

Sustainable management of the marine ecosystem through a marine spatial planning serious game



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Sustainable management of the marine ecosystem through a Marine Spatial Planning serious game

Bachelor thesis project for developing an action plan for a Marine Spatial Planning serious game with the emphasis on sustainable management of the marine ecosystem in the Dutch North Sea

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Preface

You find yourself reading the thesis report “*Sustainable management of the marine ecosystem through a Marine Spatial Planning serious game*”. We are two Coastal and Marine Management students and during this BSc program we have been active on the subjects of Marine Spatial Planning and marine policy. We wrote this thesis report in response to a call-out from our teacher David Goldsborough, who saw that change was needed for the current Marine Spatial Planning serious game, as used during the BSc program Coastal and Marine Management. Jeroen Vis from the Ministry of Agriculture, Nature and Food Quality saw this project as an opportunity to bring nature into the MSP process as a bigger player. This research was conducted during the time period of February 2020 till June 2020.

We would like to thank David Goldsborough and Jeroen Vis for giving us the opportunity to do this research and steering us in the right direction. We also appreciate the contacts they provided us with for the interviews.

We would also like to thank our interviewees for providing us with insight information about the MSP process in real-life and their visions on Ecosystem-Based Management and how the human activities affect the marine ecosystem.

Furthermore, we would like to thank Esmee Bannenberg and David Goldsborough for their guidance throughout the process and their valuable feedback on our work. Without their input, this project would have had a completely different perspective, this was also thanks to Jeroen.

The past five months have an intensive period for us, due to the fact that it was our thesis project and due to Covid-19 restrictions. Nevertheless, we were still extremely motivated to conduct the research and we are very proud of the work we have delivered.

We hope you will enjoy reading our report.

Best regards,

Elske Koelma and Anoek Meijer

Abstract

To limit the pressure on the marine ecosystem, the European Unions' Marine Strategy Framework Directive (MSFD) was developed to ensure sustainable use of the marine ecosystem. The goal of the MSFD is to achieve Good Environmental Status (GES). To achieve this goal, the MSFD prescribes using Ecosystem-Based Management (EBM). However, the implementation of EBM is difficult. To make it easier, use can be made of Marine Spatial Planning (MSP). To create understanding about MSP, a Marine Spatial Planning serious game (MSP SG) can be performed. Such a game can also help visualise the implementation of EBM and further management of marine ecosystems. Since the implementation of EBM in a MSP SG is also a difficult task, actions have to be taken. Therefore, it is necessary to understand how an action plan for a MSP SG can be developed that includes effects of human activities on the marine ecosystem and how GES can be achieved with the use of EBM. Results of a literature review and interviews conducted with stakeholders involved in real-life MSP processes, show that a MSP SG needs to be realistic. Furthermore, there are many uncertainties regarding the positive and negative effects of human activities on the marine ecosystem. In terms of EBM, the implementation is very difficult and has multiple definitions, but are all carrying the same key features. EBM is prescribed by the MSFD for Member States to use for the achievement of GES. The proposed MSP SG developed for this research, focusses on the Dutch North Sea. The game contains visualisation tools for the effects of human activities, implementation of EBM, and for measures under MSFD.

Abbreviations

EBM = Ecosystem-Based Management

GES = Good Environmental Status

MSFD = Marine Strategy Framework Directive

MSP = Marine Spatial Planning

MSPD = Maritime Spatial Planning Directive

MSP SG(s) = Marine Spatial Planning serious game(s)

OSPAR = Oslo / Paris Conventions Protecting and conserving the North-East Atlantic

OWF(s) = Offshore Wind Farm(s)

SDG(s) = Sustainable Development Goal(s)

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1 Introduction

What is sustainable management? Scientists and policy makers have a different understanding of how an ecosystem can be sustainably conserved and managed, and their scientific papers and policy documents do not always have a clear description of what they try to achieve in terms of sustainability. Especially sustainable conservation and use of the oceans is not well defined, since the ocean is such a complex system with a range of users and many uncertainties of the effect of human use on the ecosystem. For the sustainable management of marine areas in a social, economic and environmental perspective, strategies have been adopted on global, European and national scale aiming for a sustainable ecosystem. Except due to the contradicting views on sustainability the eventual goals and strategies may differ significantly. Therefore, the member states of the United Nations adopted a set of 17 Sustainable Development Goals (SDGs), aiming to end problems such as poverty, improve health and education, reduce inequality, and stimulate economic growth. At the same time the SDGs aim to tackle climate change and preserve oceans and forests (United Nations, n.d-a). One of the SDGs addresses Life Below Water (SDG 14) and aims to preserve and use the seas and marine resources in a sustainable manner, so they can be used for sustainable development (United Nations, n.d.-b). The oceans face many threats like plastic and nutrient pollution, depletion of resources, and climate change, most of which are caused by human activities. Because of these threats, biodiversity and marine ecosystems are even more pressured than they already are, which creates global socio-economic problems and risks for finances, health and safety. These threats can be battled by promoting ocean sustainability and developing innovative solutions that prevent and mitigate impacts on the marine ecosystems (SDG Compass, 2015). The SDGs were developed to create a coherent management strategy for sustainability. Besides the SDGs, other directives have been developed to specify the sustainable management of the marine ecosystem, such as the Marine Strategy Framework Directive (MSFD) or the Maritime Spatial Planning Directive (MSPD).

The MSFD was developed by the European Union to protect and restore ecological quality or integrity. This is the umbrella directive of Europe when it comes to regulations for marine water systems (Borja, Elliot, Carstensen, Heiskanen, & van de Bund, 2010; van Hoey et al., 2010). The MSFD is a directive that forms a framework, which is linked to other directives and management approaches like Ecosystem-Based Management (EBM) (Lyons et al., 2010). The key goal of the MSFD is Good Environmental Status (GES) and it should be achieved and maintained for marine waters, marine ecosystems and marine resources (Borja et al., 2010). The description given by the European Commission (2019b) on GES is that “different uses made of the marine resources are conducted at a sustainable level, ensuring their continuity for future generations”. In addition, the ecosystems should be in a healthy status and used sustainably by several different sectoral uses. Furthermore, the decrease of biodiversity is prevented, and is the biodiversity protected. Also, human activities are not allowed to cause pollution (Borja et al., 2010; Borja et al., 2011; European Commission, 2019b). This definition from the European Commission shows the integration of the EBM strategy within the directive, which addresses the complexity of ecosystems and how human uses integrate in these systems (Altvater & Passarello, 2018).

The growing pressure on the marine ecosystem is caused by an increase of human activities that take place in the marine ecosystems, therefore effective management of the marine ecosystem in the form of Marine Spatial Planning (MSP)¹ is needed (European Commission, n.d.). MSP works across country and sectoral borders and ensures the possibility for human activities at sea to happen in an effective, safe and sustainable way (European Commission, n.d.).

¹ Marine Spatial Planning and Maritime Spatial Planning are both used in literature, revering to a similar management strategy.

The definition of “Marine” (2020), according to the Cambridge dictionary, is “related to the sea or sea transport.” The definition of “Maritime” (2020) is according to the Cambridge dictionary “connected with human activity at sea.”

In terms of Marine Spatial Planning the Word Ocean Council provides the following definition; “Marine Spatial Planning is the process of analysing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic and social objectives.” (World Ocean Council, 2020)

In terms of Maritime Spatial Planning the European Commission (n.d) provides the following definition; “Works across borders and sectors to ensure human activities at sea take place in an efficient, safe and sustainable way.”

The most commonly used definition is Marine Spatial Planning and for that reason this definition is the one used for this research.

To make plans more specific for sustainable use of the marine areas, MSP is also used as a tool for allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic and social objectives (World Ocean Council, 2020).

MSP is described in the MSPD (Directive 2014/89/EU of 23 July 2014, 2014), as follows; “the application of an Ecosystem-Based approach will contribute to promoting the sustainable development and growth of the maritime and coastal economies and the sustainable use of marine and coastal resources.”. This citation from the MSPD indicates the importance of economic growth and sustainable use and is more related to achieving the Blue Growth Strategy² then achieving environmental goals (Santos, Domingos, Ferreira, Orbach, & Andrade, 2014).

In the Netherlands, Marine Spatial plans have also been written for managing the use of marine areas. Currently the National Water Plan 2016 – 2021 is in operation but is coming to the end of its policy cycle. The process for the National Water Program 2022 – 2027 already started in 2019 (Helpdesk Water, n.d.). These plans also include implementation of measures to achieve GES in the Dutch North Sea (Noordzeeloket, n.d.-b). The North Sea Agreement 2030, which is still under discussion, will provide guidance on future development and management of the North Sea. The North Sea Agreement 2030 focusses on a resilient nature, a future-proof food supply, and a sustainable energy supply (see Figure 1). According to IDON (2017), before the North Sea Agreement 2030, several stakeholder meetings had been organized to scope this strategy. The idea of the meetings was for the involved stakeholders to discuss the three strategic aspects of the triangle, which contributed to developing a common language amongst the stakeholders during the North Sea Agreement negotiations.

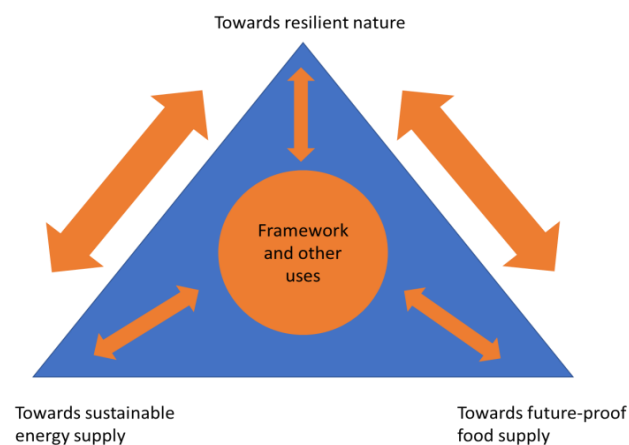


Figure 1. Strategic assignment triangle; this triangle developed by IDON illustrates interaction between three strategic assignments, which contribute to the development of the Dutch North Sea (IDON, 2017) [adapted accordingly]

During preliminary research it was observed, when looking at the implementation of the before mentioned marine management strategies (MSFD, MSPD, and Blue Growth Strategy), that the planning for the marine ecosystem is less precise. For example, looking at the implementation of EBM in MSP, no specifications are given on how GES can be achieved for the marine ecosystem, with the assistance for sustainable management of human activities (Directive 2014/89/EU of 23 July 2014, 2014). Discussions on sustainable management of the marine ecosystem are important and could be stimulated by emphasizing this aspect in a Marine Spatial Planning serious game (MSP SG). MSP Challenge (n.d.-b) mentions that a MSP SG could provide a platform for discussions, by showing stakeholders the importance of sustainable use of the marine ecosystem. They enable stakeholders to discuss important subjects, consider specific spatial planning, and contribute to visualisation of interests and conflicts in the marine area. As mentioned earlier, the sectoral use of marine areas is increasing, therefore an effective marine spatial plan is needed. MSP accommodates management of human activities in the marine areas, however the distribution and planning of the marine space in practice is more difficult. According to Abspoel et al. (2019) and Goncalves et al. (2019) a MSP process

² The Blue Growth Strategy is an initiative for different sectors to use the European seas sustainable and to respect the potential environmental concerns for the marine environment (European Commission, 2012; European Commission, 2017).

can be facilitated with a MSP SG. The game functions as a tool for visualisation, communication, negotiation, conflict management, and to better understand MSP. A MSP SG gives participants experience of how a real life MSP process takes place and how to work together with different stakeholders. The visioning of MSP also helps to encourage stakeholders to think outside their usual box, to think outside of their sectoral interest, and can consider the bigger picture and to inspire questions on “what if”? (Lukic, Schultz-Zehden, & de Grunt, 2018). Abspoel et al. (2019) mentions the following about MSP SGs: “The MSP Challenge’s ‘learning by doing’ or ‘learning by playing’ approach is both enjoyable and informative for participants”.

In the past several MSP SGs have been developed and played in different countries. The BalticSeaPlan Vision 2030 was developed jointly by seven Baltic countries, giving the process a range of different backgrounds and perspectives (Lukic et al., 2018). The MSP Challenge 2050, which is a computer supported simulation-game, is an interactive tool to discuss and explore the challenges of MSP, but also includes the European Union MSFD on how to achieve GES (European MSP Platform, n.d.). In addition, the Van Hall Larenstein University of Applied Sciences developed a MSP SG course for Coastal and Marine Management students. The online program SeaSketch is used as a visualisation tool for students to discuss spatial proposals for offshore wind farms in the Dutch North Sea in the year 2030. These games all emphasis the efficient and effective use of marine space, however, they do not focus specifically on EBM.

When analysing marine related directives, it is clear that goals and initiatives, regarding the marine ecosystem, are less considered further on in the directives. In addition, Reid (2016) mentioned the following about the Blue Growth Strategy: “It might also be seen as an initiative to support economic growth and making the transition to a competitive economy, which is also knowledge-based.” It was also seen in the MSFD and MSPD that at the start, the importance of conserving the ecosystem and at the same time maintaining economic growth and social-economic values, is always mentioned. It is apparent that later on in the directives, the conservation of the ecosystem is of a lesser importance than economic (human) activities. With the growing activities at sea the pressure on the marine environment is increasing. To ensure that there will not be an irreversible collapse of the marine ecosystem by the increasing pressures, sustainable management of the marine ecosystem (EBM) should be taken more seriously (Reid, 2016). By using a MSP SG first steps can be taken towards applying true EBM in the marine ecosystem. Currently a MSP SG in which stakeholders apply EBM directly into the game does not exist. The original plan was to develop and execute a MSP SG, except during the project it became clear that the development of a new MSP SG was not feasible, due to Covid-19 restrictions. After consultation with the problem owners it was decided that the authors would give input for the future MSP SG and develop and action plan with additional conceptual models and interactive figures.

In addition to the Strategic Assignment Triangle, see Figure 1, one aspect of the triangle is towards resilient nature, which is also mentioned in the MSPD in the form of implementing EBM. According to Directive (Directive 2014/89/EU of 23 July 2014, 2014) and Santos et al. (2014) EBM is the underlying principle for MSP to keep the pressure of human activities within limits, and to ensure the achievement of GES, which is the goal of the MSFD (Commission Decision of 1 September 2010, 2010). To conclude, EBM is implemented in both MSP and MSFD, and for that reason MSP could also be used as a tool to reach GES.

1.1 Problem statement

In order to achieve Good Environmental Status, the Marine Strategy Framework Directive prescribes that Ecosystem-Based Management should be used. However, EBM is a difficult concept to grasp and there are no specifications on how GES can be achieved for the marine ecosystem, with the application of sustainable management of human activities. In order to implement EBM, Marine Spatial Planning can be used as a tool (Brennan, Fitzsimmons, Gray, & Raggatt 2014). A MSP serious game could help facilitate the process of implementing EBM, but a serious game including EBM and how it reflects on GES does not exist.

1.2 Goal

The goal of this thesis is to develop an action plan for a Marine Spatial Planning serious game which includes how human activities affect the marine ecosystem and what measures are taken to achieve Good Environmental Status, with use of an Ecosystem-Based Management.

1.3 Research question

How can an action plan for a Marine Spatial Planning serious game be developed that includes effects of human activities in the Dutch North Sea on the marine ecosystem, and measures that can be taken to achieve GES, with the use of Ecosystem-Based Management?

1. What are the lessons learned from existing Marine Spatial Planning serious games?
2. How can effects of human activities on the marine ecosystem be visualized in a future Marine Spatial Planning serious game?
3. How can Ecosystem-Based Management be part of a Marine Spatial Planning serious game?
4. How can the Marine Strategy Framework Directive be integrated in a future Marine Spatial Planning serious game?

1.4 Reading guide

In *chapter 2 Methods*, the research scope is described and the methods used for this research are explained. In *chapter 3 Lessons Learned*, the results of the analysis of the existing MSP challenges are described and what successful or challenging elements were. In the conclusion of this chapter these elements are taken into consideration on how they can be applied in the future MSP serious game. The next chapter, *chapter 4 ecological effects from human activities*, describes the positive, neutral and negative effects of the fisheries and offshore wind sectors. This chapter also shows conceptual models which visualises the effects on the marine ecosystem and how they relate to each other. Also, an interaction triangle of the three aspects and how the effects influence the interaction between the aspects is shown. These models are given to the participants of the MSP SG. In *chapter 5 Integration of Ecosystem-Based Management*, the management strategy of EBM is described and the additional results of the literature review on the definition of EBM. The definition that is given will be used by the participants in the future MSP SG. In the following chapter, *chapter 6 Marine Strategy Framework Directive*, the results of the literature review on the implementation of the MSFD in the Netherlands are presented. Then the results on the current status of the marine ecosystem is described and the measures on achieving GES are considered. Finally, this chapter discusses how the current status and the measures will be integrated into the future MSP SG. Next in the discussion the validity, reliability, limitations and challenges of this thesis project, but also the drawbacks in policy documents are debated. In the conclusion the research question “*How can an action plan for a Marine Spatial Planning serious game be developed that includes effects of human activities in the Dutch North Sea on the marine ecosystem, and measures taken to achieve GES, with the use of an Ecosystem-Based Management approach?*” is answered. In the last chapter, recommendations for future work are given.

2 Methods

2.1 Research scope

The scope is the Dutch Exclusive Economic Zone and its environmental properties (see Figure 2). According to ICES (2019) the seabed of the Dutch North Sea consists mostly of soft sediment and patches of biogenic reefs. The areas covering the coastal zones contain mobile sediment types, such as mud, bolder and sand beaches. The most important pressures on the ecosystem of the North Sea are linked to fishing, shipping, coastal construction, gas production, dredging, sand extraction, tourism, military, and the construction of wind farms. ICES (2019) also mentions that benthic habitats are impacted by fishing, dredging and sand extraction, at the same time hard substrate is increased by the construction of wind farms, gas platforms and shipwrecks, which can cause a rise in local hard substrate biodiversity. Due to the many sectoral interests, selections for which sectors to involve were made. Within this research the focus will be on fisheries, nature (marine ecosystem) and renewable energy production (offshore wind farms (OWF)). Based on the Strategic Assignment Triangle (Figure 1, page 7) these three aspects were chosen. From these aspects the stakeholders, as presented in Table 1, were selected for the interviews. In addition, the stakeholders were also selected based on the following definition by Keijser, Ripken, Warmelink et al. (2018): “stakeholders have been defined as individuals, groups or organisations who are, in one way or another, interested, involved or affected (positively or negatively) by a particular project or action towards resources”. For a specific stakeholder description see

Appendix I.

Table 1. Selected stakeholders for the interviews

Code	Organisation	Date of interview
LNV-Nat	Ministry of Agriculture, Nature and Food Quality	15 April 2020
LNV-Vis-1	Ministry of Agriculture, Nature and Food Quality	20 April 2020
LNV-Vis-2	Ministry of Agriculture, Nature and Food Quality	28 April 2020
StNZ	North Sea Foundation	16 April 2020
TenneT-AOGD	TenneT	16 April 2020
TenneT-SA	TenneT	16 April 2020
VisNed-BM	VisNed	9 April 2020
VisNed-Dir	VisNed	7 April 2020
Wetenschap-PA	Personal advisor	17 April 2020
Wetenschap-RBINS	Royal Belgian Institute of Natural Sciences	21 April 2020
Wetenschap-WUR	Wageningen Marine Research	17 April 2020
HVHL-SG	Van Hall Larenstein University of Applied Sciences	14 April 2020
I&W-SG	Ministry of Infrastructure and Water Management	24 April 2020
RWS-SG	Rijkswaterstaat	24 April 2020

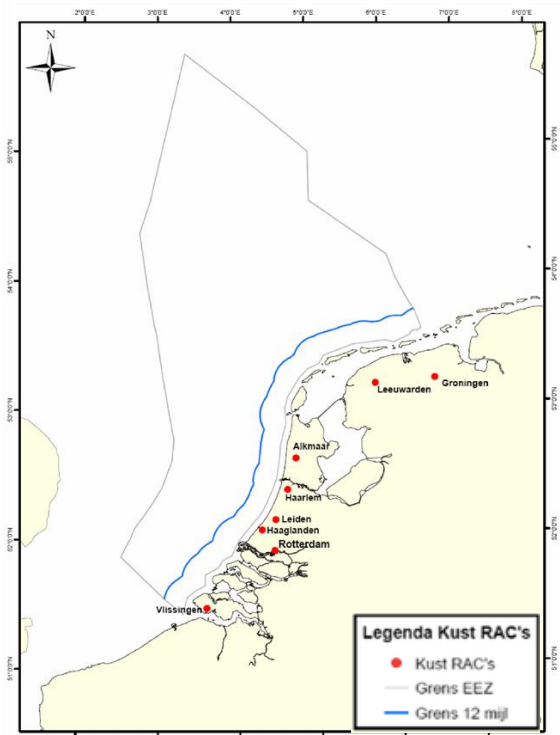


Figure 2. The Netherlands and its Exclusive Economic Zone (Wettenbank, 2009).

2.2 Methods Lessons Learned

What are the lessons learned from existing Marine Spatial Planning serious games?

The first step to answering this sub-question was by conducting literature research about the already existing serious games. The following games were researched:

1. MSP Challenge 2011;
2. The Short Sea Shipping Edition;
3. MSP Challenge 2050; and
4. MSP Challenge Simulation Platform.

These four games were chosen since they are the best known MSP SGs and are often used in different settings (MSP Challenge, n.d.-a). The MSP SGs have been played at conferences, and universities, but have also been used for specific meetings for several sectors. For example, stakeholder sessions in ecology, energy and shipping have been held (MSP Challenge, n.d.-d).

To analyse lessons learned, the following two elements were used to review the already existing games:

1. Elements that made the game successful; and
2. Elements that created challenges.

In order to find these elements, the following search words were used to find scientific papers, on Google Scholar and Greeni, related to the four games mentioned above:

- MSP Serious game
- MSP Challenge 2011
- MSP Board Challenge
- MSP board game Short Sea Shipping Edition
- MSP Challenge 2050
- MSP Challenge Simulation Platform

With these search words scientific papers between the years 2014 to 2019 were found. In total, a time period of one week was spent searching for scientific papers. These papers were then read and analysed with the two elements mentioned, on which another week was spent.

Because of these two elements, challenges in already existing MSP SGs were found, and how they were dealt with, but also what successful elements were in the games. Challenges and successful elements of the four games were placed into a matrix, see Table 2 for an example.

Furthermore, the authors had contact with two employees from the Ministry of Infrastructure and Water Management, and Rijkswaterstaat, whom are both involved with the developments of the four MSP Challenges. The second step was to discuss the found challenges and successful elements and receive more insights in what the developers did to solve these, and what lessons learned are according to them. Therefore, an interview was conducted with I&W-SG from the Ministry of Infrastructure and Water Management and RWS-SG from Rijkswaterstaat (see Table 1, page 10 or Appendix I). In Appendix II the blueprint for the interview can be found. The interview was held through an online Skype meeting. The interview was recorded, transcribed and according to the given answers, codes were enlisted.

These codes (translated from Dutch) were:

1. Participants MSP serious game
2. MSP Challenges
3. Available information
4. MSP board game
5. Role Game Overall Director

6. Differences MSP Challenges
7. Successful elements
8. Points of improvements
9. Length game

These codes were assigned to text fragments using the program MAXQDA, for the full coded transcripts in Dutch see Appendix III. When the text was analysed with MAXQDA, the points of improvement and successful elements were added to the matrix, according to the MSP Challenge. Another interview was held with an lecturer of Van Hall Larenstein University of Applied Sciences. The action plan that has been developed is for the future MSP SG that will be used in module LKZ308 for students of the BSc program Coastal and Marine Management. With HVHL-SG the current MSP SG was discussed, and points of improvement and successful elements of the game. This interview was analysed with MAXQDA as well, and codes 7 and 8 were used for this analysis. The information that was retrieved during the interview with HVHL-SG was not included in the matrix, but is included in *chapter 3 Lessons learned*, since that current game is the starting point for the future MSP SG.

As mentioned, the answers that were given during the interview with I&W-SG and RWS-SG were included in the lessons learned matrix as well, and with that matrix the authors had a full overview with aspects that made the MSP SGs successful, and what challenges were. With all the information in the matrix, the authors used this information to write the successful and challenging elements of the MSP SGs in *chapter 3 Lessons Learned*. The next step was to conclude what lessons learned would be taken into account for the future MSP SG. These conclusions were based on the lessons learned that could be used to improve the MSP SG. Table 2 shows an overview of the set-up of the matrix and in Appendix IV the analysis matrix can be found.

Table 2. Outlay of the matrix that was used for the analysis. Horizontally all serious games were placed and information according to the aspects (vertical, left) have been written down in the matrix. This information exists of literature study and interviewees' answers for each of the serious game than was concluded what lessons learned could be used for the to be developed serious game, as written in Chapter 4 Lessons Learned.

	MSP Challenge 2011	MSP Challenge 2050	Short Sea Shipping board game Edition	MSP Challenge Simulation Platform
	Scientific Articles + Interviewees answers	Scientific Articles + Interviewees answers	Scientific Articles + Interviewees answers	Scientific Articles + Interviewees answers
Aspects that made the game successful				
Aspects that created challenges				

2.3 Methods effects from human activities

How can effects of human activities on the marine ecosystem be visualized in a future Marine Spatial Planning serious game?

The human activities that were selected for this research were fisheries and offshore wind energy. These sectors play an important role in the North Sea Strategy 2030 and are also part of the Strategic Assignment Triangle in terms of sustainable energy (OWF) and future proof food supply (fisheries). The first step in answering this sub question was to perform a literature review on the effects of fisheries and OWF on the marine ecosystem. Two weeks were spent searching for scientific papers on Google Scholar and Greeni.

The following search words were used to find scientific papers on effects of fisheries:

- Effects fisheries marine ecosystem
- Effects fishing gear marine ecosystem
- Fishing impact on marine wildlife
- Ecosystem effects of fisheries
- Environmental impact assessments fisheries

The following search words were used to find scientific papers on effects of OWF:

- Effects offshore wind marine ecosystem
- Effects offshore wind marine wildlife
- Ecological effects offshore wind farms
- Environmental impact assessments offshore wind farms
- Biogenic reefs

With these search words scientific papers about fisheries were found between the years of 1994 and 2018, and for OWF between the years of 1998 and 2019.

The found scientific papers were reviewed and analysed according to three effects:

1. Positive effects
2. Neutral effects
3. Negative effects

All effects that were found in the literature were put in an effect scale ranging; positive / neutral / negative. The effects were placed in the scale according to what was mentioned in literature and based on the knowledge of the authors. Table 3 shows how the effect scale was used and for the result of the matrix see Appendix VI. The analysis of the scientific papers and processing in the effect scale took two weeks.

Table 3. Vertically the two sectors are placed. With reviewed literature and interviews found effects of the sectors can be placed in the table, under positive, neutral, or negative effects.

	Positive effects	Neutral effects	Negative effects
Fisheries articles + interviewees answers			
Offshore wind energy articles + interviewees answers			

The second step was to verify the effects from literature with stakeholders, which represented the three aspects: nature, fisheries and OWF. Therefore, interviews were held with stakeholders who are familiar with the effects that fisheries and OWF may have on the marine ecosystem and are also familiar with the MSP process from real life experience. The reason why these stakeholders were chosen to interview, is because these stakeholders will be represented by students participating in the future MSP SG. Employees from the following stakeholders were interviewed: Ministry of Agriculture, Nature and Food Quality, the North Sea Foundation, Tennet, and VisNed. Furthermore, employees of the Royal Belgian Institute of Natural Sciences and Wageningen Marine Research were interviewed, to receive insight from a scientist perspective (see table 1, page 10). All interviews were held in Dutch, since the employee of the Royal Belgian Institute of Natural Sciences spoke Dutch as well. The blueprint for these interviews can be found in Appendix V. The interviews were recorded, transcribed and analysed with MAXQDA, see Appendix VI for an example of an interview transcript in Dutch. The following codes (translated from Dutch) were enlisted for fragments of text:

1. Positive effects fisheries
2. Neutral effects fisheries
3. Negative effects fisheries
4. Positive effects OWF
5. Neutral effects OWF
6. Negative effects OWF

The third step was including the answers given during the interview in the effect scale, and by including these answers, the authors had one complete overview of positive / neutral / negative effects of fisheries and OWF on the marine ecosystem. With all the information in the effect scale, the authors visualised the effects with conceptual models. These models are a summary of all found effects and visualise how the actor affects the marine ecosystem, but also how effects are interconnected. With these conceptual models, participants are able to see what direct effect their activities have on the marine ecosystem, which is beneficial for the discussion. Using the conceptual models an interaction triangle was created, based on the Strategic Assignment Triangle, which shows how the effects influence the interactions amongst the three aspects; [1] Nature, [2] Fisheries, and [3] OWF.

2.4 Methods Ecosystem-Based Management

How can Ecosystem-Based Management be part of a Marine Spatial Planning serious game?

The first step in answering this sub question was by conducting a literature review on EBM in general. The literature review was performed to create an understanding of EBM, which can give the participants of the future MSP SG an impression of what kind of management strategy EBM is. The literature review was conducted in a period of two weeks, and the scientific papers were found with Google Scholar and Greeni. The following search words were used to find papers about the meaning of EBM:

- Ecosystem-Based Management
- Goals Ecosystem-Based Management
- Implementation Ecosystem-Based Management
- Lessons learned Ecosystem-Based Management
- Ecosystem-Based Management for the Ocean

The scientific papers that were used for this research ranged from the year 1998 to 2017, and a book from McLeod & Leslie (2009) was used as well. These papers were analysed within one week.

The second step was to conduct a literature review on the definition of EBM. To define the definition, it was necessary to understand, what the important features are to consider when performing EBM. Therefore, different scientific papers and books were reviewed, using Google Scholar, Greeni, and the library of Van Hall Larenstein University of Applied Sciences. The following search words were used to find papers:

- Ecosystem-Based Management
- Definition Ecosystem-Based Management
- Key principles Ecosystem-Based Management

The scientific papers used ranged from the year 1998 to the year 2019 and the authors spent two weeks reviewing and analysing the papers.

With the input of the literature review a list was formulated with features that are important to consider for EBM. For example, a source can give the following statement; “EBM is a management approach which can be used to manage human activities in order to protect the marine ecosystem”. The following features can be taken from this statement; [1] human activities, and [2] marine ecosystem. These features were placed in a matrix (see Table 4), from which the features per article could be analysed, and what the scientists meant with that feature. Based on each feature conclusions were written, by summarizing the most mentioned aspects within the features. These features were then combined and translated in a definition for EBM, by summarizing all conclusions of the features. See Appendix IX for the matrix with all features, conclusions and the definition for EBM. The definition will be used in the future MSP SG for the participants to have one coherent definition, it has also been added to the game action plan.

Table 4. Illustration of the information matrix. In the matrix the scientific materials like articles and books, used in the literature review, are presented in the horizontal row, here definitions of the articles and books will be placed. On the vertical row the EBM aspects are presented. They help determine important aspects of the researched definition.

	Article...	Article...	Book...	
EBM features				Conclusions: important aspects for EBM
EBM features				
EBM features				
				Conclusion: Definition of EBM

In addition to the literature review, interviews were performed in which the interviewees were asked how they define EBM, specifically from the perspective of their stakeholder. Questions were asked specifically about EBM during the same interview conducted for the effects of human activities, mentioned in *Sub chapter method 2.3*, see Appendix V for the interview blueprint. The interviews were first transcribed and then analysed and coded with the program MAXQDA, see Appendix VI for an example of a coded transcript in Dutch. The following codes (translated from Dutch) were used to analyse the interview:

1. Familiar Ecosystem-Based Management
2. Definition Ecosystem-Based Management
3. Sectoral management with Ecosystem-Based Management

The given definitions by the stakeholders can be used by the participants in the MSP SG. Participants will have a more specific view on how their stakeholder interprets EBM (fisheries, energy, government, and NGO, see Appendix XIV).

