pollution and other			May also have some positive
	Do oxygonation	limited	impact
chemical changes	De-oxygenation	IIIIIIILEU	impact
Pollution and other	Input of pitrogon 9 shoonhows	oonoidarahla	
chemical changes	Input of nitrogen & phosphorus	considerable	
Pollution and other	Organia antiahmant	limitad	Local offects
chemical changes	Organic enrichment	limited	Local effects

Impact Theme			
Code	Impact	Importance	Remark
	•		Potentially important, local scale,
Other impacts	Electromagnetic changes	considerable	effect unknown
			Distinguish between
Oth an image and	1:44	la l'aula	types/sources of litter (e.g.
Other impacts	Litter	high	netting, micro-plastics)
Species-level	Underwater noise disturbance	high	Effects lorgely unknown
impacts (condition)	(behaviour)	high	Effects largely unknown
Species-level impacts (condition)	Visual disturbance (behaviour)	considerable	
Species-level	Barrier to species movement	Considerable	We considered a shipping lane
impacts (condition)	(behaviour, reproduction)	high	also a barrier
Species-level	Introduction of microbial	ingn	
impacts (condition)	pathogens (disease)	limited	
impacto (condition)	Introduction or spread of non-	1	
Species-level	indigenous species &		We considered both Intentional
impacts (condition)	translocations (competition)	high	and accidental
Species-level			
impacts			
(distribution, popul.	Removal of target species		
size)	(lethal)	high	
Species-level			
impacts			
(distribution, popul.	Removal of non-target species		
size)	(lethal)	high	
Species-level			
impacts			
(distribution, popul. size)	Habitat loss/ damage	high	
,		high	For a sight in contant and only
Habitat damage	Siltation rate changes	high	Especially in water column
Habitat damage	Habitat structure changes - abras	ion & other phy	sicai damage
	Habitat structure changes -		F. t. was in a second of the
Habitat damaga	removal of substratum	limitad	Future increase due to
Habitat damage	(extraction)	limited	adaptation to sea level rise
Habitat loss	Habitat change (to another substratum)	limited	Man-made structures, limited geographic extent
ו ומטונמנ וטסס	Substraturii)	i iii iii leu	Maasvlakte 2, future coastal
Habitat loss	Habitat loss (to land)	high	extension
า เสมแสเ เบออ	ן ומטונמנ וטפפ (נט ומווע)	High	CALCITOTOTT

# Appendix D. Sensitivity of ecosystem components per impact

Order	Ecosystem Component	Impact	Effect	Comment
		Water flow (tidal & ocean		
	Ocean and atmospheric	currents) rate changes -		
1	processes	regional/national	Low	
	Ocean and atmospheric	Temperature changes -		
1	processes	regional/national	High	resilience: not sure
	Ocean and atmospheric	Salinity changes -		
1	processes	regional/national	Low	
4	Ocean and atmospheric			resilience: considering time
1	processes	Atmospheric climate change	High	scales for recovery
4	Ocean and atmospheric	nU shangas	Lliah	balance, chemistry, stochiometry
1	processes	pH changes	High	Stochlometry
1.1	Air-sea exchanges	Input of nitrogen & phosphorus	Negligible	<u> </u>
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	
	9	Water flow (tidal & ocean	gg	
	11	currents) rate changes -	= = = = = = = = = = = = = = = = = = =	
1.1	Air-sea exchanges	regional/national	Negligible	
1.1	Air-sea exchanges	pH changes	High	
				resilience:
1.1	Air-sea exchanges	Atmospheric climate change	High	considering time scales for recovery
		Temperature changes -		
1.2	pH	regional/national	Negligible	
				Resilience: not
1.2	pH	pH changes	High	relevant
1.2	pH	De-oxygenation	Negligible	
1.2	pH	Atmospheric climate change	High	
1.2	pH	Input of nitrogen & phosphorus	Negligible	
		Water flow (tidal & ocean		
		currents) rate changes -		
1.2	pН	regional/national	Negligible	
1.2	pH	Organic enrichment	Negligible	
	-	Salinity changes -		
1.2	pH	regional/national	Negligible	
		Temperature changes -		resistance: not
1.3	Temperature regimes	regional/national	High	relevant
1.3	Temperature regimes	Atmospheric climate change	High	
		Water flow (tidal & ocean		
4.0		currents) rate changes -		
1.3	Temperature regimes	regional/national	High	ļ
		Water flow (tidal & ocean		
1 1 1	Colinity rogimes	currents) rate changes -	Low	
1.4	Salinity regimes	regional/national	Low	

Order	Ecosystem Component	Impact	Effect	Comment
1.4	Salinity regimes	Atmospheric climate change	Negligible	
		Salinity changes -		Resistance: not
1.4	Salinity regimes	regional/national	High	relevant
		Water flow (tidal currents) rate		
1.5	Current regimes	changes - local	Negligible	
		Water flow (tidal & ocean		
		currents) rate changes -		Resistance: not
1.5	Current regimes	regional/national	High	relevant
	_	Temperature changes -	_	
1.5	Current regimes	regional/national	Low	
		Habitat structure changes -		
4.5	0	abrasion & other physical	NI a alli allialla	
1.5	Current regimes	damage	Negligible	
1.5	Current regimes	Atmospheric climate change	High	
1.5	Current regimes	Habitat loss/ damage	Negligible	
		Habitat structure changes -		
4.5		removal of substratum	N 1 1' 1 - 1 -	
1.5	Current regimes	(extraction)	Negligible	<u> </u>
1.5	Current regimes	Habitat loss (to land)	Low	
4 -	0	Habitat change (to another	NI a alli allialla	
1.5	Current regimes	substratum)	Negligible	
1.6	Wave regime & sea level	Atmospheric climate change	High	
4.0	Move veries & see level	Temperature changes -	1	
1.6	Wave regime & sea level	regional/national	Low	
1.6	Wayo rogimo 8 coa lovol	Water flow (tidal currents) rate changes - local	Negligible	11
1.0	Wave regime & sea level	Water flow (tidal & ocean	ivediidinie	
		currents) rate changes -		
1.6	Wave regime & sea level	regional/national	Moderate	
1.7	Water clarity	Atmospheric climate change	Low	
1.7	i vator danty	Wave exposure changes -		
1.7	Water clarity	regional/national	Negligible	
	1	Habitat structure changes -		
		abrasion & other physical		
1.7	Water clarity	damage	Negligible	
1.7	Water clarity	Habitat loss (to land)	Negligible	
1.7	Water clarity	Organic enrichment	Negligible	
		Habitat change (to another		
1.7	Water clarity	substratum)	Negligible	
1.7	Water clarity	pH changes	Negligible	
1.7	Water clarity	Litter	Negligible	
		Habitat structure changes -		
		removal of substratum		
1.7	Water clarity	(extraction)	Negligible	
		Habitat structure changes -		
	Water (and sediment)	removal of substratum		
2	quality	(extraction)	Moderate	Resistance: local only
	Water (and sediment)		.	
2	quality	Litter	Low	
	Water (and sediment)	De consequentiare		
2	quality	De-oxygenation	High	
	Water (and andiment)	Introduction or spread of non- indigenous species &		
2	Water (and sediment) quality	translocations (competition)	Moderate	
_	quality	i dansiocadons (competition)	iviouerate	