2.5 Methods Marine Strategy Framework Directive

How can the Marine Strategy Framework Directive be integrated in a future Marine Spatial Planning serious game?

The first step to answering this sub question was to research the implementation of the MSFD in the Netherlands. By conducting a literature review on the Marine Strategies, and reviewing the strategies, it became more clear how the MSFD is integrated in Dutch legislation. In order to find the strategies, the website Noordzeeloket was used. Here, Part 1, Part 2, and Part 3 of the Marine Strategies are available. These strategies explain in what legislation the MSFD is implemented and how the Netherlands is planning on achieving GES.

The second step was to research the current status of the marine ecosystem of the Dutch North Sea. This was done by literature review according to the Marine Strategies the Netherlands implemented in order to achieve GES, found on the website Noordzeeloket. To analyse the current status of the marine ecosystem, use was made of a factsheet, see Appendix VIII. A selected number of descriptors were used, since these were more related to the three aspects of nature, fisheries and OWF. The selected descriptors were; [D1] *Biological Diversity (birds, fish and sea mammals)*, [D2] *Non-indigenous species (exotics)*, [D3] *Commercially-exploited fish and shellfish*, [D4] *Food webs*, [D6] *Sea-floor integrity (habitats)*, [D11] *Introduction of energy, including underwater noise*. For the used descriptors the current status was analysed. The current status of the marine ecosystem is the starting point in the future MSP SG. During the game, the participants are able to see how their human activities affect the current status, with the conceptual models and interaction triangle of *chapter 4 Ecological effects of human activities*.

In order for the participants of the game to know what decisions can be made to limit their impact and to start working on reaching GES, a literature review was conducted. This literature review focussed on the measures that can be taken according to the Dutch government to achieve GES. These measures were found in the Marine Strategies, on the website Noordzeeloket. To analyse what measures can be taken for the several descriptors, they were added to the factsheet for the current status. The factsheet shows what measures can be taken for which descriptors to reach GES. These measures can give the participants an indication of what can be done considering achieving GES. The analysis of the Marine Strategies was conducted in two weeks.

In order to mitigate the effects of human activities and to implement measures, participants need to make decisions during the MSP SG. To make these decisions visual, the fourth step was to develop an interactive pie chart, which shows what decisions participants can make, and how this reflects on the three aspects and GES. The decisions are based on the effects of human activities and measures to achieve GES. When decisions are made, the total amount of one aspect shows how well that aspect is doing. When all amounts are added up, GES is calculated. This tool will help participants understand what impact their decisions have and will integrate GES in the future MSP SG. For the full interactive pie chart see Appendix XII.

3 Lessons Learned

This chapter explores already existing MSP SGs and will answer the sub question “*What are the lessons learned from existing Marine Spatial Planning serious games?*”. Figure 3 shows the timeline of the developed MSP Challenges by the Dutch Ministry of Infrastructure & Water Management, Rijkswaterstaat and Breda University of Applied Sciences. For this chapter these four MSP SGs were analysed and for each game a short description is given. Then the successful elements and challenging elements of the MSP SGs are discussed, which will result in the lessons learned. These lessons learned will be taken into account for the future MSP SG. For the analysis of the MSP SGs see Appendix IV. Finally, there is a description of the MSP SG as played by students of Coastal and Marine Management from Van Hall Larenstein University of Applied Sciences (module LKZ308). Since the future MSP SG is designed for this module, and other similar study programmes, the lessons learned will be applied on this MSP SG version.



Figure 3. Timeline of the Marine Spatial Planning serious games. From, RWS-SG, personal communication, 12 May 2020

MSP Challenge 2011

Abspoel et al. (2019) mentioned that the MSP Challenge 2011 was originally designed for a HELCOM/VASAB/OSPAR/ICES workshop on Maritime Spatial Planning in 2011. The game is based on the sea area Kattegat-Skagerrak between the countries Sweden, Norway, Denmark and Germany. In order to level the playing field, the countries were named by colour (Red, Green, Yellow and Blue) and the sea was called the Sea of Colours, see Figure 4. For playing the MSP SG the participants needed a database, installed on their laptops, to access data, map layers and geo-information. According to Abspoel et al. (2019) the goal of the MSP Challenge 2011 is for the participants to develop a marine spatial plan, while taking into account national objectives and shared interests with neighbouring countries. The MSP SG allows participants to have discussions without the interference of real-life.



Figure 4. Impression of the MSP Challenge 2011, illustrating the Sea of Colours as played in the game. Adapted accordingly from, *Serious Gaming: Marine Spatial Planning Challenge 2011 game* from Slideshare, 2013 (<https://www.slideshare.net/rogerbarber/serious-gaming-cases-msp-27663038>). Copyright 2013, TU Delft.

A successful aspect of the MSP Challenge 2011 was that the challenges were comparable to real-life situations, this made the game more interesting for participants (Keijser, Ripken, Warmelink et al., 2018). However, the MSP SG itself took a really long time to play, since it was developed for a hundred participants (I&W-SG, personal communication, 24 April 2020).

Lessons learned from the MSP Challenge 2011

When looking at lessons learned for the MSP Challenge 2011 there were no direct challenges found that could be useful to take into account. It is mentioned that the game takes a long time to play, but this will also be an aspect of the future MSP SG.

MSP Challenge 2050

The MSP Challenge 2050 was developed in 2013 and is a revision of the 2011 edition. This MSP SG is a computer-based simulation-game with integrated map layers and a Food Chain Network (European MSP Platform, n.d). According to Jean et al. (2018) the goal of the MSP Challenge 2050 is also for the participants to develop a maritime spatial plan for their country. The different countries have to work together as well, to coordinate their objectives and plans on international level. Jean et al. (2018) also mentions that the MSP SG creates an environment for participants to discuss different perspectives, knowledge and ideas, and lowers the pressure. For an impression of the MSP Challenge 2050 see Figure 5 and 6.

Mayer et al. (2014) mentioned that elements that made the MSP Challenge 2050 successful are, for example, the format of the MSP SG. It is flexible, which makes it possible to play the MSP SG in different settings, such as national or international workshops, conferences, meetings, science museums, curriculums, and it can also be distributed online. Due to the flexibility of the game, it is possible to pause the game for periods of time, in different settings. According to Abspoel et al. (2019) the MSP Challenge 2050 allows participants to take on a different role than they originally represent. This way they might understand the perspectives of the other stakeholder. Furthermore, Mayer et al. (2014) mentions that the MSP SG combines online game-technology, role-play, geodata and simulation models to create a learning environment for MSP professionals to discuss and interact. The simulation models consist of the components of human activities, factors in the geosystem and ecosystem, pressures and indicators.



Figure 5. Impression of the MSP challenge 2050, a screenshot of the computer simulation platform. Retrieved from, MSP Challenge simulation game from European MSP Platform, n.d. (<https://www.msp-platform.eu/practices/msp-challenge-simulation-game>) Copyright n.d., mschallena.info.



Figure 6. Impression of the MSP Challenge 2050 during a game session. Retrieved from, International stakeholders shape the future of shipping in the Baltic Sea from VASAB, 2018 (<https://vasab.org/international-stakeholders-shape-the-future-of-shipping-in-the-baltic-sea/>) Copyright 2018, VASAB.

According to Jean et al. (2018) elements that could be improved about the MSP Challenge 2050 are that participants find it hard to navigate the online program, and a lot of time is spent trying to understand the program. This time could be better spend discussing and gaining knowledge about the MSP process. It is difficult to transfer results from the MSP SG to real life scenarios, since there are no economic restrictions. Furthermore, Jean et al. (2018) mentions that some scenarios are difficult to play out in the MSP Challenge 2050 since the platform of the game is too common. There is not enough specific data available for activities of participants. The MSP SG uses a food web to show the pressure of human activities on the ecosystem. It was found to be unrealistic and not suitable for decision-making.

Lessons learned from the MSP Challenge 2050

For the future MSP SG the program SeaSketch¹ will be used and a brief and clear instruction manual for the program SeaSketch is needed to prevent difficulties of the program. This way, participants quickly get familiar with the program. To make the MSP SG more realistic for the participants and transferable to real life, estimated economic restrictions need to be set. It is not certain what amount of money is available for the development of an offshore wind farm with mitigating measures, or nature-inclusive building. This was concluded from the interviews, but to make the game more realistic estimations will be made with the use of parliamentary letters.

¹ The program SeaSketch is already used for the MSP SG for the BSc program Coastal and Marine Management. This version of the game will be adapted accordingly, using this research, for that reason SeaSketch will also be used again in the future MSP SG.

Short Sea Shipping board game Edition

The Short Sea Shipping Edition board game has been developed considering the European Union directive (2014/89) on MSP. The first edition was developed in 2015 (Abspoel et al., 2019). The MSP SG is set to experience the difficulties with spatial planning and interactions with short sea shipping (MSP Challenge, 2016). Participants are either taking the role of planner or shipper and they discuss how to resolve potential conflicts to achieve strategic objectives of Blue Growth and GES in the (non-existing) Rica Sea (MSP Challenge, 2016). The playing area of the Rica Sea is visualized on a large board and the players use coloured squares, with different symbols, to plan the area, see Figure 7 (Abspoel et al., 2019).

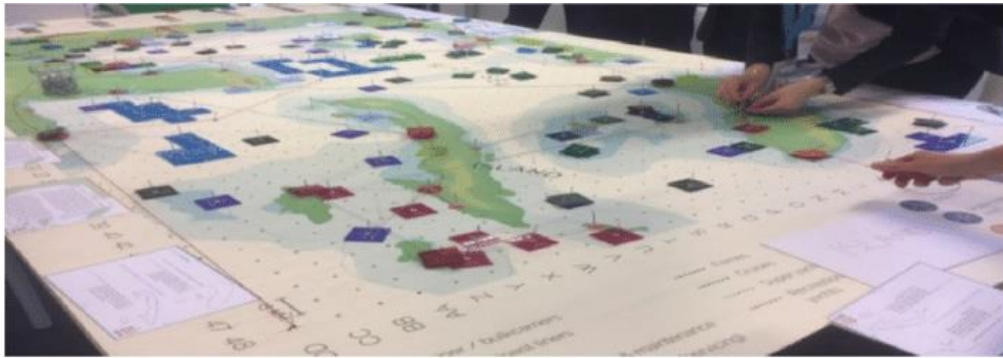


Figure 7. Impression of the Short Sea shipping board game. Retrieved from, *Maritime Spatial Planning - A Board game for Stakeholder Involvement* from Keijser, Ripken, Warmelink et al., 2018, *Simulation Gaming. Applications for Sustainable Cities and Smart Infrastructures*, pp. 58-66, copyright 2018, Igor Mayer

Elements that made the Short Sea Shipping board game successful are that participants are able to play the game in a relatively short time (Abspoel et al., 2019), since they received additional ‘*opportunity maps*’ giving the ‘*best available scientific knowledge*’ to achieve a blue economy (Keijser, Ripken, Warmelink et al., 2018). According to Keijser, Ripken, Warmelink et al. (2018) the participants also received background knowledge on their country and the Rica Sea. The game is facilitated by a Game Overall Director. This is a policy expert whom is allowed to give additional information about unclear aspects of the game, and facilitates discussions. The Game Overall Director gives feedback and is able to explain how MSP works in the real world. With the board game the participants are able to understand what difficulties MSP faces, and this is visualised in the game. According to Abspoel et al. (2019) and Keijser, Ripken, Warmelink et al. (2018) it depends on the quality of the session and the professional background of the participants how well MSP is understood after the game. Since this edition is so simple, there can be a high diversity of participants, in terms of professional background.

The Short Sea Shipping board game is not a good representative of how MSP works in the real world. The game is a simple tool to visualise MSP, to start dialogues on the subject and to understand how MSP-related conflicts work (MSP Challenge, 2016). According to Keijser, Ripken, Warmelink et al. (2018), depending on the background of the participants, the Short Sea Shipping board game rules and objectives were experienced as vague, and consequences for actions were unclear. This made the game chaotic. These participants missed background information on requirements for activities in the sea.

Lessons learned from the Short Sea Shipping board game Edition

For the future MSP SG it is important to have clear game rules and objectives. It is also important to consider the consequences that relate to these objectives. For example, when certain actions are taken, such as fisheries exclusion, it needs to be clear what kind of consequences this will have. This way participants feel responsible for their actions. Also, there should be an expert that facilitates the MSP SG, therefore a Game Overall Director will be appointed, just as was done for the Short Sea Shipping Edition.

MSP Challenge Simulation Platform

The MSP Challenge Simulation Platform was developed in 2015 and has three different editions: North Sea edition, Baltic Sea edition, and Clyde marine region edition (Abspoel et al., 2019), Figure 8. Goncalves et al. (2019) mentions the following about the simulation platform: “The MSP Challenge Simulation Platform helps planners and stakeholders understand and manage the complexity of Marine Spatial Planning (MSP)”. This MSP SG uses, just as the MSP Challenge 2050, a food web model (Goncalves et al., 2019). The simulation platform uses science-based knowledge on real geographic and marine data for shipping, ecology and energy (Abspoel et al., 2019; Goncalves et al., 2019). The MSP Challenge Simulation Platform creates an environment for participants to discuss different perspectives, knowledge and ideas, and lowers the pressure (Jean et al., 2018). For an impression of the MSP Challenge Simulation Platform see Figure 8.

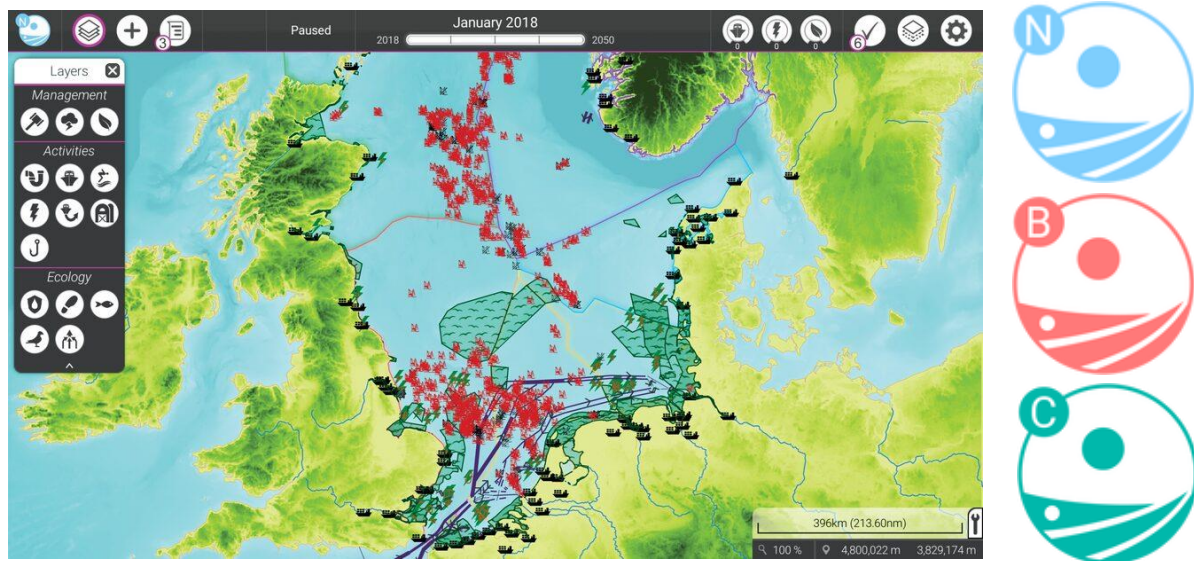


Figure 8. Impression of the MSP Challenge Simulation Platform. Adapted accordingly from, MSP Challenge, n.d.-c, (<https://www.mspchallenge.info/simulation-platform.html>)

According to Abspoel et al. (2019) successful elements of the MSP Challenge Simulation Platform are that MSP professionals and non-MSP professionals can play the game. The simulation platform allows participants to take on a different role than they originally represent. This way they might understand the perspectives of the other stakeholder. “It comes a lot closer to reality, so when you draw a wind farm, you immediately know how much Megawatts you develop. Also, you can encounter the same conflicts as in real life” (RWS-SG, personal communication, 24 April 2020). The MSP Challenge Simulation Platform is viewed as the next generation tool for MSP (Abspoel et al., 2019). “However, the dynamic does change, since everyone is sitting behind a laptop” (RWS-SG, personal communication, 24 April 2020).

Lessons learned from the MSP Challenge Simulation Platform

The MSP Challenge Simulation Platform is a follow-up of the MSP Challenge 2050. This means that all lessons learned from the MSP Challenge 2050 are taken into account for this game. It also is still under development, which means that specific lessons learned from the simulation platform have not been found yet. However, the program Sea Sketch has the ability to show how much Megawatts can be developed in an appointed OWF location, which comes closer to reality, same as the MSP Challenge Simulation Platform.

MSP serious game (MSP course Coastal and Marine Management)

The BSc program Coastal and Marine Management offers a MSP course (LKZ308) in which students participate in a MSP SG, the authors followed this course. HVHL-SG (personal communication, 14 April 2020) mentions that the focus of the MSP SG is the Dutch North Sea and the renewable energy transition. The goal of the current MSP SG is to find locations for the development of 7000 MW offshore wind. The students represent different stakeholders, with interests in the North Sea, and develop proposed locations with the online program SeaSketch. Within different meetings the students discuss their proposals and are encouraged to discuss these outside of meetings as well.

According to HVHL-SG (personal communication, 14 April 2020) successful elements of the MSP SG are that students get to experience the role of different stakeholders. In addition, the students learn how to defend their interests with well-founded argumentation and are able to listen to other arguments and find an agreement. With the use of SeaSketch the students are able to share their plans with all stakeholders, or fewer stakeholders, and are able to discuss these amongst each other. The game is a good representation of how the MSP process is done in real-life.

Challenges with the current version of the game are that not all participating stakeholders in the game are present at real-life meetings. In addition, stakeholders whom are present at the real-life meeting are not always represented in the game (HVHL-SG, personal communication, 14 April 2020). For example, Rijkswaterstaat is a stakeholder in the game, but is not part of the North Sea agreement meetings. The same applies for the Ministry of Interior and Kingdom Relations, whom is not part of the game meetings, but did attend the North Sea agreement meetings and will be the responsible party for MSP in the Netherlands (Noordzeeloket, n.d.-c). It is important to have a realistic representation of stakeholders for students to know who are involved in such MSP processes. Another challenge in the game is that each stakeholders group consists of two or more students which all have the same role. In order to motivate the students to be play an active role, each student can represent a specific role to play for their stakeholder. Furthermore, students mentioned that the data that is used in the game, is of poor quality. However, in actual MSP processes, the data is often of suboptimal quality as well as mentioned by HVHL-SG (personal communication, 14 April 2020).

To conclude, the MSP SG as performed in the course of Coastal and Marine Management will be adapted according to the following lessons learned. For every MSP SG the developers need to consider who is invited to the discussions that take place during a MSP SG. It is necessary that the game has a clear message on what needs to be achieved and what role each stakeholder takes (Abspoel et al., 2019). It is also important to include the consequences of actions taken by the stakeholders. Understanding these consequences is the responsibility of the stakeholders but can be directed by the Game Overall Director. In addition, the Game Overall Director is a MSP expert, who can help the students in the MSP process. Another aspect which is taken into account is that there will be a brief and clear instruction manual developed for the use of the program SeaSketch. This will give the students a direct overview of what is possible with the program. In order to make the game more realistic there will be economic restrictions on how much money is available for building a wind farm and additional cumulative measures. In addition, the stakeholders used in the game need to be in line with the real-life situation. The lessons learned from the literature will be taken into account in the action plan (Appendix XIV) of the future MSP SG.

4 Ecological effects from human activities

This chapter is divided in two sections. The first section shows the positive, neutral and negative effects of the human activities, fisheries and offshore wind energy on the marine ecosystem. The second section explores the ideas of how the effects can be visualised in a MSP SG. This chapter will answer the sub question “How can effects of human activities on the marine ecosystem be visualized in a future Marine Spatial Planning serious game?”.

The background of this research is based on the Strategic Assignment Triangle, which was created during stakeholder meetings by IDON (see Figure 1, page 7). The triangle shown in Figure 9 is based on the Strategic Assignment Triangle and focusses on the same aspects. These aspects were deemed as important for the North Sea and always interact with each other, whether the interactions are positive, neutral or negative. Besides interactions amongst all three aspects, they also influence the achievement of GES in the North Sea. The triangle from Figure 9 is a simplified version of the interaction triangle presented further on in this chapter.

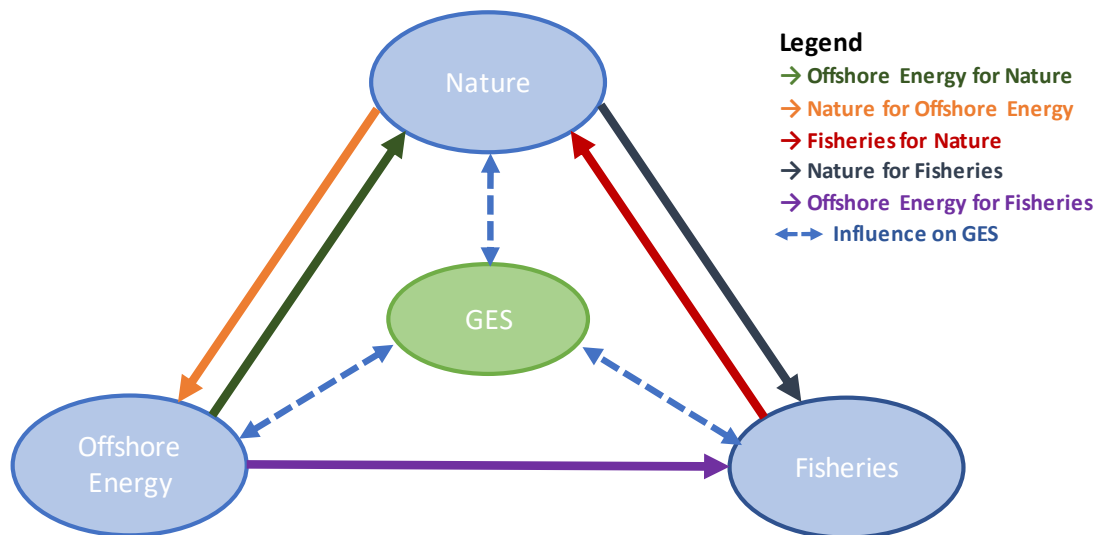


Figure 9. Interaction triangle. The Interaction triangle shows the interaction between Nature, Fisheries and Offshore Energy, in which they all influence GES.

4.1 Effects from human activities

The results from the literature review on effects of human activities, both OWF and Fisheries, were analysed in two conceptual models, presented in Figures 10 and 11. In the conceptual models the positive, neutral and negative effects are presented through the coloured lines, which also indicate the relation amongst different effects. For example, in Figure 10 a negative effect during the operation phase are the electromagnetic fields originating from the cables. These fields may cause migration barriers and disturbance of navigating abilities of marine mammals. Therefore, the line is coloured red. In Appendix X a more specific results description is given of the effects from OWF and in Appendix XI the results for Fisheries is given. Both Appendixes contain the corresponding literature references for the literature review that was conducted on these subjects.

4.1.1 Effects from Offshore Wind Energy

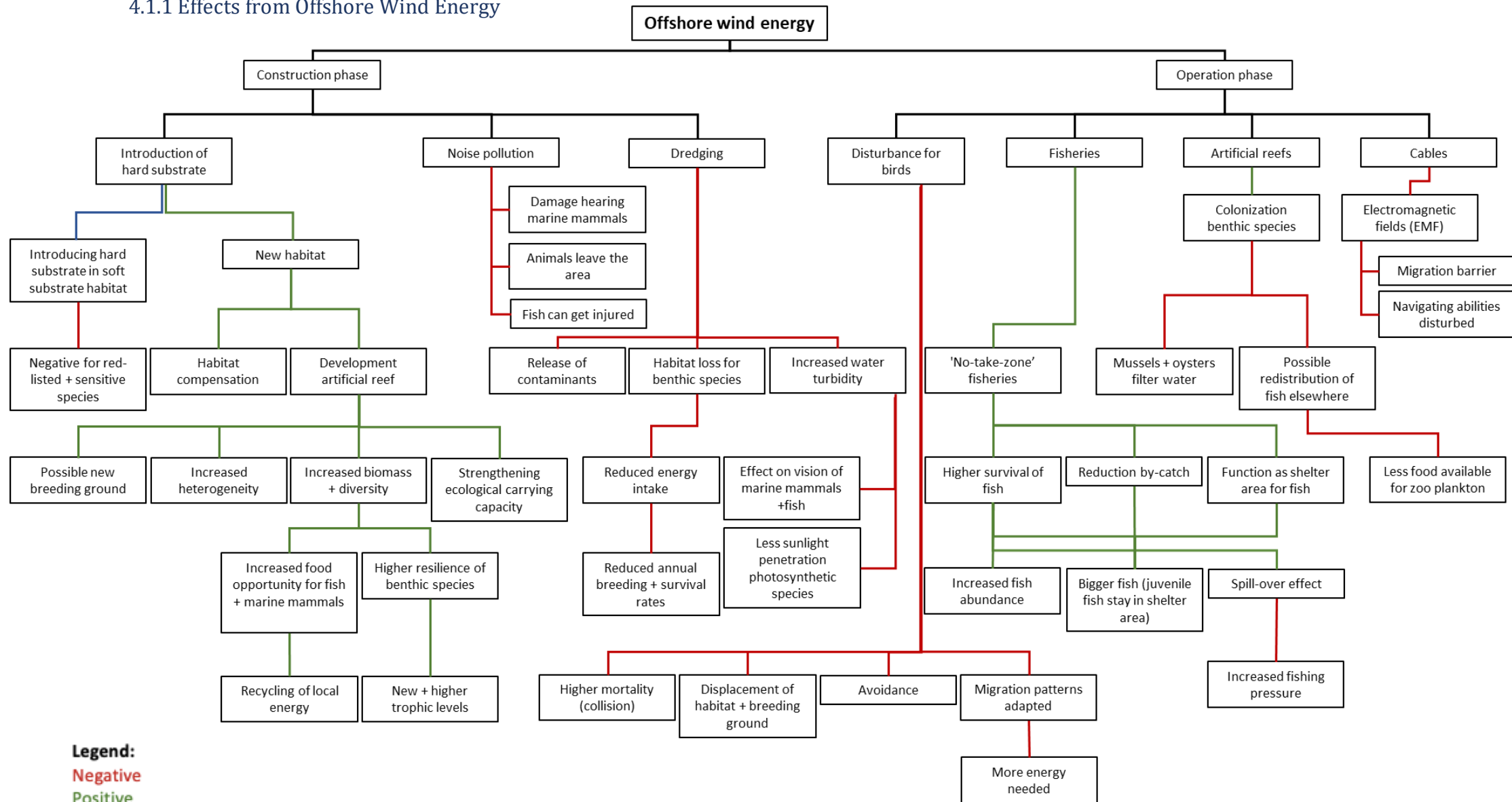


Figure 10 Conceptual model of the positive, neutral and negative effects from Offshore wind energy. The lines indicate the connection between effects and the colours (positive [green], neutral [blue], negative [red]) indicates what kind of effect they have on the marine ecosystem.

4.1.2 Effects from Fisheries

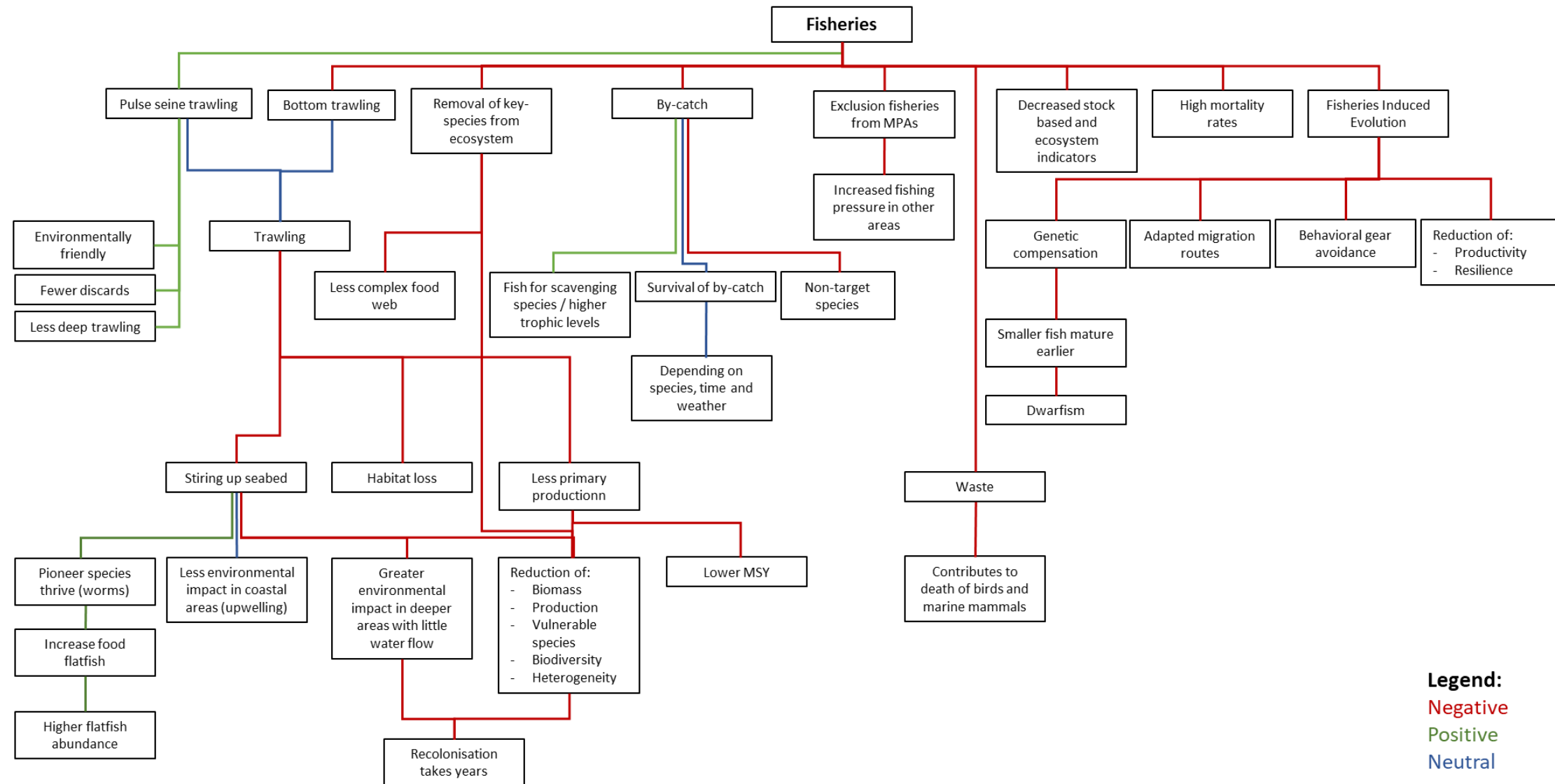


Figure 11 Conceptual model of the positive, neutral and negative effects from Offshore wind energy. The lines indicate the connection between effects and the colours (positive [green], neutral [blue], negative [red]) indicates what kind of effect they have on the marine ecosystem.

When looking at the OWF effects, there are many expected effects from OWF on the marine ecosystem, but it is not certain how these effects will turn out in the future. This is because of little available research and many uncertainties. The most negative effects will present itself during the construction phase, most positive effects will develop during the operationalisation phase, when the new habitat is evolving. The effects that are shown in Figure 10, were concluded from reviewing scientific papers, see Appendix X. Amongst some scientists there were differences in findings. As example, the construction phase has impact on the marine ecosystem, Petersen & Malm (2006) expects the effects to be minimal and Langhamer (2012), Bailey, Brookes, & Thompson (2014) and Gill (2005) assume the effects to be more damaging. To conclude, more research is needed to fully understand the effects of wind energy on the marine ecosystem, but for this thesis project the available knowledge of scientists are used.

Figure 11 shows all found effects of fisheries on the marine ecosystem. Langhamer (2012) mentions that the scale of the effects from fisheries depends on the size of the fishing vessel and the impact size on the trawled habitat. The effect on the habitat is then depending on habitat type, benthic compensation, trawling intensity and the used gear type.

Also, according to Kirby, Beaugrand, & Lindley (2009), the high mortality rates can be impacted negatively because of climate-induced ecosystem change and this was also the case in the North Sea during the mid-1980s. The ecosystem experienced a climate-induced change which affected the cod recruitment in a negative way. This together with the fact that the cod stocks were declining due to overfishing, caused a higher mortality rate.

To conclude, both activities affect the marine ecosystem, but the scale in which the ecosystem is affected is uncertain. When evaluating Figure 10 and 11, it is observed that fisheries and OWF mostly have negative effects concerning the marine ecosystem. In the collaboration between OWF and fisheries it can be seen that OWF do not directly benefit from fisheries, but fisheries can potentially benefit from spill-over effects caused by OWF. However, it is not known if these effects will occur and if the spill-over effects have positive effects on fisheries and the marine ecosystem. It could be, due to the displacement of fisheries activities, that there will be an increase in fishing pressure in other marine areas, which may lead to overfishing.

4.2 Visualisation of effects from human activities in Marine Spatial Planning serious game

The conceptual models as presented in the section above can be used for the MSP SG by the participants, with which they can see what the effects are of the separate activities of OWF and Fisheries. In addition, they can see how the effects are related to each other. However, these activities can not only be seen as two separate activities, but more as a triangle in which there is an interconnection between Nature, Fisheries and OWF (Figure 9, page 24). For the visualisation in the MSP SG this triangle was further developed, adding the effects from the conceptual models and how they influence the interactions, in a positive or negative manner, see Figure 12. These interactions reflects back to the marine ecosystem and GES.

To conclude, Fisheries and OWF activities, as mentioned above, all have an effect on the marine ecosystem. These effects can influence the ecosystem in a positive or negative manner, but there is also a lot unknown about specific effects. In order for these activities to co-exist with the ecosystem, and do not harm the ecosystem in a negative way, management is needed. In this case Ecosystem-Based Management is an important management strategy to consider, since it takes human activities into account as part of the ecosystem. To be able to use this management strategy an understanding of the meaning of EBM. This is further discussed in *chapter 5 Integration of Ecosystem-Based Management*.

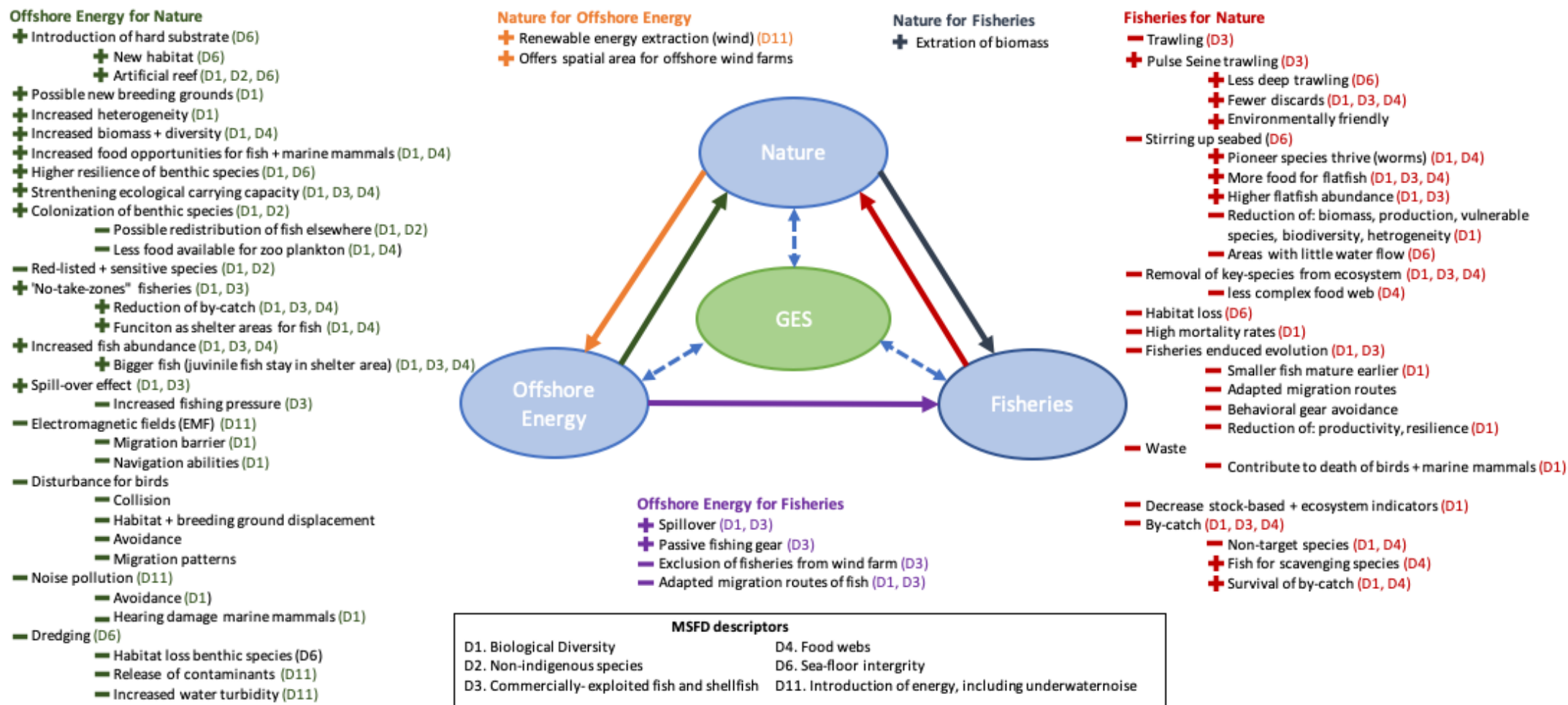


Figure 12. Interaction Triangle. The arrows indicate the interaction amongst the three aspects and the colours relate to the coloured pluses and minuses, indicating the effects on the marine ecosystem. In addition, each effect is related to a descriptor from the MSFD.

5 Integration of Ecosystem-Based Management

This chapter is divided in three sections. The first part describes the goal and key features of EBM. The description of EBM provides the reader with an understanding what kind of management strategy EBM is. The second part of the chapter elaborates on the definition of EBM that was formulated for the future MSP SG. This in light of the fact that there are numerous different definitions of EBM (Long, Charles, & Stephenson, 2015; Sevilla & Le Bail, 2017; Tam et al., 2017; VisNed-BM, personal communication, 9 April 2020). In addition, EBM will be discussed during the MSP SG, so it is necessary to have one coherent definition that all stakeholders can discuss on which they try and come to an agreement. When stakeholders discuss how their activities can be managed with EBM, one overall definition is needed. The third section of this chapter explores how EBM can be integrated in a MSP SG and how the definition can be used by the participants of the game. This chapter will answer the sub question *“How can Ecosystem-Based Management be part of Marine Spatial Planning serious game?”*.

5.1 Ecosystem-Based Management

EBM is a holistic management strategy for the protection and safekeeping of a healthy marine ecosystem (Böhnke-Henrichs, Baulcomb, Koss, Salman Hussain, & de Groot, 2013; Lynam et al., 2016; Rouillard et al., 2018). The goal of EBM is to preserve a healthy, productive and resilient marine ecosystem which delivers the ecosystem services humans want and need (McLeod, Lubchenco, Palumbi, & Rosenberg, 2005). With the use of EBM, the human activities can be managed from an ecosystem perspective, and it takes into account all the interactions within a marine ecosystem (Arkema, Abramson, & Dewsbury, 2006; Böhnke-Henrichs et al., 2013; Slocombe, 1998b; Soma, van Tatenhove, & van Leeuwen, 2015). This causes the management strategy to differ from traditional single use management approaches (Böhnke-Henrichs et al., 2013; Curtin & Prellezo, 2010; McLeod et al., 2005; Slocombe, 1998b; Soma et al., 2015). The strategy includes human activities as a central part of the ecosystem. By including the human activities, both the ecosystem and the pressures on the ecosystem are represented (Berg, Fürhaupter, Teixeira, Uusitalo, & Zampoukas, 2015; Curtin & Prellezo, 2010; Long et al., 2015; Tam, Fay, & Link, 2019). EBM also focusses on large spatial areas, regions or entire ecosystems and these systems are dynamic, interconnected and complex (Böhnke-Henrichs et al., 2013; Slocombe, 1998b; Soma et al., 2015). EBM is a way for the European Union to achieve long-term objectives, such as GES (Raakjaer, van Leeuwen, van Tatenhove, & Hadjimichael, 2014). In order to implement EBM, it is key that the interactions within these large spatial areas are understood (Slocombe, 1998b).

To consider the uncertainties within marine ecosystem research, the precautionary principle is used. When this principle is applied, a human activity may only be performed when research shows that it does not have an impact on the marine ecosystem (Berg et al., 2015; Curtin & Prellezo, 2010), which is a key element of the management. Another key feature of EBM is also the involvement of stakeholders (McLeod et al., 2005). It is common that when decisions are made about protection, restoration and maintenance of a marine ecosystem, it is often more a public decision, than it is a management strategy (Ounanian, Delaney, Raakjaer, & Ramirez-Monsalve, 2012). The intended outcome of EBM is the sustainable use of marine resources. How the outcome is defined, depends on societal values, and not just on engaging scientific research (Ounanian et al., 2012).

To conclude, EBM manages the human activities from an ecosystem perspective and focusses on large spatial areas that are dynamic, interconnected and complex. EBM has several key features and also includes uncertainties and involves stakeholders in its processes. The management strategy is prescribed by the MSFD for the European Member States to achieve GES.

5.2 Definition Ecosystem-Based Management

In this section the definition of EBM for this project is given. Since there are many different definitions for EBM (Long et al., 2015; Sevilla & Le Bail, 2017; Tam et al., 2017; VisNed-BM, personal communication, 9 April 2020), it is necessary that before the MSP SG starts there is consensus on one common definition of EBM. The definition was made with features that were often named in scientific papers. Each feature has a description on how it is linked to EBM. Table 5 shows the features of EBM, a short description and in what literature these features can be found. For a more detailed description of the features, see the EBM matrix in Appendix IX.

Table 5. Showing the features of EBM, a description of the feature and in what literature these features can be found.

Features	Description	Literature
Ecology	EBM recognizes the complex ecosystem, which indicates all the different interactions of flora, fauna, including human use, and the environmental processes within the ecosystem.	Arkema et al., 2006; Curtin & Pallezo, 2010; Levin & Lubchenco, 2008; Long et al., 2015; McLeod et al., 2005; Piet et al., 2019; Tam et al., 2017
Economy	Economic social-ecological systems emphasise the importance of understanding the interconnections between economy, social and ecological aspects.	McLeod et al., 2005; Piet et al., 2019; Raakjaer et al., 2014; Slocombe, 1998b
Social	The social aspect is recognized within EBM through social-ecological systems, which indicates human as being part of a marine ecosystem with complex interactions and adaptive to changes.	Curtin & Pallezo 2010; Long et al., 2015; McLeod et al., 2005; Piet et al., 2019
Human activities	A key feature of EBM is to regulate the human activities in the marine ecosystem that can have a negative impact on the system.	Curtin & Pallezo, 2010; Long et al., 2015; Raakjaer et al., 2014; Sevilla & Le Bail, 2017
Resource management	EBM focusses on the sustainable use of resources in the marine ecosystem, which indicates the long-term use of the seas.	Claudet, 2011; Curtin & Pallezo, 2010; Long et al., 2015; McLeod & Leslie, 2009
Ecosystem	The marine ecosystem is a complex, dynamic, adaptive system.	Arkema et al., 2006; Curtin & Pallezo, 2010; Levin & Lubchenco, 2008; Long et al., 2015; McLeod & Leslie, 2009; Sevilla & Le Bail, 2017
Ecosystem services	By maintaining a healthy ecosystem, humans can make use of the provisioning, regulating, cultural and supporting services the marine ecosystem provides.	Claudet, 2011; Curtin & Pallezo, 2010; Levin & Lubchenco, 2008; Long et al., 2015; McLeod & Leslie, 2009; McLeod et al., 2005; Sevilla & Le Bail, 2017

Connection of human activity to ecosystem	Human uses are included in the management, because of direct impact on the marine ecosystem, and are therefore also seen as part of the ecosystem	Arkema et al., 2006; Claudet, 2011; Curtin & Pallezo, 2010; Long et al., 2015; McLeod & Leslie, 2009; McLeod et al., 2005; Tam et al., 2017
Sustainability	By protecting, maintaining and restoring the ecosystem, the humans are able to use the ecosystem services over long periods of time.	Levin & Lubchenco, 2008; McLeod & Leslie, 2009; Raakjaer et al., 2014; Slocombe, 1998b
Ecological health	Only healthy ecosystems can offer the whole range of benefits that people want and need.	McLeod & Leslie, 2009; McLeod et al., 2005; Sevilla & Le Bail, 2017
Location / marine protected areas	Specific management decisions for EBM are dependent on specific areas where EBM will be implemented, since ecosystem aspects of each area differ the management strategies must adapt to these aspects.	Claudet, 2011; Curtin & Pallezo, 2010; Long et al., 2015; McLeod et al., 2005; Piet et al., 2019; Slocombe, 1998b
Adaptive management	Management decisions can be adjusted according to changes in the ecosystem or human activities.	Curtin & Pallezo, 2010; McLeod & Leslie, 2009
Precautionary principle	The precautionary principle is part of EBM since not everything about the ecosystem can be known through science. The principle is needed to ensure that irreversible damage is prevented.	Curtin & Pallezo, 2010; McLeod & Leslie, 2009; McLeod et al., 2005
Stakeholder participation	Stakeholder participation is seen as the most important aspect of EBM, and it not only includes sectoral stakeholders, but also the wider public.	Arkema et al., 2006; Curtin & Pallezo, 2010; Long et al., 2015; McLeod et al., 2005; Raakjaer et al., 2014; Sevilla & Le Bail, 2017; Tam et al., 2017
Trade-offs	Trade-offs are required to achieve long-term sustainability.	Claudet, 2011; McLeod & Leslie, 2009
Goals and objectives	Specific goals and objectives are needed for the implementation of EBM, in order to create a successful management strategy.	Slocombe, 1998a
Transdisciplinary	EBM includes multiple aspects of ecological, social and economic aspect, but also stakeholders from different sectors.	Long et al., 2015; McLeod et al., 2005; Slocombe, 1998b

Using these eighteen features, the following definition¹ of Ecosystem-Based Management was shaped: *Ecosystem-Based Management is a place-based holistic environmental management approach that recognizes the complex adaptive ecosystem and the interconnections between ecological, economic and social aspects. EBM regulates human activities, in a sustainable manner, that take place in the marine ecosystem, since they are recognized as part of the complex ecosystem. Marine resources need to be used sustainably to ensure the provision of ecosystem services. In this transdisciplinary approach stakeholder participation is seen as the most important aspect, in terms of scientific and local knowledge to adapt management plans and in terms of the precautionary principle.*

¹. For the definition of EBM not all features were included. These features were mentioned in literature as important to consider when performing EBM, except these do not contribute to the definition of EBM. For example, marine protected areas are considered a tool, but do not contribute to the meaning of EBM. For that reason, these aspects were not included in the definition.

5.3 Integration of Ecosystem-Based Management in the Marine Spatial Planning serious game

The integration of EBM in the future MSP SG will be by using the definition as described in the section above. This is the definition that will be given to the stakeholders in the first session of the MSP SG, see Appendix XIV for the action plan in which the sessions are further elaborated. During the first session the participants of the game will discuss this definition of EBM. On forehand the participants know what stakeholder they represent and what their stakeholders' values are. Based on these values they will discuss the different features mentioned in the definition and come to an agreement on which features they will focus on during the other meetings.

The starting point of the MSP SG is to understand EBM, however the current status of the marine ecosystem in the Dutch North Sea is also an important aspect in the MSP SG. In the following chapter *Marine Strategy Framework Directive*, the current status of the North Sea, according to the MSFD, will be discussed. As earlier mentioned in this chapter, EBM is a prescribed strategy in the MSFD to achieve GES. In the next chapter will also be discussed how participants of the MSP SG can reach consensus to achieve GES, while using EBM.

6 Marine Strategy Framework Directive

This chapter starts with a short paragraph about the MSFD. Next, an explanation of how the MSFD is implemented in the Netherlands and what the Netherlands understands under the GES is given. Then, the current status is given and what measures can be taken in order to achieve GES. With this information, an interactive tool has been developed which can be used in the future MSP SG. The current status will be the starting point for the status of the marine ecosystem and with the tool, participants are able to make decisions about the status of the North Sea, and eventually achieve GES. The factsheet as used in the MSP SG can be found in Appendix VIII.

6.1 Introduction to Marine Strategy Framework Directive

The European Union adopted the MSFD in 2008. It was created due to the increasing pressure on the marine environment, and its aim is to protect the marine environment of the European seas more efficiently (European Commission, 2019a). It was recognised that the marine environment needs to be protected, preserved, and where possible, restored, and that GES should be achieved (Directive 2008/56/EC of 17 June 2008, 2008). Member States are obligated to achieve GES of their marine waters and maintain this. GES can be measured with the established eleven descriptors (European Commission, 2019a; MIW & MANF, 2018). If the descriptors cannot be met without taking extra measures, extra measures need to be recognised and implemented. The following descriptors are used to determine GES:

- D1: Biological Diversity (birds, fish and sea mammals);
- D2: Non-indigenous species (exotics);
- D3: Commercially-exploited fish and shellfish;
- D4: Food webs;
- D5: Eutrophication;
- D6: Sea-floor integrity (habitats);
- D7: Hydrographical conditions;
- D8: Contaminants;
- D9: Contaminants in fish and other seafood for human consumption;
- D10: Litter;
- D11: Introduction of energy, including underwater noise.

Since this research focusses on effects of fisheries and offshore wind energy on the marine ecosystem, some descriptors are more relevant than others. Therefore, only the following descriptors were analysed in the results: D1, D2, D3, D4, D6 and D11. Most effects of fisheries and OWF are related to biodiversity, attraction of exotics, introduction of hard substrate, but also effects of noise and electromagnetic fields on marine mammals and fish. The six descriptors can be directly affiliated with these effects. All eleven descriptors are necessary to achieve GES, however the six descriptors used for this research are particularly important to managing the effects of fisheries and OWF, as described in Table 6.

Table 6. Description of the effects on the marine ecosystem of both wind energy and fisheries, compared to the descriptor responsible for the specific effects.

Descriptor	Effect OWF	Effects fisheries
D1. Biological Diversity	<ul style="list-style-type: none"> - Increased biodiversity + heterogeneity - Preservation of breeding grounds - Colonization benthic species - Food opportunities - No-take-zone → higher fish survival - Shelter area - bigger fish - Spill-over effect - Migration barrier - EMF influence - Dredging 	<ul style="list-style-type: none"> - By-catch is food for scavenging species - Fish mature earlier
D2. Non-indigenous species	<ul style="list-style-type: none"> - hard substrate attracts non-indigenous species 	
D3. Commercially-exploited fish and shellfish	<ul style="list-style-type: none"> - No-take-zone - Spill-over effect - higher survival rate → bigger fish 	<ul style="list-style-type: none"> - By-catch (non-target species) - Fisheries exclusion can have positive effects
D4. Food webs	<ul style="list-style-type: none"> - increased food opportunities - increased heterogeneity - Increase biodiversity 	<ul style="list-style-type: none"> - Species are taken out of food web
D6. Sea-floor integrity	<ul style="list-style-type: none"> - Local habitat loss - Dredging - Introducing hard substrate 	<ul style="list-style-type: none"> - Bottom trawling - Habitat loss - ecosystem for short living species
D11. Introduction of energy, including underwater noise	<ul style="list-style-type: none"> - Underwater noise during construction - Pulse Impact from blades - Dredging - Construction phase 	<ul style="list-style-type: none"> - Turbidity

6.2 Implementation of Marine Strategy Framework Directive in the Netherlands

The Netherlands is a Member State of the European Union and therefore obligated to implement the MSFD. The Netherlands describes GES as an optimally functioning and resilient ecosystem, whilst the ecosystem services and resources used sustainably by human uses. The environmental status, for GES, is the status that needs to be achieved, recovered or maintained (MIW & MANF, 2018). One example of a GES indicator is D3; *commercially-exploited fish and shellfish* and is described by the Dutch Marine Strategy (MIW & MANF, 2018) as follows; “Good environmental status will have been achieved if all 27 commercially exploited stocks of fish and shellfish comply with two criteria: maximum sustainable yield and healthy spawning stock.”

The technical description of the Dutch marine environment according to the MSFD:

According to MIW & MANF (2018) the marine environment as referred to in the MSFD, includes the area beyond the 12 nautical miles from the coastline. Exceptions are made when areas within the 12 nautical miles zone are not included in the Water Framework Directive, which regulates the marine environment within the 12 miles zone. The scope of the marine environment as described by the *Marine Strategy part 1* (MIW & MANF, 2018) consists of “the water, the seabed and the subsurface on the seaward side of the baseline where the extent of the territorial sea is measured.”

Marine Strategy

The Netherlands has three strategies to achieve GES, of which the first part is for the period 2012-2020. According to MIW & MEA (2015), the Netherlands reported the initial assessments of the current status in 2012, as well as how the Netherlands wants to achieve GES in 2020 and the environmental targets set for this purpose, to the European Commission. The Marine Strategy part 1 also included the Cabinet's vision on how to implement the MSFD and the Cabinet formed three focal points alongside already existing measures within the policy framework, to reach and preserve GES.

MIW & MEA (2015) also mentioned that Part 2 of the Marine Strategy is the monitoring program, which was reported to the European Commission in 2014, and it describes how the Netherlands meets the obligation to monitor GES within the Dutch North Sea. The strategy also explains how the monitoring of other Directives is taken into account. The starting point for the program is current monitoring originating from national and international obligations (Oslo / Paris Conventions Protecting and conserving the North-East Atlantic (OSPAR), International Maritime Organisation, Nature2000, Common Fisheries Policy, Water Framework Directive). Each year the plan will be actualised based on new insights, the latest developments, and international coordination with OSPAR and International Council of the Exploration of the Seas.

Furthermore, according to MIW & MEA (2015), Marine Strategy part 3 is the program of measures. These measures are targeted on reaching and preserving GES. The strategy explains the measures, and also the expected efficiency. It also gives insight into the processes of public consultation and international cooperation and how these processes contributed to the program of measures.

Implementation

In 2010, the Netherlands integrated the MSFD in the Decree on Water Management, which is part of the Dutch Water Act (Noordzeeloket, n.d.-a). When the MSFD started its second cycle, the program of measures was implemented in the National Water Plan 2016-2021 (MIW & MEA, 2015). The National Water Plan is a coherent and holistic policy, which holds all ambitions for the Dutch North Sea. The measures of the Marine Strategy are integrated into these ambitions on the subject of nature, environment and sustainable economic developments, and supplement where necessary to achieve GES (Noordzeeloket, n.d.-b). The integration within the Marine Strategy is mostly focussing on international policy, which is conducted at national levels, an example of such policy is the Water Framework Directive (MIW & MEA, 2015).

6.3 Current status Dutch North Sea

The results in this section are part of the factsheet in Appendix VII as to be used in the MSP SG. The current status of the Dutch North Sea, according to MIW & MANF (2018) of six descriptors are described below:

Biological diversity

Marine mammals

- There is an increase in population for porpoise and grey seals, except the total amount of species is not considered sufficient for biological diversity. The same goes for the harbour seals. The reason for these species not being considered sufficient is because of the quality of their habitat or entrapment by fishing gear.
- GES: improving, but not sufficient, for marine mammals.

Sharks and rays

- The population numbers for sharks and rays are concerning and are not in line with GES. mostly due to knowledge gaps. There are signs of stock recovery.
- GES: not yet achieved

Seabirds

- The status of seabirds is in a negative trend, both for breeding birds and non-breeding birds. When looking at breeding successes the numbers have been low in the past years. A reason for this status of the seabirds is not known and actions to improve the numbers have not been found.
- GES: not achieved, no prospect for improvement in the future.

Fish

- Fish stocks are seen to recover, as assessed by OSPAR. The negative trend for vulnerable fish species has taken a hold and the large fish community is in recovery, but still low.
- Populations for migratory fish, as assessed by the Habitats Directive, is seen as unfavourable.
- GES: not yet achieved

Benthos

- For benthos the biological diversity is not sufficient and especially for the large and long-lived species, which in lesser numbers than should be.
- GES: not yet achieved (partially unknown)

Non-indigenous species

- The current non-indigenous species in the Dutch North Sea cannot be reduced, but the amount of non-indigenous species coming into the Dutch North Sea system does go down. Currently 54 non-indigenous species have been found in the Dutch North Sea. The already present non-indigenous species are also hard to remove without harming the ecosystem.
- Another possible danger for introduction of non-indigenous species are wind farm installations. Due to the introduction of hard substrate, there is a higher change of non-indigenous species entering the system whom thrive on hard substrate habitats.
- GES: Appears to have been achieved, only looking at the amount of species entering the Dutch North Sea since 2012. Not looking at the already existing non-indigenous species.

Commercially exploited fish and shellfish

- 'Maximum sustainable yield' and 'spawning stock biomass' criteria are met for a quarter of the commercial fish stocks. In addition, 10 of the 27 commercially exploited fish and shellfish species meet one of the two criteria. These outcomes presents the influence of the Common Fisheries Policy in a positive way.
- GES: the fish and shellfish stocks are in positive trend, when this trend is kept GES is expected to be achieved.

Food webs

- GES: not yet achieved (partially unknown), for nutrient and organic matter the status is improving but GES is yet achieved.

Seafloor integrity

- There is still significant disturbance on the seabed of the Dutch North Sea.
 - Low number of long-living and vulnerable species
 - Disappearance of biogenic reefs (e.g. shell beds and other reef-forming species)
 - Physical disturbance by bottom fisheries, and shell extraction and sand suppletions
 - Physical damage from oil and gas platforms and production, but also the development of wind farms, which introduce hard substrate. Disturbance is relatively local.
- The placement of wind farms in the Dutch North Sea will be executed, since it is part of national and international renewable energy targets. This would mean future pressure on the seabed, however with the introduction of hard substrate there are opportunities for the reintroduction of biogenic reefs and the recovery of the seabed ecosystem. These developments are dependent on decision regarding bottom fisheries to be allowed within the wind farms.
- GES: on physical disturbance GES is not yet achieved, but for physical loss GES has been achieved since 2012.

Introduction of energy, including underwater noise

- Different economic activities in the Dutch North Sea will define to what end the ecosystem is negatively affected through sound pressure. The wind farm development could be an pressure on the marine ecosystem and effect the achievement of GES on underwater noise disturbance.
- GES: not yet achieved (partially unknown), with respect to impulsive sound GES is improving.

6.4 Measures

GES in the Dutch North Sea has not been met. For this reason, more measures need to be implemented in the Dutch legislation. These measures can be the implementation of conservation plans, limiting fishery or protecting certain areas. The list of measures that should be implemented according to the MIW & MANF (2018) are described here:

- Porpoise Conservation Plan (D1; D4);
- Limitation of activities and by-catch in Natura 2000 areas (D1; D3; D4);
- OSPAR's list of endangered species (D1; D3; D4);
- Licence requirements for large-scale developments, such as offshore wind energy (D1; D3; D4);
- Haringvloet locks partially opened (D3);
- Protection of seabed in the Coastal zone and the areas Central Oyster Grounds, Cleaver Bank, Dogger Bank, Frisian Front and the Raan Flats (D1; D4; D6);
- Conditions on permits for sand extraction (D1; D4; D6);
- Encouragement to use alternative fishing gear (D1; D3; D4; D6);
- International treaty for management and control of sediments and wastewater of ships should be further implemented (D2);
- Establishment of international agreements on anti-fouling (D2);
- Conditions on permits for shellfish transport to Natura 2000 areas (D2);
- Commercially exploited fish catch management (D3);
- Landing obligation (D3);
- Conditions on the issuing of licenses (D6);
- Permits for development of offshore wind farms should be required (D11);
- Code of conduct on cleaning explosives (D11);
- Regulations on use of Defence sonar and seismic research (D11);
- IMO guidelines on underwater noise derived from shipping (D11).

According to the MSFD the marine ecosystem can be characterized by the 11 descriptors mentioned earlier in this chapter. It can be concluded that the marine ecosystem is depending on these descriptors to be in a healthy status or not to be affected in a negative way. According to MIW & MANF (2018) the measures and monitoring of these elements, established by the Dutch government will then contribute to reaching this GES, improving the marine ecosystem.

6.5 Integration of MSFD in Marine Spatial Planning serious game

The starting point of the marine ecosystem in the MSP SG will be the current status. The positive, neutral and negative effects described in *chapter 4 Ecological effects of human activities* are matched with GES descriptors. The participants will receive a factsheet of the current status in the Dutch North Sea, and knowing what effects their activities have and knowing how these effects influence the descriptors, they know what kind of impact their activities may have on reaching GES. The participants will also receive a factsheet which contains measures that can be taken according to the Dutch government (MIW & MANF, 2018; MIW & MEA, 2015) and they can work towards a Dutch North Sea where their activities can take place and where GES can be achieved as well.

In *chapter 4* the interaction triangle of the interactions between the aspects Nature, Fisheries and OWF was presented in which also the effects of these aspects on the marine ecosystem were presented, as well as the corresponding MSFD descriptors. This interaction triangle was then further developed to an interactive pie chart, which is able to visualize the outcomes of decisions on Nature, Fisheries and OWF, but most importantly on GES. The interactive pie chart can be used by the participants of the MSP SG to visualize their decisions and discuss on the most beneficial decision. In Box 5.1 an example case study is presented in which the interactive pie chart is used as an example. The pie chart, as presented in Box 5.1. Figure A is connected to the table shown in Box 5.1. Figure B, which shows possibilities for decisions. These include fisheries, OWF, and nature related decisions. In addition, the measures mentioned in *sub chapter 5.3 Measures* are included. Every time the participants make a decision, the aspects of the pie chart will change accordingly. The tool shows, besides how decisions affect the three aspects, also how the decisions impact the GES. During the SG, participants can make decisions and see how these turn-out and with what decisions they can reach GES. The full Excel document with the interactive pie chart can be found in Appendix XII.

Box 5.1: Example case study: Priority development of offshore wind

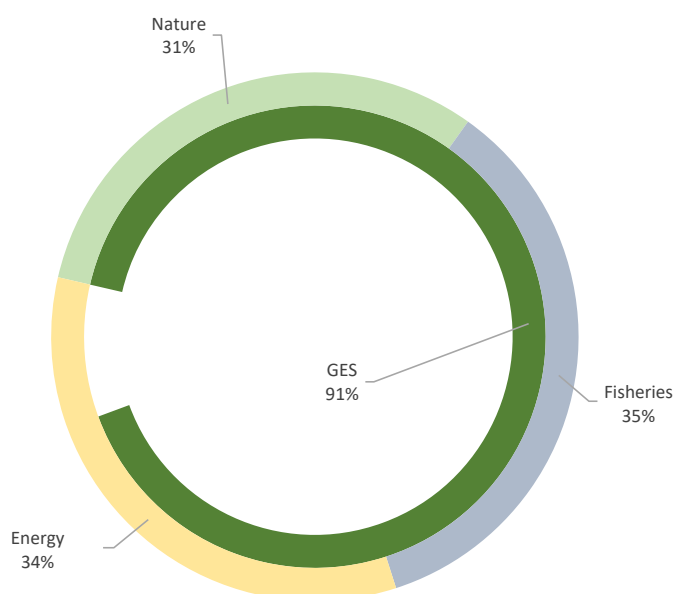
Between the years 2015 and 2030 the Netherlands will develop several offshore wind farms (OWF), which will raise the total capacity to 11 GW (Netherlands Enterprise Agency, n.d.). Since the Netherlands has the ambition to have 100% renewable energy in 2050 (Government of the Netherlands, n.d.), it is expected that the development of OWF will continue after 2030. Therefore, additional locations for the development of OWF need to be found and a total of 7 GW should be constructed. This additional 7 GW should be up and running in 2040.