Order	Ecosystem Component	Impact	Effect	Comment
	Water (and sediment)			
2	quality	Organic enrichment	High	
	Water (and sediment)			except in cases of
2	quality	Radionuclide contamination	Negligible	accidents
	Water (and sediment)			
2	quality	Input of nitrogen & phosphorus	High	
		Synthetic compound		
	Water (and sediment)	contamination (inc. pesticides,		
2	quality	antifoulants, pharmaceuticals)	High	
	Water (and sediment)	Removal of non-target species		
2	quality	(lethal)	Moderate	
	Water (and sediment)			
2	quality	PBT	High	
	Water (and sediment)	Habitat change (to another	9	
2	quality	substratum)	Negligible	
	Water (and sediment)	Removal of target species	. 109.191010	
2	quality	(lethal)	Moderate	
_	quanty	Non-synthetic compound	iviouciale	
		contamination - Heavy metals,		# 1
	Water (and sediment)	Hydrocarbons (+produced		
2	quality	water)	High	
	Water (and sediment)	water)	i i iigii	
2	quality	Habitat lass (to land)	Modigible	
	Water (and sediment)	Habitat loss (to land) Introduction of microbial	Negligible	
2			Moderate	
	quality	pathogens (disease)	Moderate	
	(Notes (and and mont)	Water flow (tidal & ocean		
0	Water (and sediment)	currents) rate changes -	NIIIII-I-	
2	quality	regional/national	Negligible	
0.4	Nutrient levels & balance	Removal of target species	Nagliaible	
2.1	(N/P)	(lethal)	Negligible	
0.4	Nutrient levels & balance	Temperature changes -	N	
2.1	(N/P)	regional/national	Negligible	
0.4	Nutrient levels & balance	Removal of non-target species		
2.1	(N/P)	(lethal)	Negligible	
	Nutrient levels & balance			
2.1	(N/P)	Atmospheric climate change	Negligible	
	Nutrient levels & balance			
2.1	(N/P)	De-oxygenation	Negligible	
0.4	Nutrient levels & balance			
2.1	(N/P)	Input of nitrogen & phosphorus	High	
		Water flow (tidal & ocean		
	Nutrient levels & balance	currents) rate changes -		
2.1	(N/P)	regional/national	Negligible	
	Nutrient levels & balance	1	l	
2.1	(N/P)	Organic enrichment	High	
_	Nutrient levels & balance			
2.1	(N/P)	pH changes	Negligible	
	Oxygen levels in water &			
2.2	sediment	Input of nitrogen & phosphorus	Low	
	Oxygen levels in water &			
2.2	sediment	Organic enrichment	Moderate	
	Oxygen levels in water &			
2.2	sediment	De-oxygenation	High	

Order	Ecosystem Component	Impact	Effect	Comment
		Water flow (tidal & ocean		
	Oxygen levels in water &	currents) rate changes -		111
2.2	sediment	regional/national	Negligible	
	Oxygen levels in water &	Temperature changes -		
2.2	sediment	regional/national	Low	
	Oxygen levels in water &			
2.2	sediment	Atmospheric climate change	Low	
0.0	Levels of other chemicals		B.41 4 -	
2.3	& heavy metals	De-oxygenation	Moderate	Fycant in account
2.3	Levels of other chemicals	Radionuclide contamination	Negligible	Except in cases of accidents
2.3	& heavy metals	Synthetic compound	Negligible	accidents
	Levels of other chemicals	contamination (inc. pesticides,		
2.3	& heavy metals	antifoulants, pharmaceuticals)	High	
	1	Non-synthetic compound		
		contamination - Heavy metals,		
	Levels of other chemicals	Hydrocarbons (+produced		
2.3	& heavy metals	water)	High	
	Levels of other chemicals	Temperature changes -		
2.3	& heavy metals	regional/national	Negligible	
0.0	Levels of other chemicals			
2.3	& heavy metals	pH changes	Low	
		Water flow (tidal & ocean	= = = = = = = = = = = = = = = = = = =	
2.2	Levels of other chemicals	currents) rate changes -	Negligible	8
2.3	& heavy metals  Levels of other chemicals	regional/national	Negligible	
2.3	& heavy metals	PBT	High	
2.4	Radioactivity levels	Radionuclide contamination	High	
3.1	Phytoplankton	Temperature changes - local	Negligible	
3.1	Friytopiankton	Salinity changes -	Tregligible	
3.1	Phytoplankton	regional/national	Negligible	unknown
0.1	- Triytopiariktori	Synthetic compound	Trognglolo	UIII UII
	11 H	contamination (inc. pesticides,	= - = - = - = - = - = -	
3.1	Phytoplankton	antifoulants, pharmaceuticals)	Low	11111111111111111111111111111111111111
3.1	Phytoplankton	Siltation rate changes	High	
3.1	Phytoplankton	Input of nitrogen & phosphorus	High	
3.1	Phytoplankton	pH changes	Low	
		Water flow (tidal & ocean		
		currents) rate changes -		
3.1	Phytoplankton	regional/national	Moderate	
		Introduction or spread of non-		
		indigenous species &		
3.1	Phytoplankton	translocations (competition)	High	
3.1	Phytoplankton	Atmospheric climate change	High	
		Temperature changes -		
3.1	Phytoplankton	regional/national	Low	
3.1	Phytoplankton	Salinity changes - local	Negligible	
3.2	Zooplankton	Organic enrichment	Moderate	
3.2	Zooplankton	De-oxygenation	Negligible	
		Temperature changes -		
3.2	Zooplankton	regional/national	High	
		Water flow (tidal & ocean		
0.0	7	currents) rate changes -		
3.2	Zooplankton	regional/national	Low	

Order	Ecosystem Component	Impact	Effect	Comment
		Introduction or spread of non-		
		indigenous species &		
3.2	Zooplankton	translocations (competition)	High	
3.2	Zooplankton	Siltation rate changes	Low	
		Salinity changes -		
3.2	Zooplankton	regional/national	Low	
		Water flow (tidal currents) rate		
3.3	Fish	changes - local	Negligible	
		Removal of target species		
3.3	Fish	(lethal)	High	
0.0	<b>—</b> - 1.	Introduction of microbial	N41 1 -	
3.3	Fish	pathogens (disease)	Moderate	
3.3	Fish	Salinity changes - local	Negligible	
	Fish	Emergence regime changes	N. a. a. ii a. iia I.a.	
3.3	Fish	(inc. desiccation) - local	Negligible	
3.3	Fish	Temperature changes - local	Negligible	
	F:_L	Habitat change (to another	N. a. a. li a. ila la	
3.3	Fish	substratum)	Negligible	
		Introduction or spread of non-		
3.3	Fish	indigenous species & translocations (competition)	Low	has yet to occur
3.3	Fish	pH changes	High	nas yet to occur
	i	- 1	1	
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	Do ovygonotion	Low	not often occurs,
3.3	FISH	De-oxygenation Wave exposure changes -	Low	important if current
3.3	Fish	regional/national	Negligible	
0.0	1 1011	Non-synthetic compound	ricgiigibic	
		contamination - Heavy metals,		detailed exp. lacks /
		Hydrocarbons (+produced		different compounds,
3.3	Fish	water)	Moderate	different effects
		Removal of non-target species		
3.3	Fish	(lethal)	High	
		Salinity changes -		
3.3	Fish	regional/national	High	
		Temperature changes -		
3.3	Fish	regional/national	High	•
				some species are
		Underwater noise disturbance		sensitive, no
3.3	Fish	(behaviour)	Moderate	knowledge on ecosystem level
3.3	Fish	Input of nitrogen & phosphorus	Negligible	effects not direct
3.3	Fish	Organic enrichment	Negligible	local
3.3	1 1011	Barrier to species movement	i vediidinie	indirect via changes
3.3	Fish	(behaviour, reproduction)	Low	in current
0.0	1 1011	Emergence regime changes		in ourion
3.3	Fish	(sea level) - regional/national	Negligible	
				<u> </u>
0.5				local.
3.3	Fish	Electromagnetic changes	Negligible	potential problem
3.3	Fish	Litter	Low	local, local, though potential problem