The development of OWF has been prioritized by the Dutch government and therefore compromises have to be made for both nature and fisheries. Meetings were held with various stakeholders representing nature, fisheries and OWF in which governmental ministries also took part.

Finally, the stakeholders came to a compromised decision which was most beneficial for OWF, except can have a possible negative impact on the marine environment and the fisheries sector. The decision was made to build OWF within the 12 nautical miles zone. This will decrease costs for the development but will have a high impact on marine mammals and birds in the coastal zone, and also causes fisheries to lose their fishing grounds. However, as can be seen as well, the choices were made to build nature-inclusive and to mitigate impacts derived from noise and electromagnetic fields. This is beneficial for nature, however, it causes to increase the costs for OWF. At the same time, these choices made, did rise the support that was necessary.

Another decision that was made that increases the advantage for OWF, was the choice not to protect the seabed in the coastal zone, and other areas. By not protecting these areas, OWF has the possibility to develop more wind farms. For fisheries it was decided to implement sustainable fishing methods, financed through the fisheries transition fund. Furthermore, it was decided that only 15% of the North Sea will be protected, which does increase the possibility for the marine ecosystem to be restored.

The outcome for the interactive pie chart shows how much the three aspects will benefit from the decisions that have been made. Nature can quite benefit from the decisions with 31% and OWF benefits with 34%. Fisheries benefits with 35%, mostly due to the transition fund. The outcome for Good Environmental Status (GES) is most beneficial at 91% (see Box I. Figure A).



Box 5.1. Figure A. Pie chart. Shows what decisions have been made for this case study. When looking at the percentages of each aspect and the GES, nature still benefits when OWF is prioritized and the Netherlands could be closer to achieving GES.

What can be adjusted?		Nature	Fisheries	Energy	GES	
Offshore wind farm						
Near shore	<12 miles	1	1	3		
Building nature-inclusive	Yes	3	2	1		
Mitigating noise emissions	Yes	3	3	2		
Mitigating EM fields	Yes	3	3	2		
Licences needed for large-scale development of OWF (D1; D3; D6; D11)	No	1	2	3		
Offshore wind farm / Fisheries						
Passive fisheries within OWF	No	3	2	3		
Sea weed cultivation in OWF	No	3	3	3		
Fisheries						
Sustainable fishing methods (D1; D3; D6)	Yes	3	3	2		
Extraction biomass	Yes	2	3	2		
Beam trawl	No	3	2	2		
Waste	No	3	3	3		
Landing obligation (D3)	Yes	3	3	2		
Commercially exploited fish catch management (D3)	No	1	1	2		
Nature						
Appointing marine protected areas	15%	3	2	2		
Implementing Porpoise Conservation Plan (D1)	No	1	2	2		
Limitation activities and by-catch in Natura 2000 areas (D1; D3)	No	1	3	2		
Implementation of OSPAR's list of endangered species (D1; D3)	No	1	2	2		
Partially opening the Haringvloet locks (D3)	No	1	2	2		
Protection of seabed in coastal zone and the areas COG*, CB*, DB*, FF* and the RF* (D1; D6)	No	1	3	3		
Total		40	45	43	128	13

Box 5.1 Figure B. Decision table. This table is connected to the pie chart which changes when a decision is changed.

In order to reach GES through managing the human activities, the MSFD prescribes to implement EBM (Berg et al., 2015; Böhnke-Henrichs et al., 2013). Paragraph 44 of the MSFD (Directive 2008/56/EC of 17 June 2008, 2008) states “programmes of measures and subsequent action by Member States should be based on an ecosystem-based approach to the management of human activities and on the principles referred to in Article 174 of the Treaty, in particular the precautionary principle”. The MSFD has eleven descriptors, part of these descriptors represent ecosystem features (D1, D2, D3, D4, D6 and D7), the other part represents the human pressures on the ecosystem (D3, D5, D8, D10 and D11) (Berg et al., 2015).

With EBM the effects of human activities on the marine ecosystems can be managed sustainably and GES is still achieved. In addition, the marine ecosystem is still able to respond to the pressures (Directive 2008/56/EC of 17 June 2008, 2008). Also, according to Directive 2008/56/EC of 17 June 2008 (2008) priority should be given to achieving GES and to preserve and protect the marine ecosystems. By adopting EBM as management strategy, the MSFD wants to enable the sustainable use of ecosystem services for future generations. In order to do so, healthy ecosystems are needed (Böhnke-Henrichs et al., 2013; Directive 2008/56/EC of 17 June 2008, 2008). Furthermore, all marine strategies should apply EBM in order for the marine ecosystem not to be compromised (Directive 2008/56/EC of 17 June 2008, 2008).

7 Discussion

At the start of this research, literature reviews were conducted. A wide range of scientific papers were reviewed, which gave a broad perspective on research subjects and provided useful information for the development of the action plan. However, there were still uncertainties found concerning human effects on the marine ecosystem and the achievement of GES. For example, there is lack of data and knowledge on what scale the human effects on the marine ecosystem take place. In addition, the uncertainties within marine ecosystem research make it more difficult to know what GES should look like and what measures should be taken. However, this was the best available information which was still reliable and useful for this research. To reduce these uncertainties, more specific research is necessary to conduct in the future. With an increase in scientific research about the human effects on the marine ecosystem, these uncertainties will decrease. However, the authors believe that this will not make the GES more clear, since the responsibility of defining GES lays with the Member States (Brennan et al., 2014). This means that Member States can set their own goals for GES, which can result in differing definitions and goals.

The MSFD uses descriptors to specify GES. It was decided to only include the descriptors concerning fish, marine mammals and the seabed, since these descriptors are directly associated with the Strategic Assignment Triangle, and therefore, were seen as most relevant for the proposed action plan. This is also the reason why only the measures for these indicators have been used. Unfortunately, concepts within the descriptors are sometimes used inconsistently. As an example, the term habitat is used in different indicators of the MSFD, for example in D1 and in D6. According to Berg et al. (2015) the definition of habitat in D1 is “being used in the sense of biotopes”, whereas in D6 it can be interpreted as “a physical habitat without biotic features”. The directive also refers to the Habitats Directives, which defines a habitat as a physical habitat with abiotic and biotic features (Berg et al., 2015). Habitat is one of the features which contributes to achieving GES, yet the MSFD uses different definitions for the feature habitat. Then the question arose with the authors: how can GES be achieved when, if for example different definitions are applied to a habitat? This could increase the difficulty on focusing what habitat actually means and how the implementation of these descriptors work. However, even with the differing definitions within the MSFD, it is still a useful tool to measure the status of the marine ecosystem and the descriptors guide what should be done to achieve GES.

The achievement of GES is required because of the MSFD. This directive, as all EU directives, prescribes that EBM should be implemented. However, the MSFD (Directive 2008/56/EC of 17 June 2008, 2008) does not mention how EBM should be used and what happens if a human activity threatens the functioning of the marine ecosystem. MSFD lacks clarity of the definition of GES, and on how to implement EBM (Brennan et al., 2014). Furthermore, according to the MSPD, all marine spatial plans of the Member States should be based on EBM as well, through the sustainable development of sectors and the preservation, protection and maintenance of the marine environment (HELCOM & VASAB, 2016). However, the definition of EBM is broad, and many different definitions are given by literature. This makes it difficult to implement EBM effectively, since there are uncertainties amongst both scientists and decision makers. The interpretation of EBM is dependent on their work environment (Arkema et al., 2006; Link & Browman, 2017). Another difficulty when implementing EBM, is that EBM works on ecological scales, meaning it should be implemented for one interactive ecosystem. Most ecosystems cross country borders, the management approach does not work the way it should, since each country decides on its own implementation of EBM (Brennan et al., 2014). The authors understand the difficulty of implementing EBM on the accurate ecological scale, since bordering Member States and countries have to cooperate. However, when EBM could be implemented on the accurate ecological scale, this would improve the chances of achieving GES. To work with one coherent definition during the MSP SG, a large number of articles were reviewed to get a clear view of the different features important for EBM. Via this review it can be expected that the definition is trustworthy. Although the definition is relatively long, it includes the most important features, which

are essential for the participants to get familiar with. For a wider use of the definition it could also be used by Member States or other countries wanting to implement EBM. The authors believe this is possible, since the definition includes all features deemed important for EBM. By having one coherent definition, the consistency of management amongst countries or Member States could be improved.

The interactive pie chart was created with the research results from the human effects and MSFD measures. The pie chart is a form of EBM which can be applied during the MSP SG. This tool is a first draft with which the participants of the MSP SG can make decisions about OWF, Nature and Fisheries. This interactive tool gives a direct impression of how decisions reflect on the three aspects and GES. However, the tool can be further developed by including the weight of one decision on the whole chart. As example, economic aspects are often prioritized and will have a different weight then for example, nature protection aspects. In addition, it is unsure how sensitive the pie chart is to changes to input parameters, and the interactions between parameters, for example synergistic effects, are currently not included. These interactions could be important to add to make the MSP SG more realistic.

In addition, other tools were created to use during the MSP SG as well. The conceptual models and the interaction triangle have been created with the research results of human effects. The conceptual models show the separate effects of OWF and fisheries on the marine ecosystem. In addition, these effects continue in the interaction triangle, in which the relation among Nature, Fisheries and OWF are combined. The effects are based on literature, which mentioned the positive and negative effects of by-catch and positive effect of pulse-sein fisheries. Due to changes in policy the discard ban causes the positive effect of discarding the by-catch to be reduced. Furthermore, pulse-sein fisheries will be banned in the Dutch North Sea from 2021. This fishing method was seen as more sustainable then other fishing methods, with less impact on the marine ecosystem. With the ban, the positive effect that pulse-sein fisheries may have, will be gone. These policy changes will have effect on the conceptual model and interaction triangle, since these activities will no longer take place.

To keep the MSP SG up to date for future use, the information gathered for the conceptual models, interaction triangle and the interactive pie-chart needs to be adapted according to new scientific findings. This means for the MSP SG that the data used should always be in line with the latest findings. This can be done through regular literature research.

Due to the outbreak of Covid-19, the authors were unable to visit the interviewees to conduct the interviews. It is proven that physically meeting a person is beneficial for the relationship between the interviewer and the interviewee. The interviews were done through Skype meetings which makes a conversation unpersonal. Especially, for interviews it is important to build trust and have an informal point at the start and the end of the interview with for example coffee or tea (Adams-Hutcheson & Longhurst, 2016). This did not affect the outcomes in a negative way, however future research might benefit from live interviews, which could result in additional information.

Some interviewees asked to receive the interview questions in advance to the interview. These interviews were deemed as better structured and shorter in time, in comparison to interviews for which the interviewees did not receive the questions in advance. This did not influence the results of the interviews, since the authors still asked follow-up questions to clarify the answers. To level the playing field and make the interviews more structured, it would have been preferred if interviewees received the questions in advance to the interviews.

8 Conclusion

Because of the increasing human pressure on the marine ecosystem, sustainable management is needed. To facilitate discussions on sustainable management, a Marine Spatial Planning serious game can be used. This research focussed on *“How can an action plan for a Marine Spatial Planning serious game be developed that includes effects of human activities in the Dutch North Sea on the marine ecosystem, and measures taken to achieve GES, with the use of an Ecosystem-Based Management approach?”*. Answering this question required first gathering information on: [1] lessons learned of current Marine Spatial Planning serious games, [2] effects of human activities on the marine ecosystem, [3] features of Ecosystem-Based Management and [4] information on the Marine Strategy Framework Directive and Good Environmental Status.

The Marine Spatial Planning serious game needs to be realistic to make it applicable to real-life situations. This can be done through having a realistic problem and data that is similar to the data in real-life. In addition, the stakeholders used in the game should be portrayed as the involved stakeholders in a real-time Marine Spatial Planning process.

There are many uncertainties on the effects of human activities on the marine ecosystem. One of the uncertainties lays with the fact that it is unknown at what scale the effects take place. Besides the uncertainties, a literature review and interviews showed that there are more negative effects than positive effects.

Ecosystem-Based Management has many different definitions, even though they are all based on the same key features. Implementation of Ecosystem-Based Management is a difficult task and the pie chart is a tool to facilitate the visualisation of Ecosystem-Based Management. The Marine Strategy Framework Directive prescribes to use Ecosystem-Based Management to achieve Good Environmental Status. However, all Member States have their own responsibility in defining Good Environmental Status and this results in differing definitions and measures.

Based on these findings, elements were proposed as part of the Marine Spatial Planning serious game action plan for the Dutch North Sea. The starting point for the serious game is the current status of the marine ecosystem and to achieve Good Environmental Status in the Dutch North Sea, measures have been included. Visualisation of the effects and how they can influence the marine ecosystem are included in the game, but also what decisions can be made to minimize negative effects on the marine ecosystem. The measures and effects are visualised in the interactive pie chart, which will be used during the Marine Spatial Planning serious game.

9 Recommendations

In order to develop the future MSP SG the following recommendations are given for future work.

In advance to the trial runs, it is recommended that new, up-to-date maps are included to the program SeaSketch. Currently, the offshore wind maps are outdated, since there are new updated offshore wind areas approved. These updated maps are essential for the MSP SG, in order to make it more realistic. In addition, there is an ongoing discussion on how the introduction of hard substrate effects the marine ecosystem, in order to help the discussions a historical hard substrate map needs to be included (see Appendix XIII). This should be done by a Geographic Information Systems lecturer or researcher involved in the MSP SG.

To further develop the interactive pie chart, it is advised to add a number of assessments and analysis. One of these assessments could be a cumulative impact assessment, which shows how effects impact each other and how big this impact is. The results of the cumulative assessment can then be added to the interactive pie chart, which means when a decision is made, this has effect on multiple other decisions. When looking at a real-life situation, economic interests and nature protection, for example, have different values. The aspect with the most social interest will have a higher value, in most cases economic interest has a higher value. This should be included in the tool as well. Furthermore, it is advised to perform a sensitivity analysis and an uncertainty analysis. The sensitivity analysis will show how sensitive the interactive pie chart is for certain decisions. Situations could arise that by changing just a few decisions, the whole system could change or that there is hardly any change visible. So, the sensitivity analysis looks at which variable it responsible for changes and how sensitive each variable is. The uncertainty analysis can be used to look at which results are based on uncertainties. This is important for the reliability of the system used for the interactive pie chart. It is recommended to perform these assessments and analyses before the trial runs, in order to have a reliable interactive pie chart during the MSP SG. In addition, it is recommended that an expert on the area of computer simulations and Excel will conduct these analyses.

When the SG is developed it is advised to perform trial runs with Coastal and Marine Management students or similar study programmes. By doing this the drawbacks can be discovered and changed. It is recommended to do these trial runs at the same time the MSP module is given. During the module the students can give direct feedback, which can be directly integrated in the adaption of the MSP SG. It is recommended that David Goldsborough will perform a trial run with students when the first opportunity arises.

In advance to the each MSP SG, the literature used in this report and for the models, should be updated in terms of the impact of human activities on the marine ecosystem and measures to achieve GES. This should be done by a lecturer or future students from the BSc program Coastal and Marine Management, who is involved with the MSP SG.

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Appendix I: Stakeholder Analysis

Person	Organisation	Interview subjects	Date of interview
LVN-Nat	Ministry of Agriculture, Nature and Food Quality	EBM; Effects of wind energy and fisheries; MSP serious games	15 April 2020
LVN-Vis-1	Ministry of Agriculture, Nature and Food Quality	EBM; Effects of wind energy and fisheries; MSP serious games	20 April 2020
LVN-Vis-2	Ministry of Agriculture, Nature and Food Quality	EBM; Effects of wind energy and fisheries; MSP serious games	28 April 2020
StNZ	North Sea Foundation	EBM; Effects of wind energy and fisheries; MSP serious games	16 April 2020
TenneT-AOGD	TenneT	EBM; Effects of wind energy and fisheries; MSP serious games	16 April 2020
TenneT-SA	TenneT	EBM; Effects of wind energy and fisheries; MSP serious games	16 April 2020
VisNed-BM	VisNed	EBM; Effects of wind energy and fisheries; MSP serious games	9 April 2020
VisNed-Dir	VisNed	EBM; Effects of wind energy and fisheries; MSP serious games	7 April 2020
Wetenschap-PA	Personal advisor	EBM; Effects of wind energy and fisheries; MSP serious games	17 April 2020
Wetenschap-RBINS	Royal Belgian Institute of Natural Sciences	EBM; Effects of wind energy and fisheries; MSP serious games	21 April 2020
Wetenschap-WUR	Wageningen Marine Research	EBM; Effects of wind energy and fisheries; MSP serious games	17 April 2020
HVHL-SG	Van Hall Larenstein University of Applied Sciences	MSP serious games	14 April 2020

I&W-SG	Ministry of Infrastructure and Water Management	MSP serious games	24 April 2020
RWS-SG	Rijkswaterstaat	MSP serious games	24 April 2020

These stakeholders were selected because these organisations are involved with activities in the North Sea. The North Sea Foundation and VisNed are often present at decision-making meetings, such as the meeting about the North Sea Agreement 2030 (Jeroen Vis, personal communication, 20 February 2020). TenneT was specifically chosen because of personal contacts between the authors and the company. By interviewing employees of TenneT, the energy company gave their perspectives on what kind of effects their activities have on the marine ecosystem, and how they define Ecosystem-Based Management. To receive scientific points of view, scientists from Wageningen Marine Research and Royal Belgian Institute of Natural Sciences were interviewed. Wageningen Marine Research does a lot of research regarding the North Sea and the effects of the human activities that take place. Rijkswaterstaat is the executive body in the North Sea. Rijkswaterstaat is also involved in the MSP process and contact has been made with Xander Keijser about his involvement in the MSP challenge 2050. Lodewijk Abspoel is also involved in the MSP challenge 2050, and he was involved in an interview about the development of the MSP serious game of this thesis. Jeroen Vis from the Ministry of Agriculture, Nature and Food Quality is the problem owner of the thesis. His consortium focusses on inclusion of the marine ecosystem in the Marine Spatial Planning process. By involving these stakeholders and by collecting information through interviews, their interests were included in the development of the future serious game.

Appendix II: Interview blueprint Lessons Learned

Theme: Lessons Learned from already existing Marine Spatial Planning serious games and receiving information about game elements.

Main question: What are the lessons learned from existing Marine Spatial Planning serious games?

Sub questions:

- What are aspects that made the serious game successful?
- What aspects created challenges during the serious game?

Target group

The interviewers sought information from stakeholders whom are active in the development of the Marine Spatial Planning Challenges and board games. The interviewees have been selected from the following organisations: Ministry of Infrastructure and Water Management (I&W), and Rijkswaterstaat (RWS). One of the interviewees was contacted during the greenlight process of the thesis project and mentioned to be interested in discussing the MSP Challenges with the researchers. During the proposal stage, the researchers met the second interviewee whom also mentioned his interest. The questions that were discussed with the interviewees are shown below.

Practical constraints

The interviews were conducted in Dutch since all the interviewees and the researchers are native Dutch speakers. In addition, the results must be presented in English, this may cause translation errors or misinterpretation of the data. For that reason, the translated version of the transcript results will be shared with the interviewee of interest, whom can check if his/her answers were presented correctly.

Another constrain was the recent development in the corona virus outbreak. This means that the interviews had to be executed via Skype or another available online conversation tool.

Analysis

For the analysis of the interviews the software program MAXQDA was used (<https://www.maxqda.com/>). Within the program MAXQDA codes were assigned to word sections, which then were further analysed using the program. For the analysis an encoding method was used to determine what codes could be used according to the answers given by the interviewees. The description of the analysis is described through a step-by-step process.

Step 1: The voice recordings were transcribed by hand in a word document, since there was no funding to use an appropriate software program or to hire a person to transcribe the recordings. This was considered in the time planning and the recordings were transcribed as soon as possible after an interview was performed.

Step 2: The transcriptions at first were read carefully, this gave an indication of what had been discussed and what answers were given by the interviewees.

Step 3: Based on the interviewees' answers a list of codes was set up. Alterations to these codes could be made along the analysis process if this was deemed appropriate.

Step 4: Again, the transcripts were read carefully, and the enlisted codes were assigned to the sections of the transcripts that corresponded to the codes.

Step 5: Then the codes were categorised. The codes that discussed similar elements were put in one category, which made for a clear overview of the interviewees' answers.

Step 6: The categories were then separately analysed, and conclusions were adapted for application in the report results. Finally, the interview results were separated and added to the matrix of *Lessons Learned*, see *Chapter 3 Method*.

Interview questions

The questions are presented in Dutch as they will be used in the interviews with the stakeholders.

1. Hoe bepalen jullie wie er mee doen aan het spel, specifiek gezien welke stakeholders nodigen jullie uit?
2. Wat voor informatie is er verkrijgbaar voor stakeholders tijdens het spel?
3. Hebben jullie een Game Overall Director?

Follow up; Wat is de rol van de Game Overall Director?

4. Wat hebben jullie anders gedaan in de verschillende versies van de MSP Challenges?
5. Wat zijn positieve punten van de verschillende MSP Challenges?
6. Waar zien jullie verbeterpunten?
7. Wat is in jullie ogen het meest effectief; een kort of lang spel?

Appendix III: Interview transcript Lessons Learned

	1	24 april 2020
	2	RWS-SG & I&W-SG - ontwikkelaars MSP Challenge 2012/2050 (Ministerie van Infrastructuur en Water Management, Rijkswaterstaat)
	3	Anoek: Wij vroegen ons af hoe jullie dat bij de MSP Challenges doen, beslissen welke stakeholders erbij betrokken worden?
Deelnemers spel	4	RWS-SG: Misschien moet je dan even een onderscheid maken in de verschillende MSP Challenges die we hebben. Dus als je naar het bordspel kijkt dan wordt die veel gebruikt voor educatie doel einden, dus dan bepaal je eigenlijk niet wie de stakeholder is. Want dat zijn dan gewoon studenten die vaak gewoon vanuit een hogeschool of universiteit het dan spelen. Het bordspel is ook vaak in workshops of conferenties gebruikt en daar bepaal je dus ook niet echt wie daar uiteindelijk aan tafel komen, dat is vaak gewoon op vrijwillige basis dan. Dan kunnen mensen zich inschrijven voor een bepaalde workshop. Daarnaast hebben we wel voor het North Sea project een aantal specifieke stakeholder workshops georganiseerd. Dus een workshop voor ecologie, daar hebben we wel echt gefocust op mensen vanuit NGO, dus die hebben we toen uitgenodigd. En de focus was ook op de regional authorities om die ook mee te nemen, dus die hebben we toen ook specifiek daarvoor toen uitgenodigd. We hebben ook een sessie gehad binnen dat project specifiek op energie gericht en daar zijn echt vanuit Schotland, omdat we in Schotland veel stakeholders die met energie bezig zijn uitgenodigd. We hebben ook een scheepvaart sessie gehad, dat was echt een aantal scheepvaart deskundigen vanuit de World Maritime University waren daarbij aanwezig en een beperkt aantal andere scheepvaart deskundigen. Maar vaak zit je ook een beetje vast aan of stakeholders überhaupt kunnen deelnemen. Dus je beperkt wel door specifieke sectoren uit te nodigen, maar het lukt niet altijd om iedereen dan ook echt aan tafel te krijgen. Zeker als het ook in het buitenland of op andere plekken wordt gespeeld.
Deelnemers spel	5	Elske: En proberen jullie hier dan ook zoveel mogelijk verschillende stakeholders, met verschillende belangen te vinden of is het speciek als jullie het over energie hebben, zoveel mogelijk energie stakeholders en als het over scheepvaart gaat zoveel mogelijk scheepvaart stakeholders?
Deelnemers spel	6	RWS-SG: We hebben ook nog een integratie sessie gehad, daarbij hebben we iedereen, dat je zeg maar alle type stakeholders bij elkaar hebt. Maar het doen van die aparte sessies was echt om input te krijgen vanuit een specifiek, vanuit de ecologie was echt de bedoelen om het voedsel web model en te focussen op ecologie en MPA's. Die sessie over energie was echt bedoelt om input te krijgen op de huidige en de toekomstige ontwikkelingen met betrekking tot energie. We hebben daar 3 specifieke sessie voor gehouden en nog een evaluatie sessie.
	7	Lodewijk: Heb jij hier nog wat op toe te voegen?
	8	I&W-SG: Nee, ik denk dat je het correct zegt dat welke andere dingen iets organiseren, maar ik begreep ook misschien de achtergrond van de vraag niet. Want waarom is dat interessant om te weten. Kijk wij maken spellen voor bepaalde doelgroepen en die doelgroepen kiezen [...]. Dat bordspel

Deelnemers spel

hebben we toen gemaakt voor een groep mensen die op directeurs niveau naar de kustvaart kijken, naar die short sea shipping. Daarna hebben wij dat wat beter als concept neer gezet, ruimtelijke planning, zeker als je naar de zee kijkt. Dus dat hebben we toen specifiek voor die doelgroep ontwikkeld en nou blijkt het een bredere doelgroep aan te spreken, tot en met de kinderen aan toe. Het spel wat gemaakt is voor die energie, 2016 bij EZK, dat was natuurlijk een vooropgezet doel, want ze wilden politieke afspraken krijgen over aan de slag met wind energie op zee. Nou hebben ze het spel ook nooit echt gespeeld en we hebben hellemaal geen vooropgezet plan, ja ik bedoel dat met ecologie maar mensen kunnen ook op een andere manier met elkaar praten. En het maakt het duidelijk als je met iemand iets zit te doen en een definitie hebt van wat weten ze wel, wat weten ze niet. Dus het is behulpzaam bij het gesprek maar het is niet een, het heeft geen uitkomst om zo te zeggen.

9 Elske: Ik denk dat het bij ons meer de vraag is, welke stakeholders laten wij de studenten zijn, dus welke stakeholder moeten er bij ons aan tafel zitten, welke ministeries en welke bedrijven, zeg maar.

Deelnemers spel

10 RWS-SG: Het is ook afhankelijk van de focus van jullie spel. Als jullie heel erg op energie zitten en wat meer stakeholder rollen met betrekking tot energie, dan heb je de energie ontwikkelaar, TenneT, het ministerie van EZK en dat soort partijen. Als je meer een spel ontwikkeld op het gebied van visserij of zo, dan zit je ook met andere doelgroepen aan tafel.

..Andere landen

11 I&W-SG: Maar let op he, hier zit je meteen in het probleem van maar welke situatie neem ik. Speel ik Nederland na of speel ik Duitsland, in Duitsland gaat het heel anders met ministeries en met wie je wel en niet samen kunt doen. In Canada, wil ik het maar even niet over hebben, of een Spanje daar is het een grote chaos. Het feit dat je neutraal hebt, je hebt natuurlijk een overheid en je hebt een managementorganisatie dat zijn wel generieke rollen. Je heb ook mensen in het parlement en je hebt dan mensen die in je coalitie zitten en je oppositie zitten, dat zijn qua governance spel, als je nog rollen zoekt, dan moet je dus op die manier doen. [Dan is het ook realistisch. Wie legt de infrastructuur aan etc., dat is het niveau om het speelbaar te maken.] Iedereen moet het mee kunnen doen, als iemand vanuit een bepaalde context meer informatie heeft of meer dingen weet, want zo gaat het ook in het echt, dat brengt evenwicht met zich mee. In het eerste spel, met die kleuren, hadden we wel een paar profielen mee gegeven. Toen hadden we geschetst welke stijl van management en bestuur ieder land had. We hadden vier landen, geel, groen, blauw en rood en daar hadden we een verhouding bij gemaakt [...]. We hadden ze ook kunnen op schrijven als Nederland, Noorwegen, Denemarken, Duitsland, maar we hebben ze een beetje herschreven en neutraal gemaakt want er ook mensen uit Portugal konden dan mee doen, dan kun je je een beetje inleven. Van oke, ik ben een hele bureaucratische, individualistisch georiënteerde, top-down, alles moet vast gelegd zijn voor dat we überhaupt iets gaan doen. Dat is meer de pragmatische manier van werken zoals wij die hebben. Dus de generieke rollen en dan kun je daar wel een profieltje aan hangen. In Estland hebben ze

MSP Challenges

..Andere landen

maritieme planning hebben ze gewoon ondergedaan bij het ministerie van financiën want die heeft toch uiteindelijk alle macht. Dus het was altijd onder de premier, omdat ze het niet voor elkaar kregen, omdat ze als overheid weinig zeggenschap hebben over de zee. Want dat zijn toch de provincies en die landen, nou daar gaat helemaal niemand over, alleen de mensen die daar zelf wonen. Dus dat is een beetje het zoeken denk ik.

12 Anoek: Ja het scenario zal toch worden dat er weer wind op zee ontwikkeld zal moeten worden, maar juist ook heel erg met dat er 25% natuur bereikt met worden en alles. Dus de echt MSFD-doelen er eigenlijk ook een beetje bij proberen te betrekken. Dus ja er zit wel van alles qua rollen bij.

13 I&W-SG: Misschien één suggestie als je naar targets kijkt en ook wilt berekenen, als je de spelers daar mee laat stoeien, houd het simpel. Want als je met percentages van 25%, kijk het is leuk als je 100 hebt en dan zeg je met 25% dan kom je daaruit, maar als je 17 hebt met een heleboel 5en dan is dat moeilijk. Mensen rekenen echt niet goed hoor, ze kunnen niet rekenen. Het kan wel natuurlijk, dan zeg je, we gaan het een beetje wat moeilijker maken, [je hoeft het ook niet allemaal in een keer te doen natuurlijk]. [Begin eenvoudige en dan werk je toe naar, wat nu als]. In ieder geval je mag wel die ingewikkelde targets stellen, als je dan maar voor je zelf onthoudt dat je ze dan moet begeleiden om het simpel te krijgen. Er moet wel even een loophole uit zijn. Maar op zich ga je dat allemaal tegenkomen als je gaat testen, dat is de gouden regel, testen, testen, testen. Dan merk je wel vanzelf wat ze wel begrijpen en wat ze niet begrijpen en wanneer het lachen overgaat in frustratie en zo. Wij hebben ook wel een digitale versie van het spel, en ik wordt er helemaal niet goed van, ook met zo'n skype meeting, ik krijg na een uur de neiging om die hele software zo het raam uit te pleuren met de computer er bij. Dan heb ik dus iemand nog die me er doorheen helpt. Op een gegeven moment krijg ik dat een beetje onder de knie en dan wordt het wel weer leuk. Dus als je iets maakt wat je intensief kan begeleiden [en waar je de stakeholders kunt begeleiden]. Vervolgens krijg je hoeveel informatie krijgen ze? Wij doen altijd twee dingen; 1. We geven mensen veel te veel informatie, [dat ze niet een de tijd hebben alles door te nemen] en dan hebben ze ook nog hun eigen informatie. Maar we zeggen nooit, doe dit, doe A, B of C, we hebben geen invloed. Het is geen invuloefening. En het is ook niet te veel, met dat bordspel hebben we een belachelijke hoeveelheid tokens bij en onze Schotse collega was ermee aan de gang en die had in eerste instantie bedacht, ah ik neem alleen de dingen mee die we nodig hebben, ja en toen waren na een uur spelen alle tokens op. Ik zei ja, daarom heb je ook veel te veel en veel te veel verschillende, omdat je dan, dan houdt het niet op. Dus het is een balans om te kijken wie is mijn doelgroep, wat weten al en wat weten ze nog niet. Kijk als je ze alles voor kauwt dan leren ze ook niets. Verder is het heel goed dat je ze te weinig heeft, want dan moeten mensen gaan bedenken, he shit in ons bord hebben we geen EEZ met het buitenland hebben we niet bepaald. Dat is een van de vaste onderdelen door de UNESCO die zetten een groepje aan het werk en zegt ga de zee grenzen maar bepalen. Als je van tevoren die zee grenzen er al in hebt getoverd en

Interessante info

MSP Challenges

Verkrijgbare informat

..Bordspel

Verkrijgbare informat

Interessante info

Verkrijgbare informatie

GOD

..Rol GOD

..Rol GOD

..Facilitator

..Rol GOD

iedereen kan met de druk op de knop en dat vinden dan heb je dus geen oefening.