Order	Ecosystem Component	Impact	Effect	Comment
	Managara	Water flow (tidal & ocean		
		currents) rate changes -		
3.3	Fish	regional/national	High	
		Synthetic compound		
0.0		contamination (inc. pesticides,	N 4 - 1 - 1 - 1 - 1	
3.3	Fish	antifoulants, pharmaceuticals)	Moderate	
		Habitat structure changes - removal of substratum		ex: gravel beds for
3.3	Fish	(extraction)	High	herring
3.3		Salinity changes -	Ingri	i nemig
3.4	Cetaceans	regional/national	Low	
0.1		Removal of target species	LOW	
3.4	Cetaceans	(lethal)	High	
	# 1	Non-synthetic compound		
	1111 H	contamination - Heavy metals,		
		Hydrocarbons (+produced		
3.4	Cetaceans	water)	High	
	1111	Habitat structure changes -		
		abrasion & other physical		
3.4	Cetaceans	damage	Negligible	indirect
		Water flow (tidal & ocean		
3.4	Cetaceans	currents) rate changes - regional/national	Negligible	indirect
3.4	Cetaceans		Negligible	
3.4	Cetaceans	pH changes  Removal of non-target species	ivegligible	
3.4	Cetaceans	(lethal)	High	
3.4	Cetaceans	Habitat loss (to land)	High	
J. <del>T</del>	Ctaccans	Wave exposure changes -	1 111911	
3.4	Cetaceans	regional/national	Negligible	
		Emergence regime changes		
3.4	Cetaceans	(inc. desiccation) - local	Negligible	
		Habitat change (to another		lack in knowledge in
3.4	Cetaceans	substratum)	Low	feeding ecology?
	_	Water flow (tidal currents) rate		
3.4	Cetaceans	changes - local	Negligible	
3.4	Cetaceans	Salinity changes - local	Negligible	
		Temperature changes -		
3.4	Cetaceans	regional/national	Low	
3.4	Cetaceans	Temperature changes - local	Negligible	
3.4	Cetaceans	Wave exposure changes - local	Negligible	
		Habitat structure changes -		look in the acceleration
3.4	Cetaceans	removal of substratum	Low	lack in knowledge in
3.4		(extraction)  Radionuclide contamination		feeding ecology?
	Cetaceans		Negligible	IUCAI
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	
2 /	Cotacoans	Barrier to species movement	Moderate	lack of data
3.4	Cetaceans	(behaviour, reproduction)	Moderate	lack of data
3.4	Cetaceans	Litter	High	

Order	Ecosystem Component	Impact	Effect	Comment
	Annual management of the state	Introduction or spread of non-		The state of the s
		indigenous species &		
3.4	Cetaceans	translocations (competition)	Negligible	
		Underwater noise disturbance		no proof on
3.4	Cetaceans	(behaviour)	High	population level
3.4	Cetaceans	Organic enrichment	Negligible	
3.4	Cetaceans	Visual disturbance (behaviour)	Negligible	
		Introduction of microbial		
3.4	Cetaceans	pathogens (disease)	Moderate	
		Synthetic compound		
		contamination (inc. pesticides,		
3.4	Cetaceans	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	
		Water flow (tidal currents) rate	July	
3.5	Seals	changes - local	Negligible	
		Barrier to species movement		Delta area
3.5	Seals	(behaviour, reproduction)	High	"population"
3.5	Seals	Electromagnetic changes	Low	unknown
		Introduction of microbial		
3.5	Seals	pathogens (disease)	Moderate	
		Habitat structure changes -		
	1	removal of substratum		lack in knowledge in
3.5	Seals	(extraction)	Low	feeding ecology?
		Emergence regime changes		
3.5	Seals	(sea level) - regional/national	High	haul-out possibilities
		Temperature changes -		
3.5	Seals	regional/national	Low	
		Emergence regime changes		
3.5	Seals	(inc. desiccation) - local	Negligible	
0.5		Wave exposure changes -		
3.5	Seals	regional/national	Low	if affecting haulout
3.5	Seals	Salinity changes - local	Negligible	
0.5	0 1-	Habitat change (to another		lack in knowledge in
3.5	Seals	substratum)	Low	feeding ecology?
3.5	Seals	Radionuclide contamination	Negligible	local
0.5		Removal of target species	11.	
3.5	Seals	(lethal)	High	
3.5	Seals	Atmospheric climate change	Negligible	
3.5	Seals	Visual disturbance (behaviour)	Negligible	
		Synthetic compound		
2.5	Coolo	contamination (inc. pesticides,		
3.5	Seals	antifoulants, pharmaceuticals)	High	 
2.5	Soolo	Underwater noise disturbance	Lliah	no proof on
3.5	Seals	(behaviour)	High	population level
		Introduction or spread of non- indigenous species &		
3.5	Seals	translocations (competition)	Negligible	grey seals?
J.J	UCAIS	i iransiocations (competition)	ivealidine	i dien seals!

Order	Ecosystem Component	Impact	Effect	Comment
	-	Non-synthetic compound		
		contamination - Heavy metals,		
		Hydrocarbons (+produced		
3.5	Seals	water)	High	
3.5	Seals	Input of nitrogen & phosphorus	Negligible	
3.5	Seals	Litter	High	
		Salinity changes -		
3.5	Seals	regional/national	Low	
3.5	Seals	Removal of non-target species (lethal)	High	
		Habitat structure changes -		
		abrasion & other physical		possibly targetting
3.5	Seals	damage	Low	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	
		Emergence regime changes		
3.7	Seabirds	(sea level) - regional/national	Negligible	
3.7	Seabirds	Temperature changes - local	Negligible	
		Temperature changes -		
3.7	Seabirds	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	
5.7	Ocabiids	Habitat structure changes -	racgiigibic	
		abrasion & other physical		
3.7	Seabirds	damage	Negligible	
		Salinity changes -		
3.7	Seabirds	regional/national	Negligible	
3.7	Seabirds	Atmospheric climate change	Negligible	
		Water flow (tidal & ocean		
		currents) rate changes -		
3.7	Seabirds	regional/national	Negligible	
0.7	Okinda	Barrier to species movement	NA - de 1 -	
3.7	Seabirds	(behaviour, reproduction)	Moderate	
27	Soobirde	Wave exposure changes -	Modiaible	
3.7	Seabirds	regional/national Non-synthetic compound	Negligible	
		contamination - Heavy metals,		
		Hydrocarbons (+produced		
3.7	Seabirds	water)	High	
<u> </u>		Water flow (tidal currents) rate		
3.7	Seabirds	changes - local	Negligible	
		Introduction or spread of non-		
		indigenous species &		
3.7	Seabirds	translocations (competition)	Negligible	
_		Habitat change (to another		
3.7	Seabirds	substratum)	Negligible	
3.7	Seabirds	Habitat loss/ damage	High	

Order	Ecosystem Component	Impact	Effect	Comment
3.7	Seabirds	pH changes	Negligible	
		Removal of target species	i i i i gugure	
3.7	Seabirds	(lethal)	High	
3.7	Seabirds	Salinity changes - local	Negligible	
3.7	Seabirds	Wave exposure changes - local	Negligible	
<u> </u>		Emergence regime changes	i regiigioie	
3.7	Seabirds	(inc. desiccation) - local	Negligible	
3.7	Seabirds	Visual disturbance (behaviour)	Moderate	
3.7	Seabirds	Habitat loss (to land)	High	
0.7		Synthetic compound	1 11911	
		contamination (inc. pesticides,		
3.7	Seabirds	antifoulants, pharmaceuticals)	High	
		Habitat structure changes -		
		removal of substratum		
3.7	Seabirds	(extraction)	Negligible	
		Introduction of microbial		
3.7	Seabirds	pathogens (disease)	Moderate	
	Seabed habitats,			
4	communities & species	De-oxygenation	Moderate	
		Habitat structure changes -		
	Seabed habitats,	abrasion & other physical		
4	communities & species	damage	High	
	Seabed habitats,			
4	communities & species	Litter	Negligible	
	0 1 1 1 - 1 1 - 1	Introduction or spread of non-		THE PROPERTY OF THE PROPERTY O
4	Seabed habitats,	indigenous species &	Liah	M 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
4	communities & species Seabed habitats,	translocations (competition)	High	
4	communities & species	Removal of target species (lethal)	High	
4	Seabed habitats,		i ligii	
4	communities & species	Habitat loss (to land)	High	
	Seabed habitats,	Underwater noise disturbance	ingii	
4	communities & species	(behaviour)	Negligible	
<u> </u>		Non-synthetic compound	i regiigioie	
	11111	contamination - Heavy metals,		1118
	Seabed habitats,	Hydrocarbons (+produced		allian de la companya
4	communities & species	water)	Negligible	
		Synthetic compound		
	Seabed habitats,	contamination (inc. pesticides,		MALLE MALLE
4	communities & species	antifoulants, pharmaceuticals)	Low	
	Seabed habitats,	Removal of non-target species	l	
4	communities & species	(lethal)	High	
	Cook and hartifact	Habitat structure changes -		
4	Seabed habitats,	removal of substratum	Lliah	
4	communities & species Seabed habitats,	(extraction)	High	
4	communities & species	Habitat change (to another substratum)	High	
+	Communices & species	- Substitutiii)	j i ligii	Habitat loss is
	Seabed habitats,			included from
4	communities & species	Habitat loss/ damage	High	different impacts
•	Seabed habitats,	Introduction of microbial	a	
4	communities & species	pathogens (disease)	Negligible	
	Seabed habitats,			
4	communities & species	Organic enrichment	High	

Order	Ecosystem Component	Impact	Effect	Comment
4.1.0	Coastal features:	Atmospheric climate change	Moderate	
		Wave exposure changes -		
4.1.0	Coastal features:	regional/national	High	
		Salinity changes -		
4.1.0	Coastal features:	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	
		Water flow (tidal currents) rate	j rregngure	
4.1.0	Coastal features:	changes - local	Low	
		Emergence regime changes		
4.1.0	Coastal features:	(sea level) - regional/national	High	
		Emergence regime changes		
4.1.0	Coastal features:	(inc. desiccation) - local	Low	
		Temperature changes -		sensitivity decreases
4.1.0	Coastal features:	regional/national	Moderate	with depth
		Water flow (tidal & ocean		
		currents) rate changes -		# 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
4.1.0	Coastal features:	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	
		Salinity changes -		
4.1b	Shelf features:	regional/national	Negligible	
4.1b	Shelf features:	Siltation rate changes	Low	
		Water flow (tidal & ocean		
		currents) rate changes -		
4.1b	Shelf features:	regional/national	Moderate	
4.1b	Shelf features:	Atmospheric climate change	Negligible	
4.1b	Shelf features:	Input of nitrogen & phosphorus	Low	
4.41		Wave exposure changes -		
4.1b	Shelf features:	regional/national	Negligible	
4.45	Ob alf fact was	Temperature changes -		81
4.1b	Shelf features:	regional/national	Low	
4.3	Intertidal sediment habitats	Temperature changes - regional/national	Moderate	
4.3	Intertidal sediment	Salinity changes -	iviouerate	
4.3	habitats	regional/national	Negligible	
7.0	Intertidal sediment	Water flow (tidal currents) rate	litegligible	
4.3	habitats	changes - local	Negligible	
110	Intertidal sediment		, rrogngiolo	
4.3	habitats	Atmospheric climate change	Moderate	
	Intertidal sediment	Emergence regime changes		
4.3	habitats	(inc. desiccation) - local	Moderate	
	Intertidal sediment			
4.3	habitats	Temperature changes - local	Negligible	
	Intertidal sediment	Wave exposure changes -		
4.3	habitats	regional/national	Moderate	
	Intertidal sediment	Emergence regime changes		
4.3	habitats	(sea level) - regional/national	High	
	<u> </u>	Water flow (tidal & ocean		
4.6	Intertidal sediment	currents) rate changes -	<b> </b>	
4.3	habitats	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	
1.0.0	Subtidal biogenic reef	Wave exposure changes -	1 11911	
4.4.3	(Annex I)	regional/national	Low	
	Subtidal biogenic reef	Salinity changes -	1	
4.4.3	(Annex I)	regional/national	Negligible	B
	Subtidal biogenic reef	Temperature changes -		
4.4.3	(Annex I)	regional/national	Negligible	
	Subtidal biogenic reef			
4.4.3	(Annex I)	Wave exposure changes - local	Low	
	Subtidal biogenic reef	Water flow (tidal currents) rate		
4.4.3	(Annex I)	changes - local	Moderate	
		Water flow (tidal & ocean		
	Subtidal biogenic reef	currents) rate changes -		
4.4.3	(Annex I)	regional/national	Negligible	
	Subtidal biogenic reef			
4.4.3	(Annex I)	Salinity changes - local	Negligible	
	Subtidal biogenic reef			
4.4.3	(Annex I)	Temperature changes - local	Negligible	
	Subtidal biogenic reef			
4.4.3	(Annex I)	Siltation rate changes	Low	
	Coastal subtidal sediment			
	habitats (down to ~50m			
4.5	depth)	Salinity changes - local	Negligible	
	Coastal subtidal sediment			
	habitats (down to ~50m	Salinity changes -		
4.5	depth)	regional/national	Negligible	
	Coastal subtidal sediment	Marian (I.a., (C. I.a.), maria (A. Maria		# 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
4.5	habitats (down to ~50m	Water flow (tidal currents) rate	NI a adi adia la	11
4.5	depth) Coastal subtidal sediment	changes - local	Negligible	
	habitats (down to ~50m			
4.5	depth)	Siltation rate changes	Low	
4.5	Coastal subtidal sediment	Siliation rate changes	LOW	
	habitats (down to ~50m			8
4.5	depth)	Wave exposure changes - local	Negligible	
7.0	Coastal subtidal sediment	Water flow (tidal & ocean	riogligible	
	habitats (down to ~50m	currents) rate changes -		
4.5	depth)	regional/national	Negligible	
	Coastal subtidal sediment			
	habitats (down to ~50m			
4.5	depth)	Temperature changes - local	Negligible	
	Coastal subtidal sediment	-		
	habitats (down to ~50m	Wave exposure changes -		
4.5	depth)	regional/national	Negligible	
	Coastal subtidal sediment			
	habitats (down to ~50m	Temperature changes -		
4.5	depth)	regional/national	Negligible	
		Salinity changes -		
1.8	Underwater noise regime	regional/national	Negligible	
		Wave exposure changes -		
1.8	Underwater noise regime	regional/national	Negligible	
		Temperature changes -		
1.8	Underwater noise regime	regional/national	Negligible	