14 **RWS-SG:** Wat we misschien met het eerste spel ook hadden is het verschil in stakeholders, dat iedereen andere informatie heeft. De visser weet bijvoorbeeld precies waar hij vist maar dat is niet voor iedereen beschikbaar, dus daar kun je ook nog een beetje mee spelen.

15 En dan die Game Overall Director, die hebben wij wel in de spellen, dus hebben we eigenlijk een facilitator en hebben we ook een Game Overall Director of een Game Captain. Het doel van dat is eigenlijk, je weet nooit hoe het spel precies verloopt en kunnen altijd vragen oppoppen er kunnen altijd dingen gebeuren die onverwacht zijn. Met dat soort dingen kun je dan bij de Game Overall Director terecht en bovendien kan de Game Overall Director ook meerdere rollen aannemen. Dus het kan ook een politician zijn of een journalist of een EU-commissaris, dus hij kan verschillende rollen aannemen waardoor je ook de dynamiek kunt sturen.

16 **I&W-SG:** Je weet overigens dat ze tegenwoordig de Game Overall Director hebben losgelaten, maar werken met een Game Captain en om het wat makkelijker te maken hebben die andere rollen die Xander beschrijft even los gemaakt met kaartjes. Zodat je het ook met meerderen kunt doen. We doen het nu zo dat de Game Overall Director die was dan iemand [...] [die deed de concepten theorie en de brede uitleg] en daarna heb ik het ook een tijdje gedaan omdat ik meer van de inhoud weet en de spel begeleider die gaat meer over hoe doen we het spel en er is iemand die super veel kennis van alles en nog wat heeft en alles kan bepalen. Die kan ook de rechter spelen als het nodig is. Dus dat is in het spel concept ook een beetje stoeien hoor. Dus als uitgangspunt is het een goed idee om daar over na te denken, hoeveel mensen heb je? Hoeveel ondersteuning hebben die mensen nodig? Hoe duidelijk zijn de spel regels? Kijk als we gaan zitten ganzenborden dan komt er niet een game captain aan te pas, dus zo eenvoudig als ganzenborden dat kun je wel af zonder dat je iemand hebt die het begeleid. Als je bijvoorbeeld een spel als harvest {tragedy of the commons}, het is een spel waarbij je gaat vissen in een zee waar wel vis zich vermenigvuldigt maar het is onduidelijk met hoeveel vis je eigenlijk in die zee begint. Iedereen moet dan in het begin opschrijven hoeveel vissen ze willen hebben in een bepaalde ronde en de meeste groepen zijn na 10 rondes gewoon door hun vissen heen. Ze kunnen zich niet beheersen om een optimum te vinden in duurzaam vissen. En in zo'n spel heb je gewoon enorme, dan is er één iemand op wie iedereen gefocust is want die voert de regels uit. De regels zijn daarin hartstikke helder, maar voor de spelers aan het begin niet te doorzien. Dan gekwalificeerde ecologen, marine ecologen die lopen vast met dit verhaal en dat ze in de val trappen zeg maar. Het is toch voor een soort mensen die alle informatie rationeel hebben, maken ze toch de verkeerde beslissing. Dat is een deel van het regels ontwerpen met de inzichten van het werk wat Daniel Kuipman heeft gedaan. Dat soort dingetjes, wat gebeurt er dan met zo iemand, het is eigenlijk net als met een docent die de materie veel beter kent en weet welke fouten er gemaakt kunnen worden en kan uitleggen hoe je



daar ook mee om kunt gaan. Dat is ook een beetje de rol van de Game Overall Director ook de spel begeleider, dat die de mensen een beetje warm maakt, een beetje de groep bestudeerd.

17 Anoek: Maar wat is dan het verschil precies met de facilitator? Want die begeleid toch ook een beetje hoe of wat?

18 RWS-SG: Wat je nu eigenlijk als verschil kunt zien is de facilitator legt een beetje het spel uit en leid zeg maar de discussies en de Game Overall Director heeft, in ieder geval met het bord spel, meer de inhoudelijke rol. Dus echt de MSP, die heeft de kennis zeg maar, dus die kan op de inhoud zeg maar ook meer dingen uitleggen.

19 I&W-SG: Want dan hebben we van die petjes voor de kapitein en de stuurman en de crew. Je hebt gewoon een aantal dingen die gedaan moeten worden in zo'n sessie en ja er kan maar één de baas zijn. Iemand kan de baas zijn over het feit dan er wel of geen drinken is, er moet altijd van alles gebeuren en het is voor de groep prettig dat één iemand de baas is. Tenzij ze zelf besluiten, nou het is toch wel leuk geweest met die meneer of mevrouw die dat uitlegt, maar nu zijn wij de baas want we snappen het. Dat gebeurt eigenlijk meestal, want je kunt eigenlijk totaal geen controle meer houden over wat er gebeurt. Ja ik vind het ook niet erg.

20 Elske: Jullie hebben verschillende versies gemaakt van die MSP Challenge en ook van die board game. Maar wat hebben jullie daar precies ander gedaan, wat hebben jullie geleerd van die andere spellen?

21 RWS-SG: We zijn begonnen natuurlijk met het spel 2011, the sea of colours, meer een rollenspel is dat. Waar in we dus echt verschillende stakeholder rollen hadden, ook met een verschil aan informatie. De visser wist wel waar hij viste, maar de beleidsmedewerker wist dat niet, precies de exacte plekken. Dat was meer een statisch spel, in de zin, tijd speelt geen rol.

22 I&W-SG: Belangrijk daar is dat je uitlegt hoe dat ook alweer was. Daar was de eis natuurlijk, we hebben 100 mensen bij elkaar vanuit [...] vanuit ICES [...] en we gaan een hele dag aan de gang en een hele avond ook.

23 RWS-SG: Dus dat is echt ontwikkeld voor een speciale sessie. Dat was toen echt zo, we hebben een conferentie waar ongeveer 100 man komen vanuit verschillende delen van Europa. Dus dan ontwikkel je al iets wat je met elkaar moet spelen. Terwijl het bord spel is ontwikkeld dat je met een man of 20 of 30 kan doen [...]. Dus daar zit vanuit de ontwerp kan al een hele andere [...]. En als je kijkt naar de inhoud dan zie je ook wel verschillen tussen de spellen en vooral als je kijkt naar bijvoorbeeld het rollen spel, dus de focus meer op de interactie tussen het leren van de verschillende stakeholder rollen, echt interactief met elkaar zijn. Terwijl de simulatie game, het simulatie platform, ook echt meer een inhoudelijk gestuurde en computer driven spel is. Natuurlijk is er ook nog wel interactie en stakeholder rollen, maar toch wordt er meer vanuit een, ja je zit achter een computer dus dat geeft al een andere dynamiek en het wordt gewoon een stuk realistischer met hoe het in de praktijk gaat. Dus je tekent echt gewoon de windparken in en je krijgt gewoon feedback van hoeveel megawatt je hebt ontwikkeld, maar ook de problemen waar je tegen aan loopt.

<p>..Verschillen</p>	<p>24 25</p>	<p>[...]</p> <p>I&W-SG: Iedereen is acteur in zijn eigen theater, is onze filosofie en dit spel is dus een middel om tot het gesprek te komen om samen iets te leren. Dan is daar ook het ontwerp naar gericht om dat voor elkaar te krijgen. Plus het feit dat we zelf wat dingen wilden uitzoeken, dat is natuurlijk ook een reden. Van A, wie zijn die mensen? Hoe werken die nu eigenlijk samen ondertussen, nu op dit onderwerp, dit vak? Wat kom je dan tegen? Licht het aan taal gebruik, omdat je in een meertalige situatie hebt en niet iedereen heeft dezelfde achtergrond. Is dat het probleem? Licht het in de bestuurscultuur? Maar goed als je over grenzen kijkt moet je wel je eigen plan hebben. Je bent bij mij ook altijd welkom op de thee, maar ja, we kunnen theedrinken maar het wordt effectiever als je weet waar over je wilt praten. En als je dat wilt moet je ook een beetje je eigen plannetje hebben. Er is niemand die voor jou dat plan, althans die mogelijkheid krijg je niet, ga maar ergens anders kijken en misschien hebben zij wel een beter plan dan wij. Zo werkt dan natuurlijk niet. Wetenschappers hebben altijd een beter plan, ik bedoel zoals onze fameuze Jan van Tatenhove, die zegt dat ie de Noordzee moet besturen met alle OSPAR-partners en die moeten dan mandaat krijgen om zelf één overkoepelend plan voor de zee te maken en dat moeten dan de Lid Staten gaan implementeren. Nou ga jij dat Boris Johnson uitleggen, never nooit niet. Je moet samen een analyse doen vinden die Engelsen al te veel neigen naar dat wij hun plannen opleggen. Dus eigenlijk was dat het eerste en wilden we in het eerste spel ook weten hoe gaan mensen om met die overload aan informatie en het feit dat niet alle informatie beschikbaar is. Dus dat kom je dan, eigenlijk speelt dat in alle stakeholder rollen en wat gaan ze dan doen. Toen hebben we gezien dat ze in dat blauwe land, Zweden, daar was een dame die bij een NGO werkte, Oceana geloof ik, maar die had een deal gesloten met de scheepvaart op eens want de hele vloot was vervangen. [...] Allemaal op waterstof en elektrische zonnepanelen en wat dan ook. Dat is knap gedaan, een persbericht over uitsturen, en ik zou ook nog een keer checken als die schepen als ze in andere landen aan tanken niet toch gewoon een dieselmotor blijken te hebben weet je wel, dat je voor de gek wordt gehouden. Het probleem met die eerste versie dat het A, duur het heel lang en B, is het voor 100 man, en hebben die jongens geloof ik wel twee uur zitten hacken om in al die laptops te komen van overheids personeel met name, om de software te installeren. Toen zeiden we, het aspect van maritieme planning er zit een tijdgebonden element in dus kunnen we dat niet meer naar voren krijgen. Hoe pakken die beslissingen uit over tijd? We hebben altijd consequent de keuze, althans misschien heb ik daar een veto op gelegd, want ik wil niet met geld spelen. Geld maakt alles stuk.</p>
<p>Verkrijgbare inform</p>	<p>26</p>	<p>RWS-SG: Als je ook geld in het spel meeneemt dan gaat iedereen op geld focussen.</p>
<p>..Verbeterpunten</p>	<p>27</p>	<p>I&W-SG: Dat kan interessant zijn, dat kan zijn dat het een leerdoel is dat je zegt, gho weet je ik laat die mensen daar even flink mee stoeien. Met name natuurlijk dat je zegt, je mag daar wel een windpark bouwen, maar ik heb geen subsidie. Dus dat je eigenlijk die rol bouwt van, ja dan krijg ik eigenlijk</p>
<p>..Verschillen</p> <p>MSP Challenges</p>		

Interessante info

..Positieve punten

..Positieve punten

Interessante info

..Verschillen

mijn businesscase niet meer rond. Want wat moeten ze dan doen, dan ga je verdeel en heers. Wat je dan ziet in de praktijk in Nederland dan hebben ze eerste gelobbyd, kan de overheid niet eerst al het milieuonderzoek doen, daar is ook nog een andere reden voor, maar als je ergens een windparkje neer gaat zetten dan kan je moeilijk van iemand vragen om de totale zee leven in ogenschouw mee te nemen. Je krijgt hele rare strategische milieuraapportages, daar staat dan gewoon een lijst in van alle mariene beschermde gebieden en dan staat er ook nog afgevinkt, ja het heeft geen invloed. Nee wat wil je als je hier in Nederland een windpark bouwt dat is niet direct gelinkt aan een natuurpark in, weet ik het, Schotland of zo. Dat levert ook non-informatie op. Wat hebben die windmolens eigenaren gedaan, die hebben gezegd, het is toch eigenlijk aan de overheid, want die gaat voor de gezonde zee, dus kunnen die dan niet alle milieuonderzoeken doen. Want we hebben nodig, windgegevens, kunnen zij dat dan niet doen? Dus daar hebben we wel ooit een beetje over zitten na denken, of je dat in kan bouwen. Dat je gedurende de spel sessie, van een uur of twee uur of je hebt een dag, dat spelers bepaalde informatie kunnen gaan opvragen of kunnen gaan zoeken. En dat ze dat dan later terugkrijgen en daarmee verder zouden kunnen. Dus in plaats van geld focussen wij meer op andere constrains en dat is met die tijd en ik moet nu een beslissing nemen, maar ik heb die informatie nog niet, dus wat ga je nu doen? Moet je dus overleggen, dus dat is anders op te lossen. In dat bord spel dagen we mensen uit om te kijken naar de ruimte ook in tijd, hoe snel vaart nou een schip? Dus als je een scheepvaartroute verlegt, wat betekend dat dan en leg dan nou eens uit, als je een route verkort dat is als fantastisch voorbeeld, dat hebben we ingebouwd. Dus het Kielerkanaal, kennen jullie het Kielerkanaal? Aan de zuidkant van Denemarken is een kanaal daar kun je zo naar de Oostzee je kan ook aan de noordkant kun je er rond, bij het Kattegat. Dat scheelt je een dag varen, dus als je met je cruiseboot/ship bent vertrokken vanuit Londen dan gaan ze eerst helemaal door het Kattegat en dan naar Sint-Petersburg en dan via Finland weer terug. Dan schieten ze dat Kielerkanaal door en dan zijn ze op tijd weer terug voor de volgende. Als dat kanaal dan dicht is dan moeten ze hun plannen aanpassen dan kunnen ze een bezoekje minder doen, want ze moeten wel op tijd weer terug zijn. Dus dan zie je eigenlijk ook meteen een vertaling van het activiteiten op zee die je eigenlijk wel kunt bedenken in geld. Dichterbij de kust, een kilometer kabel kost een miljoen als je die moet begraven, dus er zit gelukkig in die omgeving waar wij mee bezig zijn in de zee zit al een aantal dingen die logischerwijs in de papieren lopen. Wij hebben vervolgens gezegd, we willen dus korter, want mensen hebben niet de hele dag de tijd en zeker niet twee dagen en we willen die mensen van tijd erin bouwen en met een functioneel ecosysteem daar willen we response op zien. Dus het is ook incrementeel, we hebben nooit iets gemaakt wat in één keer goed was met een design van dit zal het worden. Dan krijg je namelijk bij game ontwikkelaars, geef ons een miljoen, ja dat heb ik niet hoor. We hebben wel een leuke sessie ergens te doen, dus zo bouwen we hem elke keer een stapje verder. Voor dat quick en dirty bordspel hadden we bedacht,

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van oh dan is de zee die vakjes zijn twaalf nautische mijl. Toen bleek later dat ze dat wilden toepassen in Schotland, toen zeiden zij, ja we hebben eigenlijk een veel kleiner gebied en we spelen met lokale mensen, we willen naar 3 mijl. Dus nu hebben wij dat tegenwoordig aan gepast en kan je kiezen wat je doet, 12, 24. Dat is een beetje, wat ik zij ook, testen, testen, testen, we doen het dan niet zo zeer als een test, maar je leert wel [wat beter kan]. Dus dat is eigenlijk in de verschillende versies wat we anders hebben gedaan. Maar heel veel hebben we ook gewoon hetzelfde gedaan. Het concept is gewoon, er zijn mensen samen aan het werk, samen een puzzel leggen waarbij ze, je moet in je eigen land voortgang boeken met stakeholders en je moet het over de grenzen heen ook nog afgestemd hebben of gecoördineerd. Wat we niet hebben zoveel de laatste tijd, wat we wel hadden toen we met 100 man speelden, maar toen waren er wat van die losse vogels. Want in de olie en gas wereld, dat maakt helemaal niet uit die zit gewoon in één land en die is dan gewoon in die zee bezig. Die was toen gespeeld door een knakker van de Europese Commissie, werd tegen energie gewerkt en die was enorm aan het lobbyen voor een ondergrondse gasleiding. Dat is een bekend probleem daar in die Oostzee met dat Russische gas, maar die heeft die hele dag zitten domineren en hij had het voor elkaar. Onder de grond was hij een pijpleiding aan het leggen, van land A naar land B. Heel veel commotie er om heen. Nou dat heeft naar mijn idee niet zo veel met maritieme planning te maken, want ja je raakt in principe niet zo veel mensen en zeker als je goed ingraaft niet. Die pijpleiding van drie meter dik als je die op de zee bodem neerlegt en je komt met je vissersboot langs, nou ja dat is een bekend probleem. Sommige dingen kunnen echt wel anders gaan. We hadden, Xander misschien moet jij daar iets over vertellen over die opportunity maps, what scientists know and what they don't know.

28 **RWS-SG:** Dat hebben we ontwikkeld voor het eerste bordspel, dus waar kunnen windparken goed geplaatst worden, dan moet je bijvoorbeeld aan windspeed denken en waar kun je met andere energie terecht. Olie en gas winning kun je alleen doen als er ook olie of gas in de grond zit, anders heeft het geen zin om er een olie platform neer te zetten. Dat soort dingen hebben we op die opportunity maps neergezet. We hebben één specifiek opportunity map op energie, we hebben er één specifiek naar wat zijn interessante plekken voor recreatie. Dus waar komen walvissen voor bijvoorbeeld, waar zijn scheepswrakken. Dus zo hebben we een aantal van die opportunity maps ontwikkeld. Halverwege het spel geven wij die vaak aan de speler, omdat we aan het begin [...]. We zagen dat de spelers de opportunity maps letterlijk gingen overnemen, dus hier zit kennelijk olie dus dan zetten we hier maar een olieplatform op. Dus met die opportunity maps gingen ze eigenlijk niet meer zelf nadenken maar namen het eigenlijk een beetje als uitgangspunt. Waardoor eigenlijk de sessie niet zo heel erg leuk is natuurlijk, er wordt niet meer zelf na gedacht over bepaalde dingen. Dus wij in Nederland gebruiken die opportunity maps eigenlijk niet meer in de huidige sessies. In Schotland gebruiken ze dat wel, maar zijn dan meer van, het is de huidige stap [...] maar dat betekent niet dat het allemaal correct is. Dus dat is bij ons nog wel een

..Verbeterpunten	29	beetje een puzzel van hoe gaan we daar mee verder, om toch nog iets te ontwikkelen om die opportunity maps iets beter ontwikkelen. Kijk ecologie is altijd een beetje lastig zeker als je een heel groot spelbord hebt en je ziet al een bepaald aantal plekken, hier is vis en hier zijn vogels. Spelers vinden dat toch lastig om bepaalde MPA of bepaalde gebieden te beschermen. Ze weten niet precies wat daar zit [...].
..Verschillen	30	Anoek: En dat spel wat nu voor China of met China ontwikkeld gaat worden is dat ook op basis van wat er nu al ligt of?
..Andere landen	30	RWS-SG: Ja, eigenlijk is het een het bordspel, maar er zijn wel specifiek andere tokens voor ontwikkeld. Wat je ziet in China die maken ook zeeekommer, dat wordt wel gegeten en gebruikt. Maar ook visserij villages hebben we toegevoegd en hebben we ook tokens voor industrie en voor steden. Dus we hebben eigenlijk gewoon onze token set aangepast [...] en wat je kunt plaatsen op het bord hebben we uitgebreid, dus specifiek naar andere zeegebieden. Dus daar zit eigenlijk het grootste en voornaamste verschil in.
..Verschillen	31	Anoek: Wat vinden jullie echt positieve dingen aan de games die jullie ontwikkeld hebben?
..Positieve punten	32	RWS-SG: Ja wat ik positief vind eigenlijk, je brengt gewoon heel veel mensen bij elkaar, vanuit verschillende achtergronden, jong, oud, wel ervaren, niet ervaren. Dat zorgt altijd wel voor leuke dynamiek en discussies. Wat dat betreft elke sessie is ook anders. De sessie hoort gewoon bij de spelers en de mensen die erbij zijn. Dus geen enkele sessie is gelijk, zeg maar. Dus dat maakt het wel echt heel erg leuk en je leert elke sessie ook wel nieuwe dingen, inhouden van dingen die je zelf gewoon beter kan doen of in de opzet van het spel.
..Andere landen	33	I&W-SG: Je ziet wel verschil in de informatie software voor dat deel in Schotland, [...] voor de Noordzee. Maar in de Oostzee ook, op dit Oostzee daar zit een bepaalde cultuur die neigt om op een bepaalde manier in beweging te zijn. Je moet heel erg goed naar de details kijken, heel erg nauwkeurig in het omgaan met elkaar. En echt goed begrijpen hoe processen lopen, hoe ze kunnen. Je hebt daar ook met die Russen te maken en met ook verschillende talen ook. Die zijn daar nog wat gevoelig voor en het moet ook allemaal niet snel en een beetje step-by-step. En het ligt er ook een beetje aan wie het mee ontwikkeld hebben. Wij hebben er, Xander en ik, veel aan gedaan, want ja het heeft ook geen functie daar. Die stap voor stap methode hebben ze geïntroduceerd en toen zijn er twee van de junior, twee mensen die daar rondliepen, die zei ja dan wordt het gedaan en we zien niemand meer die stap voor stap benadering gebruiken. Het is net als een taart bakken, dat doe je een keer dan volg je het recept en de volgende keer weet je, oja ik heb boter nodig, een appel voor een appeltaart, een citroenschil en nou ja, dus dat weet je dan. [...] Dan weet je het wel stap voor stap. Ik vond dat niet echt doordacht, maar ja dat is hun leer curve en nu zijn die Italianen geïnteresseerd om iets te doen, nou ja, [...]. Het positieve van verschillende dingen is toch dat ze werken voor het doel wat ze dient. We hebben gisteren of eergisteren de ICES-council en die hebben allerlei werkgroepen en wij
..Andere landen		
..Positieve punten		

..Positieve punten

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hebben een werkgroep over [...] David Goldsborough die doet altijd mee. [...] Elk heeft zo zijn voordelen. Onze Schotse collega die zegt ja juist die combinatie van iets simpels, kort een bordspel en dan iets anders wat meer ingewikkeld ligt, [...]. Verschillende niveaus van leren iets doen.

..Verbeterpunten

..Positieve punten

..Verbeterpunten

Verbeterpunten; [...] in dienst van de zee. [...] wie eet nou wat. Daar hebben we pogingen tot gedaan, he Xander. Er wordt nu gekeken naar virtual reality en dan krijg je zo'n bril op, dan ben je alle contact weer kwijt. Dat is een uitdaging hoe we dat gaan doen. [...] je hebt altijd te maken met de keuzes, wat kan je software aan en wat kan die niet aan? En omdat we toch meer de tijd wilden ontwikkelen van, je hebt op een gegeven moment iets gebouwd of geplant en laat zien wat de consequenties daarvan zijn over tijd. Nou dat kost gewoon een hele hoop energie, letterlijk in de computer rekent dat en kost dat tijd. Waardoor die 3D [...] weer minder [...]. Want in een breder gezelschap maak ik gebruik van de filosofie het is eigenlijk een informatie paradox, dat je alleen maar meer wilt weten. Dat is ook nodig want we spelen vaak met mensen die al kennis hebben van hun eigen activiteit. Als je het kan zien en pakken en beleven dan wordt het interessant.

Interessante info

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[...]

Anoek: En dan als laatste vraag. Wat is in jullie ogen het effectiefst, een kort of een lang spel?

37

Lengte spel

RWS-SG: Dat hangt ook heel erg van de doelgroep af en van het doel van je sessie denk ik. Je kan echt een heel leuk effectieve sessie hebben in een uur, maar wat we zien met studenten is het vaak twee tot drie uur of over meerdere dagen zelfs. Kijk zo'n ICES-training dan kun je dan bordspel in vijf dagen doen. In de ochtend hebben ze dan les, zeg maar, cursus over een bepaald onderwerp en dat wordt dan uitgespeeld op het bordspel. Dus gaat toepassen wat je leert. Zo ga je dat dus het hele ding doen. In die zin is dat een hele effectieve, dan heb je al bepaalde stof of leren dat moet je echt gaan toepassen en dan kun je ook zeggen hier hangen wat dan dit aan [...]. En ja dan heb je ook meer tijd nodig. Maar ik vind het heel erg lastig te zeggen, wat is nou het meest effectief. We hebben een sessie gehad op Texel en we kregen echt, dat was een hele dag, en voor sommige mensen is dat echt gewoon veel en veel te lang. Ik had echt antwoord op een questionnaire van, na twee uur had ik het echt gezien. Maar dat hangt ook af van de achtergrond van die persoon. Dat was meer lokale politici die niet echt heel erg diep die inhoud kent en denk ja leuk, wat doe ik hier, zeg maar. Voor zo iemand is een bordspel een uur sessie, een soort van introductie veel effectiever dan gelijk zo'n hele dag gelijk intensief met software achter een computer zitten met ecologie modellen.

Lengte spel

38

Lengte spel

I&W-SG: Het heeft ook te maken met de energie spanning die de mensen aan kunnen en het heeft ook te maken met hoe comfortabel maak je het. [...] ook hoe ga je met ze om [...] maar mensen hebben meestal niet zo'n lange energie boog en bij ons krijgen ze natuurlijk ook er meteen water bij. [...]. Ze moeten een comfort brake hebben, maar niet te lang. Met master studenten in Italië deden we dan twee dagen. [...] en dan sluiten we af met pizza en een bubbel en alle groepen zijn er dan door heen geweest. Maar ja dan moeten

Lengte spel

Lengte spel

ze dus ook bij de minister komen per groep om uit te leggen wat nu [...], dan staan ze met hun handen in hun zakken iets uit te leggen. [...]. Die mensen van ICES-workshops die betalen er ook voor, dus dat is ook weer anders. Het is zoeken naar wat werkt. En als het niet verder lukt, je kan afkapen. [...] en zeker in de software is dat handig als die door de tijd heen gaat, dat je ook af en toe tijd neemt om terug te kijken. Je moet ook doceren met die energie van die mensen. Wij komen altijd tijd te kort [...]. En ook met, hoe snel duik je het spel in? Daar hebben we het altijd met Igor en Bob over, ik zet mensen niet meteen aan het werk, maar vaak doen we dan eerst een spelletje en elkaar leert kennen. [...]. Maar goed dat hangt ook van de groep af. Als de groep elkaar al kent dan kun je dat al overslaan. [...]

Appendix IV: Matrix Lessons Learned

In this appendix the link to the matrix used for the analysis of the lessons learned is given. In the matrix the four existing Marine Spatial Planning serious game are described with successful aspects and challenges. The aspects were found after a literature review was conducted and an interview with two stakeholders involved in the development of the serious games.



Appendix V: Interview blueprint Ecosystem-Based Management and Human Effects

Theme: A stakeholder perspective of Ecosystem-Based Management and the management of human activities in the Dutch marine ecosystem of the North Sea.

Main question: What is the perspective of the stakeholders on Ecosystem-Based Management and how the management of human activities in the Dutch marine ecosystem of the North Sea can contribute?

Sub questions:

- What is the perspective of the stakeholders on the definition of Ecosystem-Based Management?
- What is the perspective of the stakeholders on the effects of the fisheries and the energy sectors on the marine ecosystem?

Target group

The interviewers sought perspectives from stakeholders whom are active in the North Sea on either research, conservation, policy or have economic stakes. For that reason, interviewees were selected from the following organisations: Stichting the Noordzee, VisNed, Vattenfall, Wageningen Marine Research (WMR), Ministry of Agriculture, Nature and Food Quality and TenneT. The interviewees were gathered through Jeroen Vis (Ministry of Agriculture, Nature and Food Quality) and David Goldsborough (VHL), whom are both problem owners for this project. All questions, shown below, were discussed with all the interviewees. If an interviewee was not familiar with a subject, the questions were not be discussed.

Practical constrains

The interviews were conducted in Dutch since all the interviewees and the researchers are native Dutch speakers. In addition, the results must be presented in English, this may cause translation errors or misinterpretation of the data. For that reason, the translated version of the transcript results will be shared with the interviewee of interest, whom can check if his/her answers were presented correctly.

Another constrain was the recent development in the corona virus outbreak. This means that the interviews had to be executed via Skype or another available online conversation tool.

Analysis

For the analysis of the interviews the software program MAXQDA was used (<https://www.maxqda.com/>). Within the program MAXQDA codes were assigned to word sections, which then were further analysed using the program. For the analysis an encoding method was used to determine what codes could be used according to the answers given by the interviewees. The description of the analysis is described through a step-by-step process.

Step 1: The voice recordings were transcribed by hand in a word document, since there was no funding to use an appropriate software program or to hire a person to transcribe the recordings. This was considered in the time planning and the recordings were transcribed as soon as possible after an interview was performed.

Step 2: The transcriptions at first were read carefully, this gave an indication of what had been discussed and what answers were given by the interviewees.

Step 3: Based on the interviewees' answers a list of codes was set up. Alterations to these codes could be made along the analysis process if this was deemed appropriate.

Step 4: Again, the transcripts were read carefully, and the enlisted codes were assigned to the sections of the transcripts that corresponded to the codes.

Step 5: Then the codes were categorised. The codes that discussed similar elements were put in one category, which made for a clear overview of the interviewees' answers.

Step 6: The categories were then separately analysed, and conclusions were adapted for application in the report results. Finally, the interview results were separated and added to the matrix of *Effects of fisheries and wind energy*, see chapter 2 Method 2.3.

Interview questions

The questions are presented in Dutch as they will be used in the interviews with the stakeholders.

1. Bent u bekend met de managementstrategie Ecosystem-Based Management?

Follow up; Op wat voor manier komt u in aanraking met de managementstrategie Ecosystem-Based Management?

2. Wat is uw definitie van Ecosystem-Based Management?

Follow up; Waarop heeft u deze definitie van Ecosystem-Based Management gebaseerd?

3. Wat voor effecten denkt u dat visserij in de Noordzee heeft op het marien ecosysteem?

Follow up; Zijn dit positieve effecten of negatieve effecten?

Follow up; Wat is uw perspectief van de effecten van verschillende bodem beroerende visserij op het Noordzee ecosysteem? (Boomkor, puls, ...)

4. Wat voor effecten vindt u dat de energiesector heeft op het marien ecosysteem van de Noordzee?

Follow up; Zijn dit positieve effecten of negatieve effecten?

Follow up; Wat is uw perspectief van de introductie van hard substraat aan het marien ecosysteem in de Noordzee door de plaatsing van windmolenparken.

Follow up; Wat is uw perspectief van de effecten die het aanleggen en onderhouden van kabels en energie hubs hebben op het marien ecosysteem in de Noordzee?