Order	Ecosystem Component	Impact	Effect	Comment
		Temperature changes -		
2.5	Influx quantity	regional/national	Negligible	
2.5	Influx quantity	Emergence regime changes (sea level) - regional/national	Moderate	
2.5	I Illiux qualitity	Water flow (tidal & ocean	iviouerate	
		currents) rate changes -		
2.5	Influx quantity	regional/national	Low	
2.5	Influx quantity	Atmospheric climate change	Low	
3.5.2	Grey seals	De-oxygenation	Negligible	
		Removal of target species		
3.5.2	Grey seals	(lethal)	High	
3.5.2	Grey seals	Radionuclide contamination	Negligible	local
0.50		Underwater noise disturbance		no proof on
3.5.2	Grey seals	(behaviour)	High	population level
3.5.2	Grey seals	Visual disturbance (behaviour)	Negligible	
		Introduction or spread of non-indigenous species &		
3.5.2	Grey seals	translocations (competition)	Negligible	
3.5.2	Grey seals	Litter	High	
0.0.2	City could	Introduction of microbial	i i iigii	
3.5.2	Grey seals	pathogens (disease)	Moderate	
		Synthetic compound		
		contamination (inc. pesticides,		
3.5.2	Grey seals	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	Crovingolo	Barrier to species movement (behaviour, reproduction)	Moderate	lack of data
3.5.2	Grey seals Grey seals	Atmospheric climate change	Negligible	lack of data
3.5.2	Grey seals	Salinity changes - local	Negligible	
3.3.2	Grey seals	Salinity changes - local	ivegligible	
3.5.2	Grey seals	regional/national	Low	
0.0.2		Water flow (tidal & ocean		
		currents) rate changes -		
3.5.2	Grey seals	regional/national	Negligible	in extreem cases
		Emergence regime changes	l	haul-out possibilities
3.5.2	Grey seals	(sea level) - regional/national	High	pupping
3.5.2	Grey seals	Removal of non-target species (lethal)	High	
3.3.2	Grey seals	Wave exposure changes -	j riigii	
3.5.2	Grey seals	regional/national	Low	if affecting haulout
3.5.2	Grey seals	Temperature changes - local	Negligible	<u> </u>
3.5.2	Grey seals	pH changes	Negligible	
		Habitat structure changes -		
		removal of substratum	# = = = = = = = = = = = = = = = = = = =	lack in knowledge in
3.5.2	Grey seals	(extraction)	Low	feeding ecology?
3.5.2	Grey seals	Habitat loss (to land)	High	
250	Crovessia	Water flow (tidal currents) rate	Nogliait	
3.5.2	Grey seals	changes - local Emergence regime changes	Negligible	
3.5.2	Grey seals	(inc. desiccation) - local	Negligible	
0.0.2	Ordy Scale	(into: dedication) local	INCHINIDIE	I

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	Water flow (tidal currents) rate		
(wind & wave turbines)	changes - local	Negligible	
Energy production - at sea	<b>X</b>		
(wind & wave turbines)	Wave exposure changes - local	Negligible	
	Non-synthetic compound		
Energy production - at sea	contamination - Heavy metals,		zinc anodes for
(wind & wave turbines)	Hydrocarbons (+produced water)	Negligible	corrosion inhibition
Energy production - at sea	у по общество ( тр. общество то	11099	
(wind & wave turbines)	Electromagnetic changes	Negligible	
Energy production - at sea	Underwater noise disturbance	i regiigioio	
(wind & wave turbines)	(behaviour)	Moderate	
Energy production - at sea		I	
(wind & wave turbines)	Visual disturbance (behaviour)	High	
Energy production - at sea	Barrier to species movement		
(wind & wave turbines)	(behaviour, reproduction)	  High	
(wind & wave turbines)	Introduction or spread of non-	I ligii	
Energy production - at sea	indigenous species &		
	translocations (competition)	Low	
(wind & wave turbines)	<u> </u>	Low	
Energy production - at sea	Habitat change (to another		
(wind & wave turbines)	substratum)	High	
Energy production - on land			
(power stations, inc. nuclear)	Temperature changes - local	Moderate	
	Synthetic compound		Treatment of cooling
Energy production - on land	contamination (inc. pesticides,		water may form
(power stations, inc. nuclear)	antifoulants, pharmaceuticals)	Negligible	organohalogens
			Treatment of cooling
Energy production - on land			water may form
(power stations, inc. nuclear)	PBT	Negligible	organohalogens
Energy production - on land			
(power stations, inc. nuclear)	Radionuclide contamination	Low	
Extraction - maerl	Visual disturbance (behaviour)	Low	
Extraction - navigational			
dredging (capital,	Water flow (tidal currents) rate		
maintenance)	changes - lòcal	Negligible	
Extraction - navigational			
dredging (capital,	Emergence regime changes (inc.		
maintenance)	desiccation) - local	Negligible	
Extraction - navigational	<u></u>		
dredging (capital,			
maintenance)	Wave exposure changes - local	Negligible	
Extraction - navigational	Non-synthetic compound	i i gugue	
dredging (capital,	contamination - Heavy metals,		respuspension and
maintenance)	Hydrocarbons (+produced water)	Moderate	remobilisation
Extraction - navigational	Synthetic compound		
dredging (capital,	contamination (inc. pesticides,		resuspension and
maintenance)	antifoulants, pharmaceuticals)	Moderate	remobilisation
Extraction - navigational	grandanto, priarridocuticalo)	inodolato	TOTALONIIOGUOTI
dredging (capital,			resuspension and
maintenance)	РВТ	Moderate	remobilisation
maintenante)	וטון	INIOGETALE	TOTTODIIISAUOTI

Activity	Impact	Relevance	Comment
Extraction - navigational			
dredging (capital,			resuspension and
maintenance)	Endocrine disruption	Moderate	remobilisation
Extraction - navigational			
dredging (capital,			
maintenance)	De-oxygenation	Negligible	
Extraction - navigational			
dredging (capital,			111
maintenance)	Input of nitrogen & phosphorus	Moderate	8111
Extraction - navigational	j		
dredging (capital,			
maintenance)	Organic enrichment	Moderate	
Extraction - navigational			N
dredging (capital,	Underwater noise disturbance		
maintenance)	(behaviour)	Moderate	11 11 11 11 11 11 11 11 11 11 11 11 11
Extraction - navigational	(bondviodi)	Inioaciato	1
dredging (capital,			
maintenance)	Siltation rate changes	Low	
Extraction - navigational	Habitat structure changes -	LOW	
dredging (capital,	abrasion & other physical		
maintenance)		Negligible	
	damage Habitat structure changes -	lvegligible	
Extraction - navigational			
dredging (capital,	removal of substratum	NIIIII-II-	
maintenance)	(extraction)	Negligible	1
Extraction - navigational			
dredging (capital,	Habitat change (to another		
maintenance)	substratum)	Negligible	
Extraction - oil & gas	Temperature changes - local	Low	
Extraction - oil & gas	Salinity changes - local	Negligible	
			Subsidance from gas
	Emergence regime changes (inc.		production may lead to
Extraction - oil & gas	desiccation) - local	Negligible	changes
	Non-synthetic compound		
	contamination - Heavy metals,		=======================================
Extraction - oil & gas	Hydrocarbons (+produced water)	Moderate	# 1
	Synthetic compound		
	contamination (inc. pesticides,		
Extraction - oil & gas	antifoulants, pharmaceuticals)	Negligible	
Extraction - oil & gas	PBT	Moderate	
-		•	
Extraction - oil & gas	Endocrine disruption	Negligible	
Extraction - oil & gas	Radionuclide contamination	Negligible	
	Underwater noise disturbance		
Extraction - oil & gas	(behaviour)	Low	
Extraction - oil & gas	Visual disturbance (behaviour)	High	
j	Barrier to species movement		
Extraction - oil & gas	(behaviour, reproduction)	Low	
3.42	Introduction or spread of non-		
	indigenous species &	8 	
Extraction - oil & gas	translocations (competition)	Low	
	- <u>}</u>	÷	
Extraction - oil & gas	Siltation rate changes	Negligible	
	Habitat structure changes -		
	abrasion & other physical	<u> </u>	
Extraction - oil & gas	damage	Negligible	

Activity	Impact	Relevance	Comment
	Habitat structure changes -		
	removal of substratum		
Extraction - oil & gas	(extraction)	Negligible	
	Habitat change (to another		
Extraction - oil & gas	substratum)	High	very local
	Water flow (tidal currents) rate		
Extraction - sand & gravel	changes - local	Negligible	
	Non-synthetic compound		
	contamination - Heavy metals,		
Extraction - sand & gravel	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	
	Underwater noise disturbance		
Extraction - sand & gravel	(behaviour)	Low	
Extraction - sand & gravel	Visual disturbance (behaviour)	Low	
	Barrier to species movement		
Extraction - sand & gravel	(behaviour, reproduction)	Low	
<u> </u>	Removal of non-target species		
Extraction - sand & gravel	(lethal)	High	
Extraction - sand & gravel	Siltation rate changes	High	
Extraction cand a graver	Habitat structure changes -	g	
	abrasion & other physical		
Extraction - sand & gravel	damage	Moderate	
<u> </u>	Habitat structure changes -		
	removal of substratum		
Extraction - sand & gravel	(extraction)	High	
	Habitat change (to another		
Extraction - sand & gravel	substratum)	Negligible	
	Water flow (tidal currents) rate		
Harvesting - seaweed	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	
rishing benune trawing	Organic crincinient	racgiigibic	lost nets and shipping
Fishing - benthic trawling	Litter	Moderate	material
r icimig beriand advining	Underwater noise disturbance	I	i i i i i i i i i i i i i i i i i i i
Fishing - benthic trawling	(behaviour)	Moderate	
Fishing - benthic trawling	Visual disturbance (behaviour)	Low	
rishing benune trawing	Removal of target species	LOW	
Fishing - benthic trawling	(lethal)	High	11
riching benanctawing	Removal of non-target species	<u> </u>	
Fishing - benthic trawling	(lethal)	High	
Fishing - benthic trawling	Siltation rate changes	High	
rishing - benulic trawing	Habitat structure changes -	<u> </u>	
	abrasion & other physical		
Fishing - benthic trawling	damage	High	
	Habitat structure changes -	<u></u>	
	removal of substratum		
Fishing - benthic trawling	(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	
	Underwater noise disturbance		•
Fishing - hydraulic dredging	(behaviour)	Moderate	
Fishing - hydraulic dredging	Visual disturbance (behaviour)	Low	
	Removal of target species		
Fishing - hydraulic dredging	(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 -	Inigii	
	abrasion & other physical		
Fishing - hydraulic dredging	damage	High	
	Habitat structure changes -		
	removal of substratum		
Fishing - hydraulic dredging	(extraction)	Low	
Fishing - pelagic trawling	Litter	Low	lost nets and shipping material + waste
r isning - pelagic trawing	Underwater noise disturbance	LOW	Illaterial + waste
Fishing - pelagic trawling	(behaviour)	Moderate	
	Removal of target species		•
Fishing - pelagic trawling	(lethal)	High	
	Removal of non-target species		
Fishing - pelagic trawling	(lethal)	Moderate	
Fishing - potting/creeling	Organic enrichment	Negligible	
Fishing - potting/creeling	Litter	Negligible	
Fishing potting/orgaling	Underwater noise disturbance	Negligible	
Fishing - potting/creeling	(behaviour)  Removal of target species	Negligible	
Fishing - potting/creeling	(lethal)	High	
	Removal of non-target species		
Fishing - potting/creeling	(lethal)	Negligible	
Fishing - recreational	Litter	Negligible	
	Underwater noise disturbance		
Fishing - recreational	(behaviour)	Negligible	
Fishing regressional	Removal of target species (lethal)	Low	
Fishing - recreational	(letrial)	LOW	lost nets and shipping
Fishing - set netting	Litter	Low	material
	Underwater noise disturbance		
Fishing - set netting	(behaviour)	Negligible	
Fishing - set netting	Visual disturbance (behaviour)	Moderate	
	Barrier to species movement		
Fishing - set netting	(behaviour, reproduction)	Moderate	
Fishing ast notting	Removal of target species	Lliab	
Fishing - set netting	(lethal)  Removal of non-target species	High	<u> </u>
Fishing - set netting	(lethal)	Low	
Fishing - shellfish harvesting	Input of nitrogen & phosphorus	Negligible	
Fishing - shellfish harvesting	Organic enrichment	Negligible	-
Fishing - shellfish harvesting	Litter	Negligible	
i isiling - shellilsh harvesting	LIMEI	Inediidinie	

Activity	Impact	Relevance	Comment
_	Underwater noise disturbance		
Fishing - shellfish harvesting	(behaviour)	Moderate	
Fishing - shellfish harvesting	Visual disturbance (behaviour)	Low	
Elektron akalifak kanasarian	Removal of target species		
Fishing - shellfish harvesting	(lethal)	High	
Fishing - shellfish harvesting	Removal of non-target species (lethal)	Negligible	
Fishing - shellfish harvesting	Siltation rate changes	High	
Fishing - Sheilish harvesting	Habitat structure changes -	ji ligii	
	abrasion & other physical		
Fishing - shellfish harvesting	damage	High	
	Habitat structure changes -		
	removal of substratum		
Fishing - shellfish harvesting	(extraction)	Low	
Fishing - shellfish harvesting	Habitat change (to another substratum)	High	
Fishing - Sheilish harvesting	Synthetic compound	i ligii	
	contamination (inc. pesticides,		
Aquaculture	antifoulants, pharmaceuticals)	Moderate	
Aquaculture	Organic enrichment	Moderate	
Aquaculture	Litter	Negligible	
7	Introduction of microbial	- 9 9 · -	
Aquaculture	pathogens (disease)	Moderate	
	Introduction or spread of non-		
A	indigenous species &	N4l	
Aquaculture	translocations (competition)	Moderate	
Aquaculture	Siltation rate changes	Negligible	
Beach replenishment	Water flow (tidal currents) rate changes - local	Low	
Deach replems intent	Emergence regime changes (inc.	LOW	
Beach replenishment	desiccation) - local	High	
Beach replenishment	Wave exposure changes - local	High	
	Non-synthetic compound		
	contamination - Heavy metals,		
Beach replenishment	Hydrocarbons (+produced water)	Negligible	
Beach replenishment	De-oxygenation	Negligible	Deep dredging
Beach replenishment	Input of nitrogen & phosphorus	Negligible	
Beach replenishment	Organic enrichment	Negligible	
	Underwater noise disturbance		
Beach replenishment	(behaviour)	Moderate	
Beach replenishment	Visual disturbance (behaviour)	High	
Pageb replanishment	Barrier to species movement	Lliah	
Beach replenishment	(behaviour, reproduction)  Removal of non-target species	High	
Beach replenishment	(lethal)	High	
Beach replenishment	Siltation rate changes	High	
23don replementation	Habitat structure changes -	į . 11911	
	abrasion & other physical		
Beach replenishment	damage	High	
	Non-synthetic compound		
Infrastructure - cables &	contamination - Heavy metals,	Nia ali ali I	corrosion protection,
pipelines	Hydrocarbons (+produced water)	Negligible	zinc anodes

Infrastructure - cables & pipelines Infrastructure - coastal (ports, marinas, leisure facilities)	Electromagnetic changes Underwater noise disturbance (behaviour) Habitat structure changes - abrasion & other physical	High Low	
Infrastructure - cables & pipelines Infrastructure - cables & pipelines Infrastructure - coastal (ports, marinas, leisure	Underwater noise disturbance (behaviour) Habitat structure changes - abrasion & other physical		
Infrastructure - cables & pipelines Infrastructure - coastal (ports, marinas, leisure	(behaviour) Habitat structure changes - abrasion & other physical	Low	
Infrastructure - cables & pipelines Infrastructure - coastal (ports, marinas, leisure	Habitat structure changes - abrasion & other physical	Low	
Infrastructure - cables & pipelines Infrastructure - coastal (ports, marinas, leisure	Habitat structure changes - abrasion & other physical		
pipelines Infrastructure - coastal (ports, marinas, leisure	abrasion & other physical		
pipelines Infrastructure - coastal (ports, marinas, leisure			l
Infrastructure - coastal (ports, marinas, leisure		Low	
(ports, marinas, leisure	damage	LOW	
	NATION (I and Clark and Control of Control o		
l tacilities)	Water flow (tidal currents) rate		
	changes - local	Negligible	
Infrastructure - coastal			
(ports, marinas, leisure	Emergence regime changes (inc.		
facilities)	desiccation) - local	Negligible	
Infrastructure - coastal			
(ports, marinas, leisure			
facilities)	Wave exposure changes - local	Low	
Infrastructure - coastal	Non-synthetic compound		-
(ports, marinas, leisure	contamination - Heavy metals,		
		Low	
facilities)	Hydrocarbons (+produced water)	LOW	-
Infrastructure - coastal	Synthetic compound		
(ports, marinas, leisure	contamination (inc. pesticides,		
facilities)	antifoulants, pharmaceuticals)	Low	
Infrastructure - coastal			
(ports, marinas, leisure			
facilities)	PBT	Low	
Infrastructure - coastal			
(ports, marinas, leisure			l l
	Endocrine disruption	Low	l l
,			
	Input of nitrogen & phoenhorus	Nogligible	
,	Input of filtrogen & phosphorus	rvegligible	1
,	Organic enrichment	Negligible	
(ports, marinas, leisure	Underwater noise disturbance		
facilities)	(behaviour)	High	
Infrastructure - coastal			
(ports, marinas, leisure			l l
	Visual disturbance (behaviour)	High	l l
	Trodai diotaroa (corravicar)	9	
	Parrier to enecies movement		
		Lliab	
	(benaviour, reproduction)	піgп	
	(lethal)	High	
(ports, marinas, leisure			
facilities)	Siltation rate changes	High	local
,			
		High	
,		i ligi i	-
(ports, marinas, leisure facilities)			
	! (extraction)	High	
Infrastructure - coastal (ports, marinas, leisure facilities) Infrastructure - coastal (ports, marinas, leisure	Input of nitrogen & phosphorus  Organic enrichment  Underwater noise disturbance (behaviour)  Visual disturbance (behaviour)  Barrier to species movement (behaviour, reproduction)  Removal of non-target species (lethal)  Siltation rate changes Habitat structure changes - abrasion & other physical damage Habitat structure changes - removal of substratum (extraction)	Negligible  Negligible  High  High  High	local