5. Hoe denkt u dat de sectoren visserij en energie gemanaged kunnen worden met Ecosystem-Based Management?

Appendix VI: Interview transcript Ecosystem-Based Management and Human Effects

1	16 April 2020 – 15.30
2	Interview StNZ – Stichting de Noordzee
3	Elske: We studeren allebei Kust en Zee Management in Leeuwarden en we doen nu ons afstudeerproject en we willen dus een Marine Spatial Planning serious game ontwikkelen waarbij Ecosystem-Based Management echt de voorgrond heeft en dat de deelnemers tijdens het spel ook echt daarop richten, dat dat het belangrijkste aspect is, dat het natuur aspect goed naar voren komt. Dus daarom willen we ook interviews doen met de mensen die ook in het Marine Spatial Planning betrokken zijn, zeg maar de actoren zoals ook Stichting de Noordzee is en we willen ook gewoon wat perspectieven krijgen van hoe zij Ecosystem-Based Management zien en de effecten die menselijke activiteiten hebben op de Noordzee en, dus zoals visserij en het plaatsen van windmolens op zee. Dus dat is ook een beetje waar we dit interview over wilden hebben. Had jij hier nog iets aan toe te voegen Anoeke?
4	Anoeke: Nee, nou ja het belangrijkste aspect van de interviews is, dat literatuuronderzoek wat wij hebben gevonden toch nog even wat ook van mensen die daadwerkelijk in het werkveld bezig zijn, wat zelfde effecten te horen en, ja gewoon alle actoren die wij in het spel doen daar toch ook mensen van te kunnen spreken, dus ja.
5	Elske: Dus dan moeten we maar met de eerste vraag beginnen denk ik. Want zoals we net zeiden is Ecosystem-Based Management één van de belangrijke element van de serious game. Ben jij bekend met deze managementstrategie?
6	StNZ: Ja, maar niet zozeer vanuit de theorie, meer in de praktijk.
7	Elske: Oké, en op wat voor manier ben je er dan mee betrokken?
8	StNZ: Nou ik heb wel gewerkt aan verschillende projecten die dan probeerden om een soort van structuur op te zetten zodat niks van dat ecosysteem, niks van de verschillende soorten gebruiken zou worden vergeten. Dus eigenlijk een overzicht maken van de sectoren, en de druk op het ecosysteem, en de onderdelen van het ecosysteem. Dat is eigenlijk alweer acht jaar terug ofzo. Ben ik er mee begonnen, heb je in het kader van Kader Richtlijn Marien, om dat op te zetten en nou zo heb ik er eigenlijk kennis meegemaakt, en nu zie je dat steeds verder terug in het beleid ook.
9	Elske: Om daar op door te gaan, wat is volgens jou dan een definitie van Ecosystem-Based Management?
10	StNZ: Je wilt menselijke activiteiten en de druk op het ecosysteem, die daarmee gepaard gaan wil je zo reguleren dat het in balans is met het ecosysteem als geheel, en op verschillende onderdelen van het ecosysteem op de langere termijn. Dat is eigenlijk het doel wat je hebt.
11	Elske: Dat zou jouw definitie daarvan zijn?
12	StNZ: Ja, ik weet niet of je het opneemt, maar het is natuurlijk moeilijk ... (Elske: Ja, we nemen het op en dan typen we het daarna uit.) Ja, ik had even jullie vragen doorgenomen, ik had: reguleren van menselijke drukken op het ecosysteem, dus dat houdt ook de activiteiten in, op zo'n manier dat het ecosysteem als geheel en op verschillende onderdelen daarvan duurzaam

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gebruikt worden. En dat houdt ook in, vanuit Stichting de Noordzee gezien en de Rijke Noordzee, vindt ik dat dat inhoudt, dat eigenlijk in de Noordzee ook elke soort die daar van nature voorkomt, ook nog voor zou kunnen komen op bepaalde plekken. Dan zou je het echt goed doen, of dat helemaal haalbaar is weet ik niet, maar dat moet wel je streven zijn. Dat je de gebruiken zo reguleert, dat je niet op voorhand soorten uitsluit.

13 **Elske:** Oké, ja dat is wel interessant. Ook hoe je het voor elkaar kunt krijgen, of dat überhaupt mogelijk is, is altijd de vraag.

14 **Anoek:** Als we dan qua effecten gaan kijken, dus zowel positieve als negatieve effecten van visserij, heb jij een beeld bij wat voor effecten er in de Noordzee spelen?

15 **StNZ:** Ja, denk ik wel. De effecten van de visserij, ja dan kom je op de grote algemene effecten van wat de visserij doet. Dus dat is minder grote vis, minder gevarieerde bodemhabitat, dus ik denk dat dat de belangrijkste misschien nog wel is, oververtegenwoordiging van kleine soorten, oververtegenwoordiging van zandige soorten; platvis, en ja, gewoon onttrekken van visbiomassa uit het ecosysteem. Positieve effecten van visserij, ja, die zijn er wel, maar die zijn er vooral voor kleine, nou voor aasetende soorten, voor soorten die afhankelijk zijn van kleine prooien, en voor platvis, die het heel goed doet op wormige bodems. Als je veel vist dan krijg je meer wormen, en dat is eten voor platvis, dat vinden ze lekker, en dan hebben ze zand, en wormen. Nou dan ben je natuurlijk hartstikke blij.

16 **Anoek:** En zie jij de aanlandplicht ook als iets positiefs, of als een soort van Ecosystem-Based Management..?

17 **StNZ:** Daar ga ik geen antwoord op geven. Daar zit ik niet goed genoeg in. Dat zou je iemand moeten vragen die meer in de visserij, ik deed het dossier beschermde gebieden, en dat was niet het dossier voedsel, en daar viel de aanlandplicht echt onder bij Stichting de Noordzee. Ik denk dat de bedoelingen van de aanlandplicht heel goed zijn, maar of het effect ervan uiteindelijk is wat er wordt beoogt, dat weet ik niet.

18 **Elske:** En voor de effecten van windenergie, zie je daar positieve of dan wel negatieve effecten van, hoe zie jij dat?

19 **StNZ:** Ja, boven water of onder water?

20 **Elske:** Kan allebei.

21 **StNZ:** Ja. Boven water heb je natuurlijk de vogels en de vleermuizen, en onder water heb je de zeezoogdieren, maar ook een heleboel andere dieren die effect ondervinden. En soms zelfs dieren waarvan je het misschien wel niet verwacht. Onderwatergeluid, is een vrij nieuwe druk op het ecosysteem, maar een heel interessante, en de effecten daarvan zijn eigenlijk nog helemaal niet zo duidelijk. Van impulsgeluid, dat zijn zeg maar de klappen, dat weten we nog een beetje beter dan het continue onderwatergeluid. Zo'n molen maakt, al schijnt het best een beetje mee te vallen, maar ook nog wel als die gewoon draait geluid, en geluid dat maskeert de klappen verschrikkelijk, maar dat continue onderwatergeluid maskeert, maar een heleboel communicatie gaat door geluid onder water, dus ja. Heel interessante verhalen zijn daarover en het wordt wel steeds duidelijker dat



ook ecosysteem effecten, ook echt effecten op het voedselweb kan hebben bijvoorbeeld. Omdat bepaalde soorten zich echt anders gaan gedragen, en een andere overlevingskans krijgen, en nou ja dan hoeft het maar net een paar procent te schelen, maar dat kan dan. Als het toevallig een garnaal is die iedereen eet, of een zandspiering die iedereen eet, ja dan kan dat effect hebben. We weten er heel weinig vanaf, maar het is zeker een potentieel negatief ding. En elektromagnetische straling, is er natuurlijk ook nog, van de kabels. En een heel belangrijk ding, misschien wel de belangrijkste, is verandering van stromingspatronen en stratificatie. Aan de andere kant, ik houdt me veel bezig met de positieve effecten van wind op zee, en dat is de, mijn inziens is de rust binnen de windparken voor de bodem, en de toevoeging van hard substraat. En vooral die combinatie is heel erg interessant, want we hadden vroeger veel meer hard substraat en rif structuren in de Noordzee, en die zijn verdwenen. Juist door dat toe te voegen en die bodem rust samen, creëer je natuurlijk de kans dat daar zelf weer wat gaat groeien en zich uit gaat breiden. En ook dat is afwachten, want de molens veranderen ook een heleboel stroming, dus hoe rustig is die bodem nu eigenlijk rondom die molens.

22 Elske: Ja, dat zou nu in een later stadium eigenlijk nog uitgezocht moeten worden natuurlijk.

23 StNZ: Dat is ook de basis van Ecosystem-Based Management volgens mij. Dat alles op wetenschap gebaseerd is. En dat is natuurlijk wel direct ook de moeilijkheid ervan, want we weten nog een heleboel dingen niet. En daarin is het, ik weet niet of jullie bekend zijn met het voorzorgsprincipe, dat je dingen niet moet doen als je nog niet weet wat het effect ervan is, en die vindt ik heel belangrijk in het geheel van Ecosystem-Based Management, omdat ik gewoon echt zie ten aanzien van de zee dat we daar veel te weinig leren om het goed toe te passen. Dus we lopen eigenlijk voortdurend achter de feiten aan toch wel. Dus ik denk dat we, en daarom komt het cirkeltje niet helemaal rond. Dus je zou het willen baseren op de wetenschap, maar we investeren daar niet genoeg voor om dat te kunnen, ondertussen blijven we toch door ontwikkelen. Hij klopt niet helemaal, op zich.

24 Elske: Nee het zijn wat scheve verhoudingen, als je het zo bekijkt.

25 Aniek: Maar dan, als we bijvoorbeeld bij het ontwikkelen van het Noordzeeakkoord, want Stichting de Noordzee was ook bij dat proces, zit Stichting de Noordzee daar dan ook in van "Oké, we willen dus veel meer wind op zee gaan ontwikkelen" wordt dan ook die precautionary principle aangekaart ook?

26 StNZ: Ja, dat kaarten we wel aan. Tegelijkertijd is het Noordzeeakkoord is een akkoord, en een akkoord is een uitkomst van een onderhandeling. Dus, zeker dat we dat benadrukken en onderstrepen en daarvoor opkomen en tegelijkertijd, en ik denk ook dat dat moet, want als we niet kiezen, wat we willen, dan wordt er automatisch door het menselijk gebruik eigenlijk, door de sectoren gekozen. Dus ik denk dat het beter is om te kiezen, dan helemaal niet te kiezen. En ik denk ook dat het aan ons is om te kiezen, omdat die wetenschap nooit echt het hele antwoord gaat geven. Dan zul je toch op een

- gegeven moment moeten kiezen: *“dit willen we wel, dit willen we niet”*, en dan moet je gewoon een slag om de arm nemen, omdat je de natuur net iets meer beschermt dan dat je misschien op basis van wat je zou willen gebruiken zou doen, om aan de veilige kant te zitten.
- 27 **Elske:** En met wat voor, zeg maar in die onderhandelingen, wat is zeg maar jullie belang daarbij? In dat Marine Spatial Planning proces, wat is jullie belang?
- 28 **StNZ:** Het belang is dat uiteindelijk werken maatregelen als ze ondersteund worden door alle partijen. Dat zijn ook de kernwaarden voor Stichting de Noordzee, is samen en oplossingsgericht, science-based en onafhankelijk. Dus vanuit die kernwaarden werken wij en daar past het Noordzeeakkoord dus helemaal in.
- 29 **Elske:** En als we dan weer terugkomen op Ecosystem-Based Management, hoe denk jij dat die visserijsectoren en energie samen gemanaged kunnen worden met die managementstrategie?
- 30 **StNZ:** Ik denk dat de uitdaging is voor de visserij om toch te komen tot methoden die maar een kleiner oppervlakte nodig hebben om toegepast te worden. Wat je nu ziet is dat visserij heel veel oppervlakte van de Noordzeebodem nodig heeft om z'n winsten te halen. En dat is eigenlijk waar het ook echt bijt met ecologie, denk ik. Het is niet erg als er gevist wordt, het is ook niet erg als er veel gevist wordt, maar dan het liefst op plekken waar je toch al tien keer over de bodem gaat, twintig keer, en dan plekken waar je af en toe één keer gaat, niet meer komen. En ik denk dat dat echt de uitdaging is voor de visserij. En voor de energie is denk ik dat onderzoek naar die veranderingen van die stromingen echt heel belangrijk. Dat grijpt aan op het hele ecosysteem, als dat verandert. Weet je, vogels is heel vervelend, vleermuizen is heel vervelend, maar als je echt het systeem gaat veranderen, dus door die stroming, dus dat je stratificatie in één keer niet meer voorkomt, dan denk ik dat het effect daarvan nog veel groter kan zijn.
- 31 **Elske:** En, want je zei dat er bijvoorbeeld gebieden sluit waar je normaal ook al niet zoveel komt, en op andere gebieden dan juist meer zou gaan vissen. Wat voor effecten...
- 32 **StNZ:** Nee, zo moet je het niet helemaal zien. Er zijn twee dingen: je moet je visserij proberen te concentreren op de plekken waar je toch al veel vist, dat is één. Aan de andere kant is bewezen dat visserij zich concentreert op plekken met hoge natuurwaarde. Dus als je alleen maar dat doet, dan krijgt de visserij de plekken met het meest potentieel natuur, en ben je er niet. Dus je moet ze alle twee doen. Dus visserij concentreren en je moet aanwijzen welke gebieden belangrijk voor natuur zijn, en een deel daarvan sowieso sluiten voor visserij.
- 33 **Elske:** Dat verklaart wel iets inderdaad. Ja, want ik dacht wat voor effecten heeft dat dan, als je bijvoorbeeld één gebied helemaal sluit voor visserij en het andere dan juist meer gaat. Maar als het niet...
- 34 **StNZ:** Het is best wel ingewikkeld, het is niet zo zwart-wit. Het is een moeilijke overweging, want hij is niet zo simpel, want de visserij die vist ook niet altijd op dezelfde plek. De visserij die vist waar de vis zit, dus je kunt een

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optimalisatieslag maken denk ik, maar niet perse in één keer.... Het heeft geen zin als in 2016 blijkt *"nou ze hebben daar en daar gevist, oké dan mogen ze in 2017 alleen nog maar daar vissen"*. Dat heeft geen zin, want die vissen verschuiven ook wel eens, dus je moet een soort plan maken waar die vis zit meestal, over de jaren heen, en waar die belangrijkste natuurgebieden zitten, en dan daar een afweging in maken. Maar het is dus niet zwart-wit, maar er kan wel een optimalisatieslag overheen. Want er zijn wel gebieden waar, die voor natuurwaarde wat hoger zijn, en waar over het algemeen weer minder wordt gevangen. Maar het is niet eerlijk om puur uit te gaan van, de visserij gaat de nek om als je alle gebieden sluit waar de natuurwaarde het hoogst zijn, andersom, het heeft geen zin om alle gebieden te sluiten om aan de visserij te geven waar zij het minste winst maken, want daar kunnen de natuurwaarde vaak ook weer hoog zijn. Het zit er tussen in, je moet het allebei doen. En je moet ook wat verliezen, je moet ook wat mooie plekken van natuur opgeven voor visserij.

35 Elske: Dus er zit eigenlijk een soort van samenwerking, als ik dat zo begrijp, een samenwerking tussen natuur en visserij.

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36 StNZ: Nou, nee. Het zijn gewoon, ze willen hetzelfde hapje eten, dezelfde, het bijt elkaar. En dat kun je, het liefst los je dat op in de ruimte, en dat kan soms wel en soms niet. Dus waar natuurwaarde voorkomen buiten belangrijke plekken voor visserij, dat is mooi, dan bijt het elkaar niet. En waar natuurwaarde voorkomen op plekken waar ook het meeste geld uit de zee wordt gevist, dan bijt het elkaar wel, en daar moet je een afweging maken, ja wat is dan de balans.

37 Aniek: Wat misschien nog wel een leuke vraag is, heb je ooit meegedaan aan een serious game?

38 StNZ: Ja, volgens mij wel, maar het is niet bijgebleven. Op de Noordzeedagen ofzo, het is wel een uitdaging om dat goed op te zetten denk ik. Nou leuke opdracht, en een goede opdracht voor Ecosystem-Based Management want dan hoor je gelijk van alle verschillende perspectieven hoe ze erover denken en waar die ingewikkeld wordt. Dat is wel mooi. Jullie doen dit met David Goldsborough? Ja, het is gewoon heel interessant en ik denk wat ik schetste van die kennis, die blijft altijd een beetje achter, omdat het duur is om onderzoek te doen op zee. Dus je zult ook gewoon beslissingen moeten maken, en een soort veiligheidsmarge moeten inbouwen voor natuur.

39 Elske: Misschien nog een laatste vraag, wie denk jij dat die beslissing moet maken?

...Sterke punten

40 StNZ: Ja, nou ik vindt wel heel mooi bij het Noordzeeakkoord, dat er echt een onafhankelijk iemand is ingevlogen. Ik denk dat dat ook wel goed is.

41 Elske: Wat voor persoon was dat, een wetenschapper of een?

42 StNZ: Nee, het was de oud-burgemeester van Groningen: Jacques Wallage, dat is een bestuurder. Ja dat is dus iemand die echt dit soort processen begeleid, en alle stakeholders bij elkaar brengt. Daar ben ik ook positief over, dat het zo is aangevlogen. Wie zouden deze beslissingen moeten nemen? Ik zou willen zeggen de overheid, maar die doen het niet, blijkt. Ja, idealiter zou het, als de overheid het echt zou lukken om vanuit Ecosystem-Based

...Sterke punten

Management te werken, dan zou er met de duurzaamheid niet zo veel aan de hand moeten zijn, op de Noordzee. Maar dat ben ik niet van mening dat dat nu zo is. Ik denk ook verschillende mensen bij de overheid niet, maar ja, dat blijkt ook gewoon wel uit analyses over, halen we de doelen van de Kader Richtlijn Marien of halen we de doelen van de Natura2000. Het antwoord is daar gewoon heel vaak nog nee op.

43 **Elske:** Ja het is dan jammer dat het nog niet voor elkaar is.

44 **StNZ:** Ja, maar ik denk dat wind op zee zeker negatieve effecten, maar wind op zee dwingt ons wel om beter na te denken over menselijk gebruik op de Noordzee. En dat is wel een positief effect op dat niveau. Door wind op zee komen dingen meer ruimtelijk vast te liggen, en daardoor wordt ook duidelijk wat er allemaal gebeurt en wordt er opnieuw nagedacht over wie er daar nou recht zou hebben op welke dingen. Ik zie dat ook wel als een kans, al zijn er zeker een heleboel negatieve dingen. En onderwater zijn er ook echt wel degelijk kansen voor natuurversterking.

Appendix VII: Matrix Effects of human activities



Effect scale.xlsx

Appendix VIII: Factsheet MSFD current status and measure

The European Union Marine Strategy Framework Directive (MSFD) entered into force in 2008. The MSFD obligates Member States to achieve and/or maintain Good Environmental Status (GES) of their marine waters and to take measures to meet the established targets. The assessment of the current environmental status in the Netherlands' part of the North Sea shows that the main objective, achieving good environmental status, has come closer to being met. The physical changes to the North Sea could have effects for the ecosystem and biodiversity. The economic activities on and along the North Sea largely determine the extent of the impact on the marine environment and on the current and future environmental status. In light of this the description of GES refers to the environmental status as the status that is to be achieved, recovered or maintained. Good environmental status does not refer to the virgin marine ecosystem from the past, but an ecosystem that functions optimally and is resilient, thereby offering opportunities for sustainable human use. The current status and the measures taken to achieve GES have been determined based on the following descriptors¹:

- D1 – Biological diversity (birds, fish, sea mammals)
- D2 – Non-indigenous species (exotics)
- D3 – Commercially-exploited fish and shellfish
- D4 – Food webs
- D6 – Sea-floor integrity (habitats)
- D11 – Introduction of energy, including underwater noise

D1: Biological diversity	
Marine mammals	
There is an increase in population for porpoise and grey seals, except the total amount of species is not considered sufficient for biological diversity. The same goes for the harbour seals. The reason for these species not being considered sufficient is because of the quality of their habitat or entrapment by fishing gear.	
<i>Current status</i>	Good environmental status: improving, but not sufficient, for marine mammals
<i>Measures</i>	Porpoise Conservation Plan

D1: Biological diversity	
Sharks and rays	
The population numbers for sharks and rays are concerning and are not in line with GES. mostly due to knowledge gaps. There are signs of stock recovery.	
<i>Current status</i>	Good environmental status: not yet achieved
<i>Measures</i>	OSPAR's list of endangered species

D1: Biological diversity	
Sea birds	
The status of seabirds is in a negative trend, both for breeding birds and non-breeding birds. When looking at breeding successes the numbers have been low in the past years. A reason for this status of the seabirds is not known and actions to improve the numbers have not been found.	

1. Disclaimer: Officially the MSFD consists of 11 descriptors, for the factsheet only six of these descriptors are used. Since these descriptors can be directly affiliated with the effects of wind energy and fisheries were found as most fitting to the MSP serious game in which nature, fisheries and offshore wind energy play a key role.

<i>Current status</i>	Good environmental status: not achieved, no prospect for improvement in the future.
<i>Measures</i>	Licence requirements for large-scale developments, such as offshore wind energy

D1: Biological diversity	
Fish	
	<ul style="list-style-type: none"> • Fish stocks are seen to recover, as assessed by OSPAR. The negative trend for vulnerable fish species has taken a hold and the large fish community is in recovery, but still low. • Populations for migratory fish, as assessed by the Habitats Directive, is seen as unfavourable.
<i>Current status</i>	Good environmental status: not yet achieved
<i>Measures</i>	<ul style="list-style-type: none"> • Limitation of activities and by-catch in Natura 2000 areas • Encouragement to use alternative fishing gear

D1: Biological diversity	
Benthos	
	For benthos the biological diversity is not sufficient and especially for the large and long-lived species, which in lesser numbers than should be
<i>Current status</i>	Good environmental status: not yet achieved (partially unknown)
<i>Measures</i>	Protection of seabed in the Coastal zone and the areas Central Oyster Grounds, Cleaver Bank, Dogger Bank, Frisian Front and the Raan Flats

D2: Non-indigenous species	
	<ul style="list-style-type: none"> • The current non-indigenous species in the Dutch North Sea cannot be reduced, but the amount of non-indigenous species coming into the Dutch North Sea system does go down. Currently 54 non-indigenous species have been found in the Dutch North Sea. The already present non-indigenous species are also hard to remove without harming the ecosystem. • Another possible danger for introduction of non-indigenous species are wind farm installations. Due to the introduction of hard substrate, there is a higher change of non-indigenous species entering the system whom thrive on hard substrate habitats.
<i>Current status</i>	Good environmental status: Appears to have been achieved, only looking at the amount of species entering the Dutch North Sea since 2012. Not looking at the already existing non-indigenous species.
<i>Measures</i>	<ul style="list-style-type: none"> • International treaty for management and control of sediments and wastewater of ships should be further implemented • Establishment of international agreements on anti-fouling

	<ul style="list-style-type: none"> • Conditions on permits for shellfish transport to Natura 2000 areas
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D3: Commercially exploited fish and shellfish	
Maximum sustainable yield' (MSY) and 'spawning stock biomass' (SSB) criteria are met for a quarter of the commercial fish stocks. In addition, 10 of the 27 commercially exploited fish and shellfish species meet one of the two criteria. These outcomes presents the influence of the Common Fisheries Policy in a positive way.	
<i>Current status</i>	Good environmental status: the fish and shellfish stocks are in positive trend, when this trend is kept GES is expected to be achieved.
<i>Measures</i>	<ul style="list-style-type: none"> • Limitation of activities and by-catch in Natura 2000 areas • OSPAR's list of endangered species • Licence requirements for large-scale developments, such as offshore wind energy • Haringvloet locks partially opened • Encouragement to use alternative fishing gear • Commercially exploited fish catch management • Landing obligation

D4: Food web	
-	
<i>Current status</i>	Good environmental status: not yet achieved (partially unknown), for nutrient and organic matter the status is improving but GES is yet achieved.
<i>Measures</i>	<ul style="list-style-type: none"> • Limitation of activities and by-catch in Natura 2000 areas • OSPAR's list of endangered species • Licence requirements for large-scale developments, such as offshore wind energy • Protection of seabed in the Coastal zone and the areas Central Oyster Grounds, Cleaver Bank, Dogger Bank, Frisian Front and the Raan Flats • Encouragement to use alternative fishing gear •

D6: Seafloor integrity	
<ul style="list-style-type: none"> • There is still significant disturbance on the seabed of the Dutch North Sea. <ul style="list-style-type: none"> ○ Low number of long-living and vulnerable species ○ Disappearance of biogenic reefs (e.g. shell beds and other reef-forming species) ○ Physical disturbance by bottom fisheries, and shell extraction and sand suppletions 	

<ul style="list-style-type: none"> ○ Physical damage from oil and gas platforms and production, but also the development of wind farms, which introduce hard substrate. Disturbance is relatively local. ● The placement of wind farms in the Dutch North Sea will be executed, since it is part of national and international renewable energy targets. This would mean future pressure on the seabed, however with the introduction of hard substrate there are opportunities for the reintroduction of biogenic reefs and the recovery of the seabed ecosystem. These developments are dependent on decision regarding bottom fisheries to be allowed within the wind farms. 	
<i>Current status</i>	Good environmental status: on physical disturbance GES is not yet achieved, but for physical loss GES has been achieved since 2012.
<i>Measures</i>	<ul style="list-style-type: none"> ● Protection of seabed in the Coastal zone and the areas Central Oyster Grounds, Cleaver Bank, Dogger Bank, Frisian Front and the Raan Flats ● Conditions on permits for sand extraction ● Encouragement to use alternative fishing gear ● Conditions on the issuing of licenses

D11: Introduction of energy, including underwater noise
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Different economic activities in the Dutch North Sea will define to what end the ecosystem is negatively affected through sound pressure. The wind farm development could be an pressure on the marine ecosystem and effect the achievement of GES on underwater noise disturbance.

<i>Current status</i>	Good environmental status: not yet achieved (partially unknown), with respect to impulsive sound GES is improving.
<i>Measures</i>	<ul style="list-style-type: none"> ● Permits for development of offshore wind farms should be required ● Code of conduct on cleaning explosives ● Regulations on use of Defence sonar and seismic research ● IMO guidelines on underwater noise derived from shipping

Appendix IX: Matrix Ecosystem-Based Management features



EBM features.xlsx

Appendix X: Effects of Offshore Wind on the marine ecosystem

Positive effects <i>Offshore Wind</i>	Description	Literature
Introduction of new hard substrate	<p>The placement of scour protection at the bottom of the windmill introduces new hard substrate in the marine, which can function as compensation for the habitat that was lost with the placement of the wind farm. The new habitat created by the scour protection, can strengthen the ecological carrying capacity, though colonization of benthic species. This habitat can have positive effect for possible new breeding grounds. It also can develop in an artificial reef, which can give a boost to the ecosystem in terms of species diversity and biomass. The reef effect may cause an increase in heterogeneity, which also has a positive effect on the total biodiversity and biomass in the ecosystem. With the increase in biodiversity these can also be an increased food opportunity. In addition, the reef effect may attract a larger number of shellfish and other species who feed on them, for example fish, marine mammals and birds. The increase in biodiversity and biomass may cause a higher resilience of benthic species, which can have additional positive effects on other species. For that reason, this can create new and higher trophic interactions with the introduction of a new habitat. In order for these artificial reef effects to be positive of the marine ecosystem the location of the windfarm and the used materials are of great importance.</p>	Causon & Gill, 2018; Langhamer, 2012; Wilson & Elliot, 2009
Hard substrate as compensation habitat loss		Fox, Desholm, Kahlert, Christensen, & Petersen, 2006; Langhamer, 2012; Wilhelmsson et al., 2010
New habitats by introduction of hard substrate		Bergström et al., 2014; Causon & Gill, 2018; Fox et al., 2006; Langhamer, 2012; Wilhelmsson et al., 2010; Wilson & Elliot, 2009
Strengthening of carrying capacity because of hard substrate		Wilson & Elliot, 2009
Colonization on hard substrate		Gill, 2005; Lindeboom, Degraer, Dannheim, Gill, & Wilhelmsson, 2015; Petersen & Malm, 2006
Preservation of existing breeding and spawning grounds		Fox et al., 2006
Artificial reef forming for environmental and commercial interests		StNZ, personal communication, 16 April 2020; TenneT-AOGD & TenneT-SA, personal communication, 16 April 2020
Increased biodiversity		Bailey, Brookes, & Thompson, 2014; Bergström et al., 2014; Bos, Coolen, & van der Wal, 2019; Causon & Gill, 2018; Gill, 2005; Kaldellis, Apostolou, Kapsali, & Kondili, 2016; Langhamer, 2012; Punt, Groeneveld, van Ierland, & Stel, 2009; Vaissière, Levrel, Poich, & Carlier, 2014; Wilhelmsson et al., 2010;

		LNV-Nat, personal communication, 15 April 2020; Wetenschap-PA, personal communication, 17 April 2020; Wetenschap-WUR, personal communication, 17 April 2020
Increased heterogeneity		Gill, 2005; Langhamer, 2012; Petersen & Malm, 2006; Wetenschap-PA, personal communication, 17 April 2020
Food opportunities		Bailey et al., 2014; Vaissière et al., 2014
Resilience of epi-benthic organisms		Causon & Gill, 2018; Fox et al., 2006; Gill, 2005
New trophic interactions		Causon & Gill, 2018; Fox et al., 2006; Gill, 2005
Trawling exclusion within wind farm areas causes increase of ecological carrying capacity and fish abundance	Trawling fishing activities will be excluded in and around wind farms. These 'no take zones' that are then created could have positive effects on the marine environment in terms of increase of the carrying capacity and fish abundance. Due to the higher carrying capacity there are opportunities for more energy intake for organisms. The wind farms might function as shelter areas for juveniles, commercially exploited fish and other species. The commercially exploited fish and other species can recover in these shelter areas, which leads to a higher fish abundance, which could eventually lead to a spill-over effect. This spill-over effect can in addition have positive effects for fisheries, since there will be more available commercially exploited fish. Bailey et al. (2014) mentioned the following about positive effect for fisheries; "Exclusion of some or all types of fishing could also result in local increases in prey abundance for top predators, whilst reducing the risk of by-catch in fishing gear." The reduce of by-catch is a positive aspect for fisheries since they lose valuable profit when they are obligated to take their by-catch to shore (discard ban).	Bailey et al., 2014; Berström et al., 2014; Bos et al., 2019; Kaldellis et al., 2016; Langhamer, 2012; Punt et al., 2009; Vaissière et al., 2014; Wilhelmsson et al., 2010; Wetenschap-PA, personal communication, 17 April 2020; Wetenschap-WUR, personal communication, 17 April 2020
Recycling of local energy		Bergström et al., 2014; Fox et al., 2006; Gill, 2005
Reduction by-catch		Bailey et al., 2014
Functions as sanctuary/ shelter area for trawled organisms		Causon & Gill, 2018; Gill, 2005; Kaldellis et al., 2016; Langhamer, 2012; Wilson & Elliot, 2009; LNV-Vis-1, personal communication, 20 April 2020; LNV-Vis-2, personal communication, 28 April 2020
Bigger fish (juvenile fish stay in shelter area)		Causon & Gill, 2018; Langhamer, 2012

within wind farms)		
Higher survival of fish (no-take-zone)		Bergström et al., 2014
Increase of commercially exploited fish causes positive spill-over effect outside of OWF		Causon & Gill, 2018; Langhamer, 2012

Neutral effects <i>Offshore Wind</i>	Description	Literature
Insufficient knowledge about currents, wind and sediment plumes, causes uncertainties when decisions have to be made	Most articles argued that the scientific knowledge on the effect of the placement and operation of wind farms is insufficient. This causes uncertainty in the decision-making process in which sometimes decisions have to be made on assumptions. There is also insufficient knowledge on what effects the wind farms will have on the ecosystem in terms of currents, wind and sediment plumes. In the positive effects it was mentioned that the wind farms might function as shelter areas, but there is the possibility that fish avoid the farms, because of vibrations.	Bailey et al., 2014; Pelc & Fujita, 2002; LNV-Vis-1, personal communication, 20 April 2020; StNZ, personal communication, 16 April 2020; VisNed-Dir, personal communication, 7 April 2020
Impact of construction phase is seen as negligible	What can be concluded from studies is that the environmental impact during the construction phase will be minor. The impact, the construction phase, has on benthic species and seabed is seen as negligible when looking at the total seabed size in comparison to the wind farm area	Langhamer, 2012; Petersen & Malm, 2006; Vaissière et al., 2014; LNV-Nat, personal communication, 15 April 2020
Noise disturbance is most likely not to be harmful	Marine mammals will be disturbed by noise, but it is not likely to be harmful. It can be expected that the marine mammals leave the area during the construction and will later return to the area	Bailey et al., 2014; Bergström et al., 2014; Wetenschap-PA, personal communication, 17 April 2020
Cables (Electromagnetic fields [EMF]) has a small direct impact	research has shown that species which are sensitive to electromagnetic fields (EMF) might be disturbed, but the direct impact is small	Petersen & Malm, 2006; TenneT-AOGD & TenneT-SA, personal communication, 16 April 2020; VisNed-Dir, personal communication, 7 April 2020

Adding hard substrate in soft substrate habitat attracts new species, which are non-target species for the Dutch fishing fleet	When the wind farm is built, hard substrate is added into a soft substrate habitat. This is most often seen as positive, since the hard substrate can function as artificial reef. The species who live in the soft substrate habitat are not endangered and can be considered as adaptive to harsh circumstances. Furthermore, the hard substrate will attract new species, however these are non-target species for the Dutch fishing fleet.	Vaisiere et al., 2014; VisNed-BM, personal communication, 9 April 2020
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Negative effects <i>Offshore Wind</i>	Description	Literature
Noise pollution of OWF can affect echolocation, and can injure fish	During the construction phase boat traffic, dredging and drilling activities cause noise pollution, effecting fish and marine mammals. Marine mammals use echolocation for hunting, finding partners and avoiding predators. These echolocated activities could be disturbed from the sound produced by the windfarm construction. Regarding fish, research done by Vaissière et al. (2014) mentions that fish can get injured by the noise pollution, but the effect is minor and temporarily. It is more likely that the fish and marine mammals move away to avoid the noise.	Langhamer, 2012; Bailey et al., 2014; Bergström et al., 2014; Gill, 2005; Kaldellis et al., 2016; Lindeboom et al., 2015; Petersen & Malm, 2006; Punt et al., 2009; Vaissière et al., 2014; Wilhelmsson et al., 2010; LNV-Nat, personal communication, 15 April 2020; TenneT-AOGD & TenneT-SA, personal communication, 16 April 2020; VisNed-BM, personal communication, 9 April 2020; Wetenschap-RBINS, personal communication, 21 April 2020; Wetenschap-WUR, personal communication, 17 April 2020
Temporary habitat loss for benthic species	The construction phase also results in habitat loss for benthic species, by for example dredging which is temporarily. Gill (2005) mentioned the following about the construction and decommissioning of a wind farm; “During construction and decommissioning the seabed will be disturbed ... Removal of sediments will lead to direct loss of habitats and there will be an increase in local water turbidity arising from suspended solids. Resuspended sediments will be transported by prevailing water movement during construction, which may also mobilize any contaminants within the sediments”. The loss of habitat will reduce the energy intake of other organisms, of foraging	Kaldellis et al., 2016; Petersen & Malm, 2006; Wetenschap-RBINS, personal communication, 21 April 2020;
Loss of habitat reduces annual breeding		Fox et al., 2006
Loss of habitat reduces survival rates		Fox et al., 2006

	species, decrease the energy the organisms put in foraging. This will eventually lead to reduction of annual breeding and survival rates	
Dredging causes temporary habitat loss	Another environmental impact, during the construction phase, is dredging. This causes turbidity which effects vision for fish and marine mammals and reduces sunlight penetration for photosynthetic species. Dredging also causes temporary habitat loss for benthic species, and also causes the release of contaminants into the water column.	
Turbidity affects vision for fish, marine mammals, and reduces sunlight penetration for photosynthetic species		Petersen & Malm, 2006; Vaissière et al., 2014; Wilhelmsson et al., 2010; LNV-Nat, personal communication, 2020
Contaminants are released because of dredging		Gill, 2005; Petersen & Malm, 2006; LNV-Nat, personal communication, 2020
Cables (EMF) may affect navigating abilities	Furthermore, the electromagnetic fields, produced by the cables transporting electricity, may have a potential effect on the navigating abilities of fish and on the migration of fish, fish distribution and food availability. However, research done by Punt et al. (2009) concludes that the environmental impact of cables is considered minimal.	Punt et al, 2009; VisNed-BM, personal communication, 9 April 2020
Cables (EMF) may cause migration barriers		Bailey et al., 2014; Bergström et al., 2014; VisNed-BM, personal communication, 9 April 2020
Increase of bird mortality (collisions)	In respect to bird mortality multiple articles argued the potentially fatal collisions of birds with windmills. Collision can occur due to the moving blades from the mills and the chance of collision is greater with low visibility. The possibility for bird to collide with windmills is depending on the location of the wind farm, if it is placed in a flight/ migration route the possibility of collision if greater. In addition, birds may also be disturbed, especially during the construction phase, by intensive human activity of for example boat traffic.	Bailey et al., 2014; Fox et al., 2006; Kaldellis et al., 2016; Lindeboom et al., 2015; Pelc & Fujita, 2002; Petersen & Malm, 2006; Punt et al., 2009; Vaisière et al., 2014; Wilhelmsson et al., 2010; LNV-Nat, personal communication, 15 April 2020; Wetenschap-PA, personal communication, 17 April 2020; Wetenschap-RBINS, personal communication, 21 April 2020; Wetenschap-WUR, personal communication, 17 April 2020
Habitats, foraging and breeding grounds of birds might be displaced	A response of birds could be that they avoid the wind farm areas. This could have negative effects when the wind farm is located within the migration route of the organisms. This avoidance causes an increase in the migration distance, which requires the organisms to use more of their energy provision.	Bailey et al., 2014; Fox et al., 2006; Kaldellis et al., 2016; Lindeboom et al., 2015; Pelc & Fujita, 2002; Punt et al., 2009; Wilhelmsson et al., 2010

	In addition, it might cause a displacement of habitat and possibly foraging and breeding grounds.	
Introduction of invasive species may have negative impact on less resilient species	Through the addition of hard substrate from the wind turbines and scour protection a new habitat can be created, giving potential for hard substrate species. This may have negative effects on less resilient species whom are marked as key-species or red-listed. For example, when mussels or oysters locate themselves around the wind turbines, they will filter the water which could result in less food availability for other organisms.	Bergström et al., 2014; Langhamer, 2012; Lindeboom et al., 2015; Wilhemsson et al., 2010; LNV-Vis-2, personal communication, 28 April 2020
Spill-over effect can lead to overfishing	The exclusion of fisheries, resulting in 'no take zones' and then possible spill-overs, is mentioned in the positive effects, but there can also arise negative effects from this measure. When fisheries are banned from the offshore wind farms the pressure on other remaining fishing grounds will increase. Because of the spill-over effect from the wind farm area there will be more fishing pressure close to the wind farms as well.	Langhamer, 2012
Increased fishing pressure in other areas, because of no-take zones in OWF		Langhamer, 2012
Reduction habitat heterogeneity (removal OWF)	At the end of the permit period the windfarm owner is now obligated to remove the windfarm installations. When the wind farm is removed the habitat is directly affected through reduction of heterogeneity and the benthic species are negatively affected as well, in terms of habitat loss.	Gill, 2005; LNV-Nat, personal communication, 15 April 2020

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Appendix XI: Effects of Fisheries on the marine ecosystem

Positive effects <i>Fisheries</i>	Description	Literature
Fish for scavenging species in the form of by-catch	Scavenging species, such as seabirds, often eat the discarded fish which is thrown back into the sea. The discards provide not only food for the seabirds, but also for opportunistic feeders in pelagic and demersal ecosystems. The energy is passed on to higher trophic levels, which means the discards are beneficial for a larger part of the food web	Cashion et al., 2018; Gislason, 1994; LNV-Vis-1, personal communication, 20 April 2020; VisNed-BM, personal communication, 9 April 2020
Pulse fisheries decreases by-catch, environmentally-friendly and less disruptive	Whereas bottom trawling has a high number of discards (Cashion et al., 2018), pulse seine fishery has considerably less discards, while still being able to contribute massively to the global landings. In addition, pulse fishing is better for the environment and less disruptive for the seabed.	Cashion et al., 2018; VisNed-BM, personal communication, 9 April 2020; Wetenschap-PA, personal communication, 17 April 2020; Wetenschap-WUR, personal communication, 17 April 2020
Bottom-trawling creates small ecosystem for pioneer species	Bottom trawling disrupts the seabed, causing pioneer species to reach the surface. This creates a certain ecosystem on which species of flatfish, such as sole and plaice, thrive.	LNv-Vis-1, personal communication, 20 April 2020; LNV-Vis-2, personal communication 28 April 2020; StNZ, personal communication, 16 April 2020; VisNed-BM, personal communication, 9 April 2020

Neutral effects <i>Fisheries</i>	Description	Literature
No established environmental impacts of fisheries	There may exist relationships between population responses of species and climatological events, and these may be either positive or negative. However how fisheries would affect the environment, can only be guessed.	Daan, Gislason, Pope, & Rice, 2005; LNV-Vis-1, personal communication, 20 April 2020; VisNed-BM, personal communication, 9 April 2020; Wetenschap-PA, personal communication, 17 April 2020
When long-time trawled areas are no longer fished, these small ecosystems disappear and there is the	As mentioned at the positive effects, there is an ecosystem created with short-living species. When the fishing activities stop at these areas, it is no longer disrupted which means there is the possibility that there is less primary production. This could result in a lower MSY.	LNv-Vis-2, personal communication, 28 April 2020; VisNed-BM, personal communication, 9 April 2020

possibility of less primary production, resulting in lower Maximum Sustainable Yield		
Fisheries has greater impact in deeper areas with little water flow, and lower impact in areas with natural upheaval (coastal zones)	Fisheries will have a greater impact on ecosystems that are located in deeper areas and where little water flow is. In areas where there is already a lot of natural upheaval, coastal zones, the fisheries effects will be less.	Wetenschap-WUR, personal communication, 17 April 2020
By-catch can survive, depending on fish species, fishing time and weather circumstances	Whether or not discarded by-catch survives depends on the type of fish, fishing time and under what weather circumstances. If there is nice weather out, it is far more likely for the fish to survive than when it is storming.	VisNed-BM, personal communication, 9 April 2020

Negative effect <i>Fisheries</i>	Description	Literature
Trawling results in reduction of vulnerable species, production, biodiversity, heterogeneity and biomass	Trawling is a type of fishing where heavy gear is towed over the seabed, this can either be hard or soft substrate. With soft substrate bottom sediments are stirred up and suspended into the water column. This has immense impact on the marine environment. As a result of trawling, there is reduction of vulnerable species, production, biodiversity, heterogeneity and biomass.	Crowder et al., 2008; Gill, 2005; Langhamer, 2012; LNV-Nat, personal communication, 15 April 2020; LNV-Vis-2, personal communication, 20 April 2020; VisNed-BM, personal communication, 9 April; Wetenschap-PA, personal communication, 17 April 2020; Wetenschap-WUR, personal communication, 17 April 2020
After the seabed has been trawled, recolonization can take months to years	As just mentioned, trawling effects the biodiversity and biomass of the seabed. After the trawling activity, recolonization of the seabed can take months to years. Furthermore, in deeper areas where there is little wave and tidal action, and the habitat is made up from biogenic species, recolonization takes a long time as well	Gill, 2005; Kaiser et al., 2011; LNV-Nat, personal communication, 15 April 2020
Removal of important ecosystem species can cause changes in the marine food webs	Studies have shown that when important species for a local ecosystem are removed, the consequences for the local biodiversity and local ecosystem processes can be devastating, and can also cause trophic effects to cascade in the ecosystem. Furthermore, the removal of	Crowder et al., 2008; Gill, 2005; Kirby, Beaugrand, & Lindley, 2009

	important ecosystem species has caused changes in marine food webs	
Trawling contributes substantially to the by-catch of non-targeted species	Bottom trawling contributes substantially to by-catch of non-targeted species, and discarding of these non-targeted species.	Cashion et al., 2018; LNV-Vis-1, personal communication, 20 April 2020; LNV-Vis-2, personal communication, 28 April 2020
Trawling leads to habitat loss which influences the productivity of commercially exploited fish	Trawling activity may lead to loss of habitat for juveniles of target species. Trawling indirectly influences the productivity of the commercially important species over a longer period of time. Bottom trawling contributes substantially to alterations and loss of habitat, and is often associated with high fuel use.	Cashion et al., 2018; Sinclair et al., 2002
Fishing leads to high mortality rates	Fishing leads to high mortality rates and decrease in stock-based and ecosystem indicators. It has also caused for the diversity in demersal fish species to be reduced in the Northern North Sea.	Gascuel et al., 2016; Greenstreet, Fraser, & Piet, 2009
Exclusion of fisheries from marine protected areas can lead to netto losses instead of gains	When fisheries are excluded from a certain area (MPA) this may have unintentional consequences. When the fisheries are excluded, other areas may receive a higher fishing pressure which can lead to net losses for the marine ecosystem, instead of gains.	Greenstreet et al., 2009
Fish mature earlier because of fishing activities, negatively influencing stock productivity, resilience, genetic compensation	Since the larger and older fish are caught, the maturation schedules shift. This means that the smaller fish mature at an earlier age. This has negative influences on stock productivity, stock resilience, genetic compensation, behavioural gear avoidance, adapted migration routes, selection of habitat, mating behaviour, and stocks may evolve to a state of dwarfism.	Crowder et al., 2008; Laugen et al., 2014; Mollet, Poos, Dieckmann, & Rijnsdorp, 2015; LNV-Vis-2, personal communication, 28 April 2020
Increase of waste from general shipping and gear loss	Waste from ships in de form of general waste and loss of gear effects the ecosystem in a negative way as litter in the sea. In addition, it also contributes to deaths of marine mammals and sea birds.	Wetenschap-RBINS, personal communication, 21 April 2020
Fishing contributes to the death of marine mammals and birds		Gislason, 1994
Fishing changes the complexity of ecosystem food web	When target species become less in numbers in a food web, or disappear, the complexity of the food web is altered and changed because of the fishing activities taking place.	Daan et al., 2005
Overrepresentation of small fish and sandy species	There is an overrepresentation of small fish and sandy species, such as flatfish.	StNZ, personal communication, 16 April 2020

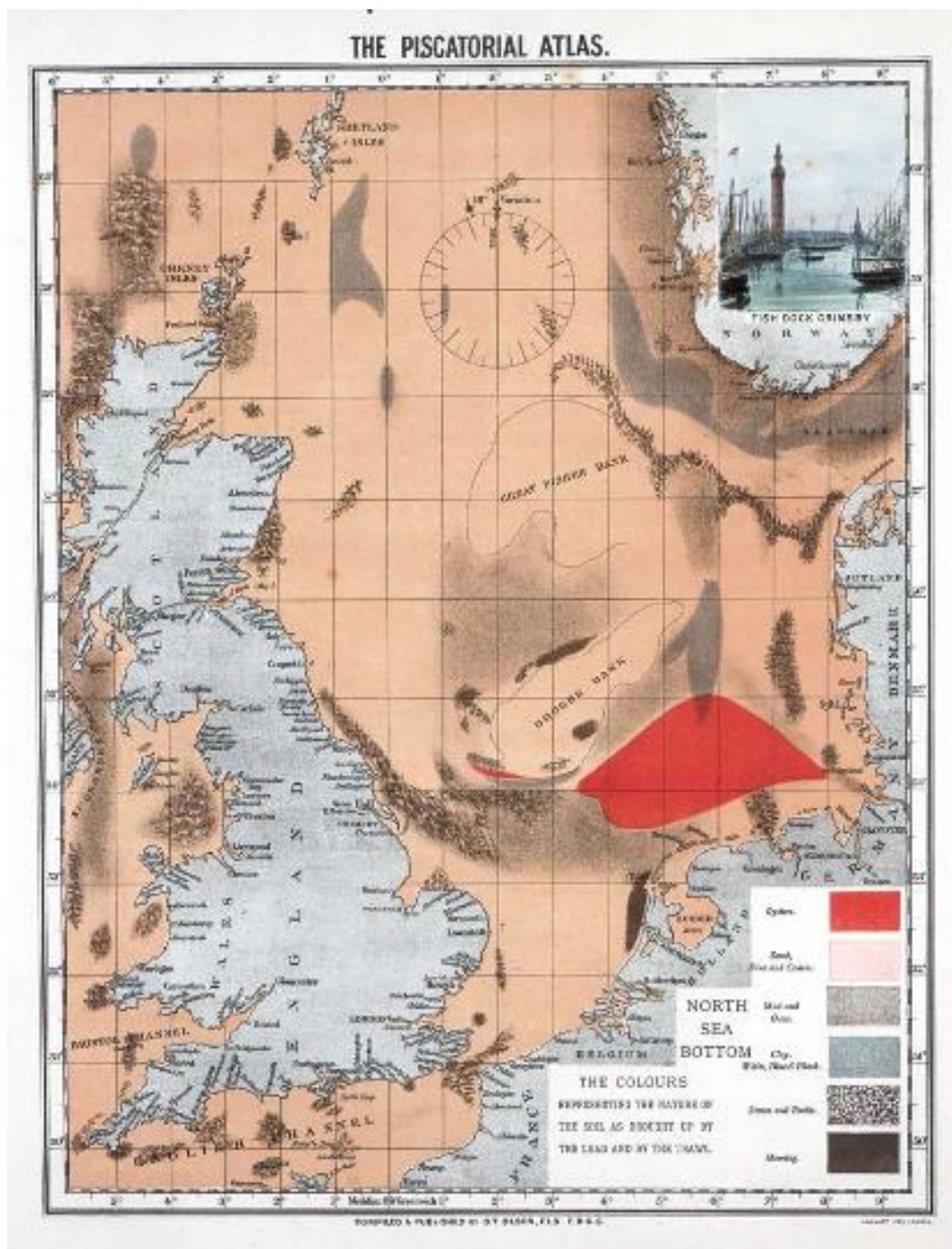
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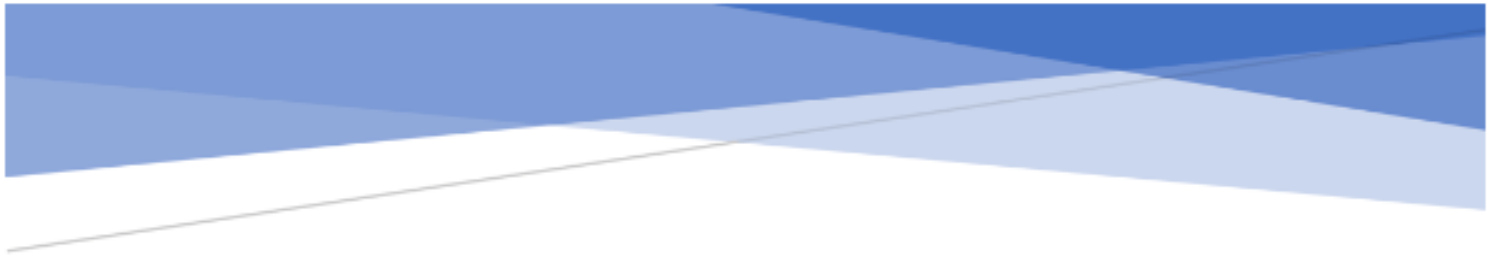
Appendix XII: Interactive pie chart



Appendix XIII: Historical hard substrate map



Appendix XIV: Action plan Marine Spatial Planning Serious Game



ACTION PLAN

Marine Spatial Planning Serious Game

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Introduction

The European Commission established a policy for the development and promotion of sustainable energy in the European Union: The Renewable Energy Directive (RED). This directive (2009/28/EC) requires Member States of the EU to have at least 20% renewable energy in 2020. The directive was revised in 2018, aiming to keep the EU as a global leader in renewable energy and to help the European countries meet the emissions reduction under the Paris Agreement. The new directive (2018/2001/EU) has set a target for the Member States, to have 32% renewable in 2030, which may be if it seems feasible during the 2023 revision. (European Commission, 2020)

The Member States are obligated to write national renewable energy action plans, which describe how they plan to meet the targets for 2020, and the course of their renewable energy policy. Every two years the Member States publish their progress reports and is the progress towards the national targets measured (European Commission, 2020).

Goals of the Netherlands towards renewable energy:

- 14% in 2020;
- 27% in 2030;
- 100% in 2050 (Wind op zee, n.d.-b).

To meet these goals, the Netherlands is investing in offshore wind. It is expected that in 2030, 40% of the renewable energy that is available in the Netherlands, originates from offshore wind (Wind op zee, n.d.-b). In 2023 the Netherlands wants to have a capacity of 4.5GW up and running, and in order to achieve the goals set in the Climate Agreement, another 11GW should be up and running in 2030 (Wind op zee, n.d.-a). This has been recorded in the Offshore wind energy roadmap (*Routekaart windenergie op zee*) and the Offshore wind energy roadmap 2024-2030 (Noordzeeloket, n.d.-a). The increase of offshore wind farms in the North Sea, will further pressure the marine ecosystem and other activities have to make place. Therefore, stakeholders asked for a North Sea Agreement. The North Sea Agreement focuses on the following three aspects: [1] transition towards a sustainable energy supply, [2] towards future-proof food supply, and [3] towards resilient nature (Noordzeeloket, n.d.-b), see Figure 1. The agreement should synchronise these three aspects with each other, as well as with other activities (Noordzeeloket, n.d.-a; Port of Rotterdam, 2019). Both the sectors offshore wind and fisheries have impact on the marine ecosystem. To manage these activities, Ecosystem-Based Management can be used (EBM). The goal of EBM is to preserve a healthy, productive and resilient marine

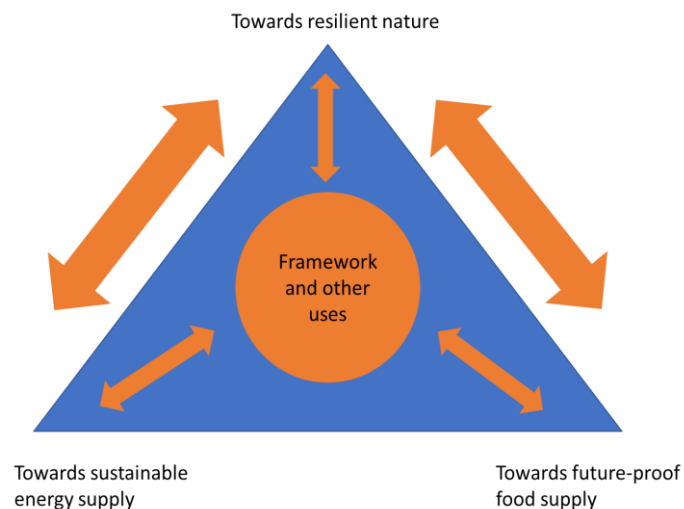


Figure 1. Strategic assignment triangle; this triangle developed by IDON illustrates interaction between three strategic assignments, which contribute to the development of the Dutch North Sea (IDON, 2017) [adapted accordingly]

ecosystem which delivers the ecosystem services humans want and need (McLeod, Lubchenco, Palumbi, & Rosenberg, 2005). EBM manages the human activities from an ecosystem perspective, and takes all interactions within a marine ecosystem into account (Arkema, Abramson, & Dewsbury, 2006; Böhnke-Henrichs et al., 2013; Slocombe, 1998b; Soma, van Tatenhove, & van Leeuwen, 2015). EBM includes the human activities as a central part of the ecosystem and by including these activities, both the ecosystem and the pressures are represented (Berg et al., 2015; Curtin & Prellezo, 2010; Long et al., 2015; Tam, Fay, & Link, 2019). Ecosystem-Based Management is a way for the EU to achieve long-term objectives, such as Good Environmental Status (GES) under the Marine Strategy Framework Directive (MSFD) (Raakjaer, van Leeuwen, van Tatenhove, & Hadjimichael, 2014). When GES is achieved in the Dutch North Sea, the ecosystem is optimally functioning and resilient, whilst the ecosystem services and resources are used sustainably by humans (MIW & MANF, 2018).

Game description

The interaction triangle (see Appendix D), which includes Fisheries, Nature and Offshore Wind Energy, is expected to contribute to the sustainable fisheries transition, achievement of GES and increase in offshore wind development. These three aspects all need space in the North Sea. With the increase of wind farm installations in the North Sea, the space for fisheries and nature protection will decrease. In some cases, these aspects may work together, but eventually difficult decisions have to be made (OFL, n.d). In light of the climate agreement goals it is expected that an additional 5GW will be developed between 2030 and 2040 and the Netherlands can produce 16GW of wind energy by 2040. In order to achieve GES, certain actions have to be taken, for example protecting parts of the North Sea, or using sustainable fishing gear. To keep up with these future developments in the North Sea sustainable management is needed, in the form of Ecosystem-Based Management.

To develop the energy grid, an amount of 4,3 billion euros is available for TenneT, see Table 1. This amount has been calculated with the amount of money that is available to develop the 7GW between the time period 2023-2030. This amount of money **does not** include the costs to develop the offshore wind farm.

Table 1. Overview of the amount of money that is available to develop the energy grid by TenneT

Time period	Amount of GW	Available money Energy grid
till 2030	7	6 billion euros
till 2040	5	4,3 billion euros

Each stakeholder has to propose areas for the development of 5GW wind farms, which should be outside of current assigned wind farm locations. Each stakeholder has to include their own goals and objectives in the proposal and defend their proposal. Through several meetings the stakeholders try to come up with one, unified, location. When they are unable to come to an agreement, the Ministry of Interior and Kingdom Relations will decide on the final location.

EBM definition:

Ecosystem-Based Management is a place-based holistic environmental management approach that recognizes the complex adaptive ecosystem and the interconnections between ecological, economic and social aspects. EBM regulates human activities, in a sustainable manner, that take place in the marine ecosystem, since they are recognized as part of the complex ecosystem. Marine resources need to be used sustainably to ensure the provision of ecosystem services. In this transdisciplinary approach stakeholder participation is seen as the most important aspect, in terms of scientific and local knowledge to adapt management plans and in terms of the precautionary principle.

Learning tasks

- **Policy Brief**

The policy brief, per stakeholder, is written in response to the outcome of the meetings and includes the spatial proposal and is directed to the Ministry of Interior and Kingdom Relations. A policy brief is a “concise summary of a particular issue, the policy options to deal with it, and some recommendations on the best option. It is aimed at government policymakers and others who are interested in formulating or influencing policy. Policy briefs can take different formats.” A policy brief can be an advocacy brief, which “argues in favour of a particular course of action” or an objective brief, which gives “balanced information for policy maker to make up his or her mind” (Food and Agriculture Organization , 2011).

The following requirements apply to this policy brief:

- It is presented as a “two pager”(max. 1400 words) and has an attractive design;
- Should be understandable for the main target group: The minister of Interior and Kingdom Relations;
- Is written from the viewpoint of your stakeholder. Depending on which stakeholder you represent, you can choose to write an advocacy letter or an objective letter;
- It should reflect on the outcomes of the meetings. Even when you are not happy with the outcome of the negotiations, you should still be able “to sell” this decision.

- **Content and Reflection Report**

Your strategy, and how you tried to find supportive evidence has to be described in a short report. You can also reflect on the serious game in general, and document your main observation. You can also reflect on your strategy as a group.

- **Reflection Paper (individual)**

You must reflect on your individual role as a member of a stakeholder in an individual reflection paper (max. 1 A4). In this paper you must also describe the key take home message for you regarding the MSP serious game outcome and MSP in practice.

Meeting assignments

Meetings	Preparations	Assignment
Meeting 1	<ul style="list-style-type: none"> ▪ Mission/ vision stakeholder ▪ Mission/ vision stakeholder on wind energy ▪ What are the most important criteria (environmental, economic and social)? ▪ Interests of other stakeholders (stakeholder analysis) ▪ 5 min presentation on stakeholder perspective and interests 	<p><u>EBM definition:</u> Each stakeholder gives their 5 min presentation.</p> <p>Discuss the EBM definition from your stakeholder perspective and come to a common description. What parts of the definition will be focussed on during the meetings?</p>
Meeting 2	<ul style="list-style-type: none"> ▪ Reflection of meeting 1 <ul style="list-style-type: none"> - What do the other stakeholders want? - How is this in comparison to your expectations? (explain differences or similarities) - How are you going to anticipate on this? - What do you expect from the other stakeholders? (resilience and support) - How are you going to anticipate on this? - What is the expected opinion on your 3 most suitable area's? ▪ Get familiar with Sea Sketch, see Appendix A for a short manual ▪ Adjust stakeholder analysis accordingly ▪ Find the 3 most suitable areas using Sea Sketch, maps that can be used for this, are found in Appendix A. Table 1. 	<p><u>Offshore wind farm areas:</u> Present the 3 most suitable areas and emphasize on your stakeholder perspective.</p> <p>(Room for questions)</p>
Meeting 3	<ul style="list-style-type: none"> ▪ Strategy for negotiations to meet criteria and interest goals ▪ Use the Interactive Pie Chart (see Appendix E) to see what effects your proposed area will have ▪ Reflection of meeting 2 <ul style="list-style-type: none"> - What did the other want? - What was the result of the meeting? - Compare with your strategy - Reflect on your strategy ▪ Outcome of negotiations are input for the Policy Brief 	<p><u>Negotiations:</u> Negotiate on all proposed areas</p> <p>(Use the conceptual model (see Appendix B and C) and interaction triangle (see Appendix D) during the negotiations)</p>
Meeting 4	<ul style="list-style-type: none"> ▪ Write Policy Brief ▪ Read all Policy Briefs ▪ Prepare pitch for final proposal 	<p><u>Decision making:</u> Pitches of each stakeholder to present their idea to the ministry of Interior and Kingdom Relations. Ministry will decide on the final area.</p>

Stakeholders

Stakeholders for the Marine Spatial Planning serious game are divided in five groups:

1. Government;
2. Energy;
3. Fisheries;
4. NGOs; and
5. Ports

Depending on the number of participants in the game, the number of stakeholders will increase.

Minimum number of participants: 14

Maximum number of participants: +/- 32

Standard Group

14 participants: Ministry of Agriculture, Nature and Food Quality (ANF)
Ministry of Economic Affairs and Climate (E&C)
Ministry of Infrastructure and Water Management (I&W)
Ministry of Interior and Kingdom Relations (I&K)
TenneT
VisNed
North Sea Foundation

With every two extra participants a new stakeholder will be added to the Standard Group;

- Greenpeace
- Netherlands Wind Energy Association (NWEA)
- Nederlandse Vissersbond
- World Wildlife Fund Netherlands
- Port of Rotterdam
- Netherlands Oil and Gas Exploration and Production Association (NOGEPA)
- Natuur en Milieu
- Energie Beheer Nederland (EBN)
- Vogelbescherming Nederland
- Natuurmonumenten

The participants receive their stakeholder description as presented below.

Formal process

These stakeholder description help to come up with a strategy, preparing the meetings and writing the policy brief, content report and reflection report. If necessary, the lecturer can provide additional advice and guidance.

The Ministry of Interior and Kingdom Relations will chair the meetings, meaning they have to prepare agendas and share these with the other stakeholders in advance. Each meeting should be no longer than 90 minutes.

Stakeholder description

North Sea Foundation

The North Sea Foundation strives for a sustainable North Sea, both for nature and people. There should be a boundary on the maximal pressure of human activities on the ecosystem so that it stays functional and resilient. If the North Sea is used sustainably, the next generation can enjoy the North Sea and her nature as well. (Stichting de Noordzee, n.d.-d).

To be able to use the North Sea sustainably, all stakeholders need to be involved and active. To reach this, the North Sea Foundation is willing to combine forces, enter into dialogue, collaboration and realize improvement (Stichting de Noordzee, n.d.-d). The core values of the Foundation are to work independently, science-based, together and solution-oriented (Stichting de Noordzee, n.d.-d).

Interests of the North Sea Foundation

Protection of the North Sea Ecosystem

The North Sea is viewed as a unique marine area with huge species richness and vast productivity (Stichting de Noordzee, n.d.-a). Humans have been using the sea for centuries and as a result, marine areas have been disturbed and contaminated. Because of increasing pressure, the unique marine area does not get the opportunity to restore itself (Stichting de Noordzee, n.d.-a).