Activity	Impact	Relevance	Comment
Infrastructure - coastal		. TOIO VAI 100	
(ports, marinas, leisure	Habitat change (to another		
facilities)	substratum)	High	# 10 m
Infrastructure - coastal	Japonatamy	1 11911	
defence & land claim	Temperature changes - local	Negligible	
Infrastructure - coastal	Temperature changes - local	i vegligible	-
defence & land claim	Salinity changes - local	Nogligible	
		Negligible	
Infrastructure - coastal	Water flow (tidal currents) rate	Madarata	
defence & land claim	changes - local	Moderate	
Infrastructure - coastal	Emergence regime changes (inc.		
defence & land claim	desiccation) - local	Low	1
Infrastructure - coastal	1	N 41 1 -	
defence & land claim	Wave exposure changes - local	Moderate	
	Non-synthetic compound		
Infrastructure - coastal	contamination - Heavy metals,		
defence & land claim	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	Underwater noise disturbance		
defence & land claim	(behaviour)	High	
Infrastructure - coastal			
defence & land claim	Visual disturbance (behaviour)	High	
Infrastructure - coastal	Barrier to species movement	<u> </u>	
defence & land claim	(behaviour, reproduction)	High	
Infrastructure - coastal	Removal of non-target species	<u> </u>	
defence & land claim	(lethal)	High	
Infrastructure - coastal	(Ioural)	:g.,	
defence & land claim	Siltation rate changes	High	
defende a fana ciann	Habitat structure changes -	!g	
Infrastructure - coastal	abrasion & other physical		
defence & land claim	damage	High	11
Infrastructure - coastal	Habitat change (to another	i iigii	
defence & land claim	·	High	
Infrastructure - coastal	substratum)	i ligii	
defence & land claim	Habitat loss (to land)	High	
Infrastructure - offshore	Water flow (tidal currents) rate	i iigii	
	changes - local	Nogligible	
(artificial reefs)	changes - local	Negligible	
Infrastructure - offshore	Weye expenses shapes local	Nia ali albia	
(artificial reefs)	Wave exposure changes - local	Negligible	<u></u>
Laterate at an affair and tall	Non-synthetic compound		
Infrastructure - offshore (oil	contamination - Heavy metals,	<u> </u>	
& gas platforms)	Hydrocarbons (+produced water)	Negligible	
Infrastructure - offshore (oil	Underwater noise disturbance		
& gas platforms)	(behaviour)	Low	
Infrastructure - offshore (oil			***************************************
& gas platforms)	Visual disturbance (behaviour)	High	
Infrastructure - offshore (oil	Barrier to species movement		
& gas platforms)	(behaviour, reproduction)	Low	
Infrastructure - offshore (oil	Barrier to species movement		
& gas platforms)	(behaviour, reproduction)	High	

Activity	Impact	Relevance	Comment
	Introduction or spread of non-		
Infrastructure - offshore (oil	indigenous species &		
& gas platforms)	translocations (competition)	Low	
Infrastructure - offshore (oil			
& gas platforms)	Siltation rate changes	Negligible	
gare promotions,	Habitat structure changes -		
Infrastructure - offshore (oil	abrasion & other physical		
& gas platforms)	damage	Negligible	1
a gao pianomio,	Habitat structure changes -	1.109.19.10	
Infrastructure - offshore (oil	removal of substratum		1
& gas platforms)	(extraction)	Negligible	B
Infrastructure - offshore (oil	Habitat change (to another	Trogngiolo	
& gas platforms)	substratum)	High	very local
Infrastructure - offshore	Water flow (tidal currents) rate	I ligit	Very local
(wind turbines)	changes - local	Negligible	
Infrastructure - offshore	Changes local	Tracgiigibic	
(wind turbines)	Wave exposure changes - local	Negligible	
(wind turblines)	Non-synthetic compound	ivegligible	
Infrastructure - offshore	contamination - Heavy metals,		
	Hydrocarbons (+produced water)	Nogligible	
(wind turbines)	Hydrocarboris (+produced water)	Negligible	
Infrastructure - offshore		Nia aliaibia	
(wind turbines)	Electromagnetic changes	Negligible	
Infrastructure - offshore	Underwater noise disturbance	N 4	
(wind turbines)	(behaviour)	Moderate	**************************************
Infrastructure - offshore			
(wind turbines)	Visual disturbance (behaviour)	High	
	Introduction or spread of non-		
Infrastructure - offshore	indigenous species &		
(wind turbines)	translocations (competition)	Low	
Infrastructure - offshore	Habitat change (to another		
(wind turbines)	substratum)	High	
	Non-synthetic compound		
	contamination - Heavy metals,		
Tourism & recreation	Hydrocarbons (+produced water)	Negligible	
	Synthetic compound		
	contamination (inc. pesticides,		
Tourism & recreation	antifoulants, pharmaceuticals)	Negligible	
Tourism & recreation	Organic enrichment	Negligible	
Tourism & recreation	Litter	High	
Todriom a rocioadori	Habitat structure changes -	g.:	
	abrasion & other physical		
Tourism & recreation	damage	Negligible	
Seismic survey (military,	Underwater noise disturbance	rtogrigibio	
exploration, construction)	(behaviour)	High	if it explodes = 4
Seismic survey (military,	Removal of non-target species	i iigii	in it explodes = 4
exploration, construction)	(lethal)	High	
exploration, construction)	Non-synthetic compound	1 11g11	
	contamination - Heavy metals,		
Shipping	Hydrocarbons (+produced water)	Moderate	
Chipping	Synthetic compound	iviouerate	
	contamination (inc. pesticides,		
Shipping		Low	
Shipping	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
· · · · ·	~		Gruise strips
Shipping	Litter	High	
Chinning	Underwater noise disturbance	Lliab	
Shipping	(behaviour)	High	
Shipping	Visual disturbance (behaviour)	Moderate	
	Introduction of microbial	<b></b>	
Shipping	pathogens (disease)	Moderate	
	Introduction or spread of non-		
Shipping	indigenous species &	Lliah	
Shipping	translocations (competition) Habitat structure changes -	High	
	abrasion & other physical		
Shipping	damage	Negligible	
Shipping	Non-synthetic compound	inegligible	
Pollution - air-based sources	contamination - Heavy metals,		
(inc. greenhouse gases)	Hydrocarbons (+produced water)	Moderate	
Pollution - air-based sources	Tryurodarbono (Tproduced Water)	I	
(inc. greenhouse gases)	PBT	Moderate	PAHs
Pollution - air-based sources		Iniduciate	1 7 11 10
(inc. greenhouse gases)	Input of nitrogen & phosphorus	Moderate	
Pollution - air-based sources	<u> </u>		
(inc. greenhouse gases)	Organic enrichment	Negligible	
Pollution - land-based			
sources	Temperature changes - local	Negligible	
Pollution - land-based			
sources	Salinity changes - local	Negligible	
	Non-synthetic compound		
Pollution - land-based	contamination - Heavy metals,		
sources	Hydrocarbons (+produced water)	High	
	Synthetic compound		
Pollution - land-based	contamination (inc. pesticides,		
sources	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	Onnania amidala and	NA - James	
Sources	Organic enrichment	Moderate	
Pollution - land-based	Vigual diaturbanes (habasiassa)	Nogligible	
Sources  Pollution land based	Visual disturbance (behaviour)	Negligible	
Pollution - land-based	Introduction of microbial pathogens (disease)	Mogligible	
sources	<u> </u>	Negligible	
Pollution - sewerage	Temperature changes - local	Negligible	
Pollution - sewerage	Salinity changes - local	Negligible	
	Non-synthetic compound		
	contamination - Heavy metals,		
Pollution - sewerage	Hydrocarbons (+produced water)	LOW	

Activity	Impact	Relevance	Comment
	Synthetic compound		
	contamination (inc. pesticides,		
Pollution - sewerage	antifoulants, pharmaceuticals)	Low	
Pollution - sewerage	PBT	Low	
Pollution - sewerage	Endocrine disruption	Low	
Pollution - sewerage	Visual disturbance (behaviour)	Negligible	
5	Introduction of microbial		
Pollution - sewerage	pathogens (disease)	Low	
Pollution - sewerage	Siltation rate changes	Low	
Waste disposal - fish waste			
(land-based processing;			
processing vessels)	Organic enrichment	Low	
	Non-synthetic compound		
Waste disposal - munitions	contamination - Heavy metals,		
(chemical & conventional)	Hydrocarbons (+produced water)	Negligible	
	Synthetic compound		
Waste disposal - munitions	contamination (inc. pesticides,		
(chemical & conventional)	antifoulants, pharmaceuticals)	Negligible	
Waste disposal -			
navigational dredging	Water flow (tidal currents) rate		
(capital, maintenance)	changes - local	Negligible	
Waste disposal -			
navigational dredging	Emergence regime changes (inc.		
(capital, maintenance)	desiccation) - local	Negligible	
Waste disposal -			
navigational dredging			
(capital, maintenance)	Wave exposure changes - local	Negligible	
Waste disposal -	Non-synthetic compound		
navigational dredging	contamination - Heavy metals,		
(capital, maintenance)	Hydrocarbons (+produced water)	Moderate	
Waste disposal -	Synthetic compound		
navigational dredging	contamination (inc. pesticides,		resuspension and
(capital, maintenance)	antifoulants, pharmaceuticals)	Moderate	remobilisation
Waste disposal -	Synthetic compound		
navigational dredging	contamination (inc. pesticides,		resuspension and
(capital, maintenance)	antifoulants, pharmaceuticals)	Moderate	remobilisation
Waste disposal -			
navigational dredging			resuspension and
(capital, maintenance)	PBT	Moderate	remobilisation
Waste disposal -			
navigational dredging			resuspension and
(capital, maintenance)	Endocrine disruption	Moderate	remobilisation
Waste disposal -			
navigational dredging			
(capital, maintenance)	De-oxygenation	Negligible	
Waste disposal -			
navigational dredging		   N.A !	
(capital, maintenance)	Input of nitrogen & phosphorus	Moderate	
Waste disposal -			
navigational dredging		N 41	
(capital, maintenance)	Organic enrichment	Moderate	
Waste disposal -			
navigational dredging	Violation distant		
(capital, maintenance)	Visual disturbance (behaviour)	Low	

Activity	Impact	Relevance	Comment
Waste disposal -			11 H
navigational dredging	Barrier to species movement		
(capital, maintenance)	(behaviour, reproduction)	Negligible	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
Waste disposal -			
navigational dredging	Removal of non-target species		
(capital, maintenance)	(lethal)	Moderate	
Waste disposal -			
navigational dredging			
(capital, maintenance)	Siltation rate changes	High	
Waste disposal -	Habitat structure changes -		
navigational dredging	abrasion & other physical		
(capital, maintenance)	damage	High	
Waste disposal -			
navigational dredging	Habitat change (to another		
(capital, maintenance)	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	Water flow (tidal currents) rate		
(Annex I)	changes - local	low	low
Intertidal seagrass beds	Salinity changes - local	none	negligible
<u> </u>	Wave exposure changes - local	negligible	none
Water (and sediment) quality	De-oxygenation Input of nitrogen & phosphorus Organic enrichment Introduction of microbial pathogens (disease) Introduction or spread of non- indigenous species & translocations	negligible negligible negligible negligible	considerable low low high
	(competition)	considerable	low
	Removal of target species (lethal) Removal of non-target species (lethal)	considerable high	low 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) Synthetic compound contamination (inc. pesticides, antifoulants, pharmaceuticals)  De-oxygenation	negligible negligible negligible	low low high
Ocean and atmospheric			
processes	Atmospheric climate change	considerable	considerable
Phytoplankton	Atmospheric climate change	none	high
Fish	pH changes Temperature changes - regional/national Salinity changes - regional/national	low low	low low
	Water flow (tidal & ocean currents) rate changes - regional/national	negligible	low
	rate orianges regional/national	FUCAURING	IOVV

Ecosystem Component	Impact	Resistance	Resilience
zeceyetem compension	Non-synthetic compound	T toolotanoo	T COMOTION
	contamination - Heavy metals, Hydrocarbons (+produced water) Synthetic compound contamination	low	low
	(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) Habitat structure changes - abrasion & other physical damage	none	low
	Habitat structure changes - removal of substratum (extraction)	low	low
Ocean and atmospheric	- Casonatani (Oznacion)		
processes	pH changes Temperature changes -	considerable	considerable
	regional/national	negligible	none
Air-sea exchanges	Atmospheric climate change	considerable	considerable
	pH changes	considerable	considerable
	Temperature changes - regional/national	negligible	considerable
рН	Atmospheric climate change	considerable	low
Temperature regimes	Atmospheric climate change Water flow (tidal & ocean currents)	low	low
	rate changes - regional/national	negligible	high
Current regimes	Atmospheric climate change	considerable	low
Wave regime & sea level	Atmospheric climate change Water flow (tidal & ocean currents)	considerable	low
	rate changes - regional/national	negligible	high
Water (and sediment) quality	Non-synthetic compound contamination - Heavy metals, Hydrocarbons (+produced water) Synthetic compound contamination	negligible	low
	(inc. pesticides, antifoulants, pharmaceuticals) PBT	negligible negligible	low negligible
Levels of other chemicals & heavy metals	PBT	negligible	negligible
Seabed habitats, communities & species	De-oxygenation	none	low
	Organic enrichment Introduction or spread of non- indigenous species & translocations	considerable	considerable
	(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 Habitat structure changes - abrasion	considerable	considerable
	& other physical damage Habitat structure changes - removal	none	low
	of substratum (extraction) Habitat change (to another	none	low
	substratum)	none	none
	Habitat loss (to land)	none	none
Coastal features:	pH changes Temperature changes - regional/national	none considerable	none
	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 Emergence regime changes (sea	considerable	considerable
	level) - regional/national	considerable	considerable
	Wave exposure changes - regional/national Emergence regime changes (inc.	considerable	considerable
	desiccation) - local	none	negligible
Saltmarsh (Annex I)	Salinity changes - local	low	considerable