The goal of the North Sea Foundation is to safeguard the balance between nature and human activities by establishing an ecological network of Marine Protected Areas (MPAs) which would cover 30% of the Dutch North Sea. The goals of the Foundation are to:

- Meaningful close of the MPAs Doggersbank, Klaverbank, and the North Sea coastal zone;
- Protect the Frisian Front and the Central Oysterbanks entirely for all forms of fisheries; and
- Designate other protected areas on the North Sea, such as Borkumse Stenen. (Stichting de Noordzee, n.d.-a)

Sustainable energy

The North Sea Foundation is in favor of extraction and generation of energy from the sea if it happens in a nature-friendly manner with minimal negative impacts on the North Sea ecosystem. The development of wind energy at sea cause threats, but also has opportunities for new life since wind farms can serve as a habitat for many fish and crustacean species. (Stichting de Noordzee, n.d.-c)

The goal of the North Sea Foundation is to ensure that the energy transition is used as a lever for nature enhancement. The goals are to:

- Limit ecological risks and seize opportunities in the design and construction of wind farms at sea;
- Experiment with methods to enhance or restore the North Sea ecosystem within wind farms; and
- Take into account the ecological criteria in the dismantling of oil and gas infrastructure. (Stichting de Noordzee, n.d.-c)

Sustainable fisheries

Fisheries is one of the oldest uses of the North Sea. This has caused pressure on many fish stocks. Some big and long-living species have disappeared completely, such as the skate and several shark species (Stichting de Noordzee, n.d.-b). Over the last view years, there have been some positive developments for some commercial fish species. Because of better managing the fisheries, pressure on species such as cod, plaice and sole have decreased and the fish stocks were able to restore. However, there are still challenges of managing when it comes to sensitive species such as the sea bass, sharks and skates, but also for typical discard species such as turbot, lemon sole, and brill. (Stichting de Noordzee, n.d.-b)

The goal of the North Sea Foundation is to reach a sustainable, well-managed North Sea fishery. This means clear management goals and rules that are enforced. This means that catches need to be fully documented and creating a favorable environment for experiment and innovation in the sector. (Stichting de Noordzee, n.d.-b)

Marine Spatial Planning process

During a MSP process the North Sea Foundation mentions the importance of the precautionary principle (StNZ, personal communication, 16 April 2020).

Environmental organisations interests during the negotiations for the North Sea Agreement

Environmental organisations aim for a twofold goal: on the one hand to stimulate the energy transitions with a fundamental role for the development of offshore wind farms, and on the other to achieve the Good Environmental Status in the North Sea in 2020. Furthermore, adequate protection of the Natura 2000 areas and the creation of enough space for soil protection is of great concern, just as to ensure the security of vulnerable underwater and above water nature. (OFL, 2018)

Ecosystem-Based Management

You want to regulate the pressure of human activities on the marine ecosystem. The regulation of activities should be done in a way that the entire ecosystem and several parts of it, can be used sustainably. EBM is science-based, but the problem is that there is a lot we do not know. That is why the precautionary principle is so important. (StNZ, personal communication, 16 April 2020)

Stakeholder roles

- **Expert in nature preservation**

You will focus on how marine ecosystems responds to human activities and what effects of nature protection can be.

- **Expert in sustainable development (fisheries and offshore wind)**

You will focus specifically on sustainable development in the North Sea, looking at offshore wind farms fisheries and how they affect the marine ecosystem. In addition, how these activities can be sustainably and nature friendly developed.

Greenpeace

Greenpeace is an independent, internationally operating environmental organization committed to a green, peaceful planet (Greenpeace, n.d.-b). Greenpeace believes that a green and sustainable world is needed, and achievable. However, to reach that world the current status quo needs to be breached (Greenpeace, n.d.-a). The core values of Greenpeace are nonviolent, brave, open and tenacious, independent, and collaboration (Greenpeace, n.d.-b).

Interests of Greenpeace

Pure climate

Greenpeace demonstrates together with independent scientists that the disastrous consequences of climate change can be countered with clean energy from the sun, wind, water and green hydrogen, in combination with smart energy use (Greenpeace, n.d.-a).

Safe oceans

The oceans are a spectacular habitat of thousands of marine species and they also play an important role in the regulation of the climate. However, 80% of the fish stocks are overfished, the deep sea is destroyed and coral bleaches. There is also the problem of plastic pollution. The oceans are strong and they can restore, but they need help. (Greenpeace, n.d.-a)

Environmental organisations interests during the negotiations for the North Sea Agreement

Environmental organisations aim for a twofold goal: on the one hand to stimulate the energy transitions with a fundamental role for the development of offshore wind farms, and on the other to achieve the Good Environmental Status in the North Sea in 2020. Furthermore, adequate protection of the Natura 2000 areas and the creation of enough space for soil protection is of great concern, just as to ensure the security of vulnerable underwater and above water nature. (OFL, 2018)

Stakeholder roles

- **Expert in climate change adaptation**

You will focus on how climate change can be countered with sustainable energy development

- **Expert in habitats**

You will focus on the Natura 2000 areas and the ecological valuable areas and it's different habitats. In addition, you have knowledge of the different seabed types in the North Sea.

World Wildlife Fund Netherlands

For the World Wildlife Fund Netherlands, nature does not stand opposite of the human, but we are an integral part of it (Stichting Het Wereld Natuur Fonds-Nederland, n.d.-d). Biodiversity and the continued existence of the earth are a great asset to us. That is why we do everything in our power to protect and restore it, and this is necessary because we exhaust the earth more than she can handle. The World Wildlife Fund wants to restore the relationship between humans and nature to ensure that future generations can enjoy nature too. (Stichting Het Wereld Natuur Fonds-Nederland, n.d.-d)

What does WWF focus on?

The World Wildlife Fund Netherlands focusses on protection, restoration and resilience of nature (Stichting Het Wereld Natuur-Fonds Nederland, n.d.-b).

Overfishing

Over the last few decades, industrial fisheries developed significantly. The gear is bigger and heavier; also, some fishing gear stirs up the sea bottom, causing damage. Since fishermen started using radars to trace the fish, many fish stocks depleted, and species are threatened with extinction. (Stichting Het Wereld Natuur Fonds-Nederland, n.d.-c) To ensure the ocean habitats are less damaged, WWF supports fishers in the transition to less-invasive fishing gear (Stichting Het Wereld Natuur Fonds-Nederland, n.d.-c).

WWF about the North Sea Agreement 2030

The Agreement is for the World Wildlife Fund Netherlands an essential milestone in the realization of a healthy and resilient North Sea. There is an increase in the protection of the ecosystem; in 2025, the seabed will be protected for 12,5%. Also, new bird protection sites will be established, and sensitive species such as sharks and seabirds are better protected. (Stichting Het Wereld Natuur Fonds-Nederland, 2020) Even though an agreement of 12,5 protection has been achieved, WWF will continue to commit to 30% protection of the Dutch seabed (Stichting Het Wereld Natuur-Fonds Nederland, 2020) as it is one of their goals.

The goals of the World Wildlife Fund are:

- In 2030, the protected areas are sustainably managed;
- In 2030, the areas that WWF-NL protects are sustainably fished. That causes food insurance, less pressure on fish high up in the food web, sustainable solutions for companies, and less plastic pollution. (Stichting Het Wereld Natuur Fonds-Nederland, n.d.-a)

Environmental organisations interests during the negotiations for the North Sea Agreement

Environmental organisations aim for a twofold goal: on the one hand to stimulate the energy transitions with a fundamental role for the development of offshore wind farms, and on the other to achieve the Good Environmental Status in the North Sea in 2020. Furthermore, adequate protection of the Natura 2000 areas and the creation of enough space for soil protection is of great concern, just as to ensure the security of vulnerable underwater and above water nature. (OFL, 2018)

Stakeholder roles

- **Expert in sustainable management**

You will focus on how marine protected areas can be sustainably managed with Ecosystem-Based Management.

- **Expert in sustainable fishing gear**

You will focus on how the fisheries can make a transition towards more sustainable fishing gear, which is less damaging for the marine ecosystem.

Natuur en Milieu

Mission and vision

Natuur en Milieu focusses the coming years on reaching a climate-neutral society in 2050, and restoration of biodiversity. To achieve this, a transition is needed towards a sustainable energy supply (Natuur en Milieu, n.d.-a).

Strategy

Natuur en Milieu collaborates with people, companies, and the government to make the market more sustainable. The NGO stimulates people to make sustainable choices and inform the society about developments about energy reduction, less meat consumption, and different ways of traveling. (Natuur en Milieu, n.d.-a)

Core values

The core values of Natuur en Milieu are:

- Letting the facts speak;
- Accelerate solutions; and
- Together we can do more (Natuur en Milieu, n.d.-a).

Wind energy from the sea

Natuur en Milieu believes that wind energy will be the most critical sustainable source of electricity for the Netherlands. Wind energy is clean, inexhaustible, and we can produce it ourselves. The most considerable potential for wind energy is wind energy at sea. If a North Sea grid is used as interconnection with neighboring countries, increasements and declines in the generation of wind energy can be intercepted, and costs fall sharply. (Natuur en Milieu, n.d.-b)

Over the next few years, consistent management is needed, and the Climate Agreement should be the framework for large-scale development of wind energy. Also, when wind farms are developed, they should be building nature-inclusive where possible. Furthermore, by have interconnections with neighbouring countries, it is possible that 50-75% of all energy used in the Netherlands originates from wind energy from the sea. (Natuur en Milieu, n.d.-b)

According to the North Sea Agreement 2030, 11.5 Gigawatts of wind energy is going to be developed on the North Sea in the next ten years. Natuur en Milieu wants the Netherlands to use wind energy from the sea as soon as possible and therefore advocates to develop two GW of wind energy every year so that in 2030 the amount of 18.5 GW is established and operational in the North Sea. (Natuur en Milieu, 2019)

Environmental organisations interests during the negotiations for the North Sea Agreement

Environmental organisations aim for a twofold goal: on the one hand to stimulate the energy transitions with a fundamental role for the development of offshore wind farms, and on the other to achieve the Good Environmental Status in the North Sea in 2020. Furthermore, adequate protection of the Natura 2000 areas and the creation of enough space for soil protection is of great concern, just as to ensure the security of vulnerable underwater and above water nature. (OFL, 2018)

Stakeholder roles

- **Expert in society**

You will focus on how social economic systems, and how the society responds to the development of offshore wind farms.

- **Expert in wind energy**

You will focus on nature-inclusive development of offshore wind.

Vogelbescherming Nederland

Vogelbescherming Nederland is an independent, national environment protection organisation. The NGO was founded in 1899 and is the Dutch organisation for the protection of all wild birds and their habitats (Vogelbescherming Nederland, n.d.-a).

Vogelbescherming Nederland uses protection programmes, collaborations, political lobbying, legal action, information and campaigns to protect birds in the Netherlands. They use the best scientific insights and have achieved many successes, such as the return of the stork, kingfisher, spoonbill and barn owl. (Vogelbescherming Nederland, n.d.-a)

Mission and vision

Vogelbescherming Nederland stands up for wild birds and their habitat. The organisation does this together with people who care about protecting birds and the environment. In this way, they contribute to the conservation of nature and a liveable world (Vogelbescherming Nederland, n.d.-a).

Vogelbescherming Nederland wants a world with a rich diversity of birds and nature that people are committed to and enjoy (Vogelbescherming Nederland, n.d.-a).

Wind energy from the sea

Wind energy is a sustainable energy source; however, they are often placed in areas relevant to birds. That means that interests of wind energy and birds regularly at odds are with each other (Vogelbescherming Nederland, n.d.-b).

Point of view of Vogelbescherming Nederland

- The transition of fossil fuels towards sustainable energy generation is crucial to absorb the consequences of climate change. Vogelbescherming is in favour of the application of all viable forms of energy generation, so wind energy as well;
- Birds do not know country boundaries. Vogelbescherming believes that the transition to a sustainable energy supply has to be dealt with internationally. Europe needs to assess energy generation and integrate these assessments in a marine spatial planning process that takes the bird species and habitats into account;
- Vogelbescherming thinks that sensitivity analyses, strategic environment assessments should be the basis of wind farm initiatives;
- The choice of placement of wind farms has an essential influence on what kind of impact the farms have on birds. Vogelbescherming advocates that the choice of placement, design and management of the wind farms must be designed so that there are no notable negative effects for birds;
- Out of precaution, Vogelbescherming believes that wind farms should not be placed in prominent bird areas and their immediate environment. Those locations are, among other areas, migration routes, Natura 2000-areas, and other important bird areas. Turbines could be placed in the remaining areas, provided that no significant adverse effects on bird populations are expected;
- To anticipate the negative effects, research needs to be conducted on measures for species within and around wind farms, to be protected appropriately and to increase the resilience of the bird populations;
- With all plans, the legal protection of birds and their habitats need to be taken into account. When unfavourable effects cannot be ruled out, mitigation and compensation must be carried out in good time;
- Research towards new ways of wind farm development that cause fewer risks for birds is encouraged and supported;

- Independent research and monitoring should increase the knowledge base about the effects that wind turbines have on birds and increase the knowledge base on the efficiency of mitigation and compensation measures. This should be done internationally;
- Vogelbescherming believes that shared use in wind farms should only be allowed based on customization. Wherever it is possible, nature should be restored and enhanced. When multi-use is permitted within a wind farm, innovative methods should be used to ensure minimal impact on the ecosystem. (Vogelbescherming Nederland, n.d.-b)

What does Vogelbescherming Nederland do during a marine spatial planning process?

Vogelbescherming Nederland advocates the interests of birds when planning large-scale wind farms on the North Sea. The aim is to preserve crucial bird areas from wind turbines and to focus on maximum mitigation of the influences in other areas. Also, Vogelbescherming stimulates the monitoring and research of the effects of wind farms on birds, on land and at sea. (Vogelbescherming Nederland, n.d.-b)

Environmental organisations interests during the negotiations for the North Sea Agreement

Environmental organisations aim for a twofold goal: on the one hand to stimulate the energy transitions with a fundamental role for the development of offshore wind farms, and on the other to achieve the Good Environmental Status in the North Sea in 2020. Furthermore, adequate protection of the Natura 2000 areas and the creation of enough space for soil protection is of great concern, just as to ensure the security of vulnerable underwater and above water nature. (OFL, 2018)

Stakeholder roles

- **Expert in birds**

You will focus on the habitat and foraging areas of marine birds, and the effects wind farms have on birds.

- **Expert in research wind farms**

You will focus on research on effects of OWF that needs to be conducted and for what reasons and make this clear during meetings.

Natuurmonumenten

Natuurmonumenten is an organisation for people with a heart for nature. The association protects nature reserves, valuable landscapes and cultural heritage. When it is protected, the environment is preserved, and it can be enjoyed for decades (Natuurmonumenten, n.d.-a).

Natuurmonumenten applauds initiatives that add to a more favourable climate. With robust nature areas that capture CO₂, climate buffers, biomass, and reducing its climate footprint, the organisation contributes to a sustainable world (Natuurmonumenten, n.d.-a).

Wind energy

Natuurmonumenten (n.d.-b) is in favour of the shift to sustainable energy forms. Only then, CO₂ emissions and additional by-products of gasses can be limited. The organisation believes that the government should be fully engaged in energy saving. Natuurmonumenten sees why wind energy is needed; at the same time, it can have an impact on the environment. Therefore Natuurmonumenten advocates for suitable placement of the wind turbines, so it fits into the atmosphere (Natuurmonumenten, n.d.-b).

Natuurmonumenten supports the development of wind energy at sea if they are located in areas where they least impact the environment (Natuurmonumenten, n.d.-b). It is of great importance that the construction of wind energy fits within the ecological borders of the ecosystem. Since the installation of wind turbines always affects the environment, wind farms should not be built within Marine Protected Areas, Nature 2000 areas, and other ecological valuable regions. Furthermore, the organisation believes that wind farms should be established outside the twelve nautical mile zone since there would be little impact on society. Natuurmonumenten also sees opportunities for the marine ecosystem for environmental enhancement. Fish and benthic can take advantage of a newly created habitat. (Natuurmonumenten, n.d.-b)

The organisation encourages the negotiation agreement for the North Sea since it is an essential step for more protection of the marine ecosystem and an increase in sustainable energy. It also advocates to connect opportunities for wind power and nature, so the North Sea shifts to a robust ecosystem. Adverse ecological consequences should be avoided as much as possible, and opportunities for the ecosystem should be maximised. Since there still is a shortage of knowledge on what the effects are of large-scale wind farm expansion, the precautionary principle is of vast importance. (Natuurmonumenten, n.d.-b)

Environmental organisations interests during the negotiations for the North Sea Agreement

Environmental organisations aim for a twofold goal: on the one hand to stimulate the energy transitions with a fundamental role for the development of offshore wind farms, and on the other to achieve the Good Environmental Status in the North Sea in 2020. Furthermore, adequate protection of the Natura 2000 areas and the creation of enough space for soil protection is of great concern, just as to ensure the security of vulnerable underwater and above water nature. (OFL, 2018)

Stakeholder roles

- **Expert in ecological effects OWF**

You will focus on the effects OWF has on the marine ecosystem.

- **Expert in nature preservation**

You have knowledge of protected areas in the North Sea and what legal aspects protect these areas.

Port Authority of Rotterdam

The Port Authority of Rotterdam is an independent company with two shareholders; the municipality of Rotterdam and the Dutch government. The Port Authority of Rotterdam was established to develop the port of Rotterdam (Port of Rotterdam, n.d.-a).

Mission, Vision and Strategy

The Port Authority of Rotterdam realizes the sustainable growth of the port, together with customers and stakeholders (Port of Rotterdam, n.d.-a). The Port Authority continuously improves the port to be the safest, the most efficient, and the most viable port in the world. To stay the best port of Europe and to remain competitive, the following years the Port Authority will, together with its customers and stakeholders, finance the sustainable expansion of the port, so that it will generate societal and economic value for the future. (Port of Rotterdam, n.d.-a)

Wind energy at sea

The Port Authority of Rotterdam is part of the consortium of the North Sea Wind Power Hub, together with TenneT TSO B.V. (Netherlands), EnergiNet (Denmark), TenneT TSO GmbH (Germany) and Gasunie. The Port Authority of Rotterdam knows of creating land on the sea, and this knowledge is of great interest to the consortium. (Port of Rotterdam, 2017)

Why is the Port Authority of Rotterdam included in a marine spatial planning process (North Sea Agreement)

Some interest of the Port Authority of Rotterdam must remain safeguarded when wind farms are developed on the North Sea. This includes, for example, that part of the North Sea remains secure for continuous sea shipping. Also, for the energy transition of the port of Rotterdam, the North Sea offers significant potential for sustainable energy generation and sufficient space for CO₂ storage. Other interests of the Port Authority include bundling of cables and pipelines to use the required area on the seabed, as efficient as possible, limiting pollution and nuisance in an international context and actions for shipping should be arranged through the International Maritime Organisation. (Port of Rotterdam, 2019)

The Port Authority of Rotterdam is against a wind farm of the coast of Maasvlakte 2, since it would endanger the secure handling of sea shipping (Port of Rotterdam, n.d.-b).

Port Authority of Rotterdam interests during the negotiations for the North Sea Agreement

Sea transport must be secured, and the importance of the shipping routes must be included. Also, it must be realized that the energy transition concerns more than just offshore wind farms. The concept of energy must be much deeper than that, and for example, also address new technologies such as tidal energy and CO₂ storage. (OFL, 2018)

Stakeholder roles

- **Expert in shipping lanes**

You have knowledge of the international and national shipping lanes that are used in the Dutch North Sea, and why these must be secured.

- **Expert in creating land in sea**

You will focus on how land can be created at sea, and are able to use this information during the negotiations.

TenneT

TenneT is a leading European network operator with its most essential projects in the Netherlands and Germany (TenneT, 2020-c).

Vision and Mission

Since society has chosen for the large-scale development of renewable energy, changes its dynamics of the electricity supply. At the same time, we become more dependent on energy. To keep a balance, innovations and solutions are needed to ensure that there is sufficient grid capacity. (TenneT, 2020-f). TenneT wants to create value for stakeholders by guaranteeing the security of electricity supply in our markets, and as a leading network operator to cooperate in the development of an integrated and sustainable electricity market in Northwest Europe (TenneT, 2020-f). TenneT's core values are quality and integrity (TenneT, 2020-f).

Wind at sea

TenneT is the network operator of wind at sea, in the Netherlands and Germany. Being the network operator means that TenneT is responsible for connecting the offshore wind farms to the onshore electricity grid, via the offshore grid. Developing the offshore grid contributes to TenneT's ambition of being the driving force behind the energy transition. (TenneT, 2020-b)

When it comes to offshore wind, TenneT has three programmes:

1. Program 2023;
2. Program 2030; and
3. Long term vision 2050 (TenneT, 2020-b).

Program 2023 arises from the "Energy Agreement 2013". In this program, TenneT will develop and deliver three offshore grids, which will generate 3,5 GW and will provide electricity for 5 million households. The areas are:

- 2019: Borssele Alpha - 700 MW;
- 2020: Borssele Beta - 700 MW;
- 2021: Hollandse Kust Zuid Alpha - 700 MW;
- 2022: Hollandse Kust Zuid Beta - 700 MW; and
- 2023: Hollandse Kust Noord - 700 MW. (TenneT, 2020-d)

Program 2030 results from the "Roadmap Wind energy at sea 2030". In the roadmap, the government has designated three new areas for the construction of renewable energy, and TenneT will develop the offshore grid for these wind farms as well, between the year 2024 and 2030. The areas are:

- 2024: Hollandse Kust West Alpha (AC) - 700 MW;
- 2025: Hollandse Kust West Beta (AC) - 700 MW;
- 2026: Ten Noorden van de Waddeneilanden (AC) - 700 MW;
- 2027: IJmuiden Ver Alpha (DC) - 2000 MW; and
- 2029: IJmuiden Ver Beta (DC) - 2000 MW.



Figure 1 North Sea map with the wind farm sites to be developed between 2019 and 2023 (TenneT, 2020-d)



Figure 2 North Sea map with the already existing wind farm sites from 2023 onward and the sites to be developed between the years 2024 and 2030 (TenneT, 2020-e)

For IJmuiden Ver a new platform needs to be developed so that the generated power can be transformed to the onshore electricity grid. (TenneT, 2020-e)

Long term vision till 2050 is the development of an offshore power hub. The North Sea Wind Power Hub has a consortium existing of TenneT in the Netherlands and Germany, Energinet from Denmark, Gasunie and the Port Authority of Rotterdam. The vision of the hub is that wind farms of all North Sea countries can connect to the hub and that it will increase energy efficiency. (TenneT, 2020-a)

Marine Spatial Planning process

The projects have a long lead time, sometimes ten years. Because a lot of research needs to be done of where, for example, the best place is to land an offshore cable, they need to know early on in the process where wind farms might be located. This way they can plan ahead. (TenneT-SA & TenneT-AOGD, personal communication, 16 April 2020)



Figure 3 The placement of where the North Sea Wind Power hub would be developed in the Greater North Sea. It would be shared with the countries Norway, Denmark, Germany and the United Kingdom (TenneT, 2020-a)

TenneT interests during the negotiations for the North Sea Agreement

TenneT wants the ambitions of all sectors to be endorsed. The connection strongly determines the lead times of offshore wind. So to facilitate the transition economically, in terms of planning and ecology, TenneT wants the most widespread probable plan (OFL, 2018).

TenneT view on Ecosystem-Based Management

TenneT wants to be a green network operator and therefore includes nature restoration before obtaining a permit for the installation of wind farms. This arises from TenneT's policy and the development framework (TenneT-SA & TenneT-AOGD, personal communication, 16 April 2020).

Research

Since TenneT develops the energy grid and thus disturbs the marine ecosystem, they feel that they should do research what effects are of electromagnetic fields (EMF) and how they can build the grid nature-inclusive. Within the grid, the gas FS6 is used, which is not environmental friendly. Together with suppliers they discuss what alternative gasses are possible. Also, sensors are placed on the platform, so they can keep track of bird and bat migration patterns. TenneT wants to take the responsibility to mitigate the ecological impacts, and perhaps create a "plus" around the grid, when it comes to natural impacts. (TenneT-SA & TenneT-AOGD, personal communication, 16 April 2020)

Costs

TenneT has around eight billion euros to develop the grid for the "Routekaart". For nature-inclusive building they have not received a budget, since it is not certain how much that would cost (TenneT-SA & TenneT-AOGD, personal communication, 16 April 2020).

Stakeholder roles

- **Expert in nature-inclusive building**

You will focus on the nature-inclusive development of the energy grid.

- **Expert in energy grid**

You will focus on what is necessary to develop an energy grid.

Netherlands Wind Energy Association (NWEA)

The Netherlands Wind Energy Association (NWEA) is the umbrella organisation of the wind sector. With a view to the sustainable Dutch energy supply, NWEA promotes the development of wind energy. NWEA works for and with her members to create a strong wind sector and a new policy that is necessary to achieve this. (NWEA, n.d.-b)

NWEA is on behalf of the sector the contact person for ministries and other organisations about several subjects within wind energy. NWEA has connections with national and regional governments, with policymakers, scientists and research institutes, with companies and with environmental and societal organisations in the Netherlands. (NWEA, n.d.-b)

Wind energy

The wind is the most efficient and most affordable renewable energy source. Wind energy is effective against climate change because of the low CO₂ emissions (NWEA, n.d.-d).

The importance of including the influences on nature in the development of wind energy is widely recognized and supported. A lot of research is conducted, and initiatives have started to minimize the harmful effects of wind energy on animals (NWEA, n.d.-e).

NWEA interests during the negotiations for the North Sea Agreement

Social costs of the energy transition should be viewed strategically. If we desire to transfer the North Sea to a *state of the art area*, the sectors have to agree on the social costs and who bears them. When the sectors agree on this, potential uncertainties might be mitigated when the construction of large-scale development of wind at sea starts. (OFL, 2018)

Marine Spatial Planning process

NWEA is present at a MSP process as a representative of the interests of the wind sector (NWEA, n.d.-a). NWEA finds it essential to reach an agreement with all involved stakeholders to ensure the achievement of the climate goals and to make the transition to a sustainable North Sea (NWEA, n.d.-c). The challenge, and the primary starting point, according to NWEA, is to make this significant contribution to a green energy supply without subsidy. The wind sector is still under development, which means they cannot bear costs for multi-use of the wind farms. Therefore, NWEA believes that nature and fisheries sectors should pay this and support the transition fund these sectors will receive. (NWEA, n.d.-c)

Stakeholder roles

- **Expert in legislation**

You will focus on the legislative aspects of building a wind farm and you are in direct contact with the ministries for the lobby of offshore wind energy.

- **Expert in effect on marine life**

You will focus on how offshore wind farms effect the marine ecosystem and how to minimize the negative effects.

Netherlands Oil and Gas Exploration and Production Association (NOGEPA)

In the Netherlands, there are thirteen companies with a license to extract oil from the North Sea. All these companies explore the seabed of the North Sea for potential natural gas supplies, and when found, ensure the extraction of natural gas in an efficient, safe and environmentally conscious way (Offshore Werken, 2020). These thirteen companies are united within NOGEPA, the Netherlands Oil and Gas Exploration and Production Association. (NOGEPA, n.d.)

NOGEPA represents the interests of these companies and wants to deliver an open and transparent contribution in the transition so that the Netherlands has a fully sustainable energy supply in 2050. Until then, natural gas will ensure reliable energy (NOGEPA, n.d.).

Since natural gas supplies are expected to be exhausted in 2050, natural gas will only be used where it contributes to CO₂ savings and where it does not hinder the development of sustainable energy. In this way, the sector can accelerate the transition to a durable, affordable and reliable energy supply. (VisNed, 2019)

The extraction of Dutch natural gas is favoured over the import of foreign gas, as long as it fits within the frames of the Paris Agreement, the extraction is safe, and if there are no more suitable alternatives (NOGEPA, 2020).

NOGEPA interests during the negotiations for the North Sea Agreement

The oil and gas industry wants to say goodbye to the North Sea in a valuable way. Before that happens, we can create value in two other ways. First, there is still a lot of gas to be extracted in the Dutch North Sea. Secondly, we can valorise our existing infrastructure in the new energy system, for example with CCS or hydrogen. (OFL, 2018)

Stakeholder roles

- **Expert in energy transition**

You will focus on the energy transition and how the oil and gas industry can contribute to this.

- **Expert in oil and gas**

You will focus on which areas can still be beneficial for oil and gas extraction.

Energie Beheer Nederland (EBN)

Energie Beheer Nederland B.V. executes segments of the climate and energy policy of the Ministry of Economic Affairs and Climate (EBN, n.d.-c).

Until 2016, EBN mainly focussed on the exploration, winning and storing of oil and gas. EBN is involved with almost all oil and gas projects in the Netherlands (EBN, n.d.-c).

Currently, EBN is one of the driving powers behind the energy transition in the Netherlands. EBN has background knowledge when it comes to energy, in the Netherlands and has a crucial role in combining private and public stakeholders in the energy sector. Cooperation is of great importance to realise the climate goals. (EBN, n.d.-c)

Energy transition

When looking at the energy transition, EBN focusses on geothermal energy and how sustainable energy can be stored (EBN, n.d-a). EBN also explores solutions for the already existing infrastructure, so it does not have to be dismantled. Possibilities are to use the foundation for the transport and production of hydrogen or to store CO₂. By storing CO₂, not only does the infrastructure get a second life, but the empty oil and gas fields under the North Sea seabed can be used for this as well. This would distinctly reduce emissions. (EBN, n.d.-b)

EBN interests during the negotiations for the North Sea Agreement

Take good care of what happens to the old infrastructure, and take into account the space required for CO₂ storage. Strive for sustainable use of the North Sea, with an appropriate balance between energy, nature, transport and fishing (OFL, 2018).

Stakeholder roles

- **Expert in oil and gas**

You will focus on which areas can still be beneficial for oil and gas extraction.

- **Expert in energy storage**

You will focus on how energy can be stored in a sustainable manner.

VisNed

VisNed represents the interests of the Dutch cutter fishermen located in the southwest of the Netherlands, Urk and the Kop of Noord-Holland including Texel. Two-third of the Dutch cutter fleet, in numbers and supply value, is represented by VisNed, which makes it the largest advocate for the fishing industry in the Netherlands. (VisNed, n.d.-c)

VisNed is an umbrella organisation in which several Producer Organisations are active. The POs are the regional contact point for the members and represent their interests and facilitate, among other things, quota management and questions regarding crew requirements and qualifications. On behalf of the affiliated POs, VisNed represents the interests nationally and internationally and focusses on cross-regional and sectoral interests. VisNed works close with fellow advocates at home and abroad and maintains good relationships with all stakeholders involved, from governments to scientists to NGOs. (VisNed, n.d.-c)

Marine Spatial Planning

VisNed finds it important that when spatial planning decisions are made on the North Sea, all human activities and interests from stakeholders are taken into account from the beginning of the process (VisNed, n.d.-a). VisNed is involved during the process to transfer the interests of their members and to reach agreements all stakeholders agree on (VisNed, n.d.-b).

Marine Spatial Planning is meant to safeguard the existing activities. The oldest uses of the North Sea were fisheries, waging war and trading. Over the years a lot of new sectors started using the North Sea as well, and now you can see, the oldest use of the sea, the fisheries, has to take a step aside. (VisNed-Dir, personal communication, 7 April 2020)

Interests of VisNed when it comes to MSP

- When areas are closed, research needs to be conducted on multi-use (VisNed, n.d.-a);
- All North Sea fishermen should have the same rules (VisNed, n.d.-a);
- Cooperation for acceptable alternatives for fisheries;
- Transition for fisheries is needed;
- Larger fishing vessels should be allowed to sail through a wind farm;
- More research needs to be conducted on the effects of wind farms and cables. (VisNed, n.d.-b)

Fisheries interests during the negotiations for the North Sea Agreement

The outcome of the energy transition must also be an economically and ecologically sustainable fishery. Fishermen should be able to continue to catch the available quota of fish with a fleet that, in terms of size, matches the new use of space in the North Sea. The fisheries advocate a transition fund to help make the sector more sustainable, for example, fishing and shipping emission-free. (OFL, 2018). VisNed also advocates multi-use of wind farms and nature (VisNed-BM, personal communication, 9 April 2020).

VisNed view on Ecosystem-Based Management

How can the North Sea be used respectfully and sustainably and take nature into account as much as possible? In VisNed' point of view; it is an user sea that takes into account nature as much as possible and to mitigate and prevent human impact on the ecosystem to the highest degree. (VisNed-Dir, personal communication, 7 April 2020)

Ecosystem-Based Management has two sides; [1] you can see what impact you have on fish, how much fish can you extract from the ecosystem that it remains responsible, while the ecosystem continues working (MSY). And [2], you can look at the impact you have on the entire ecosystem and how you can mitigate that impact. (VisNed-BM, personal communication, 9 April 2020)

Fishery always has an impact on the ecosystem, because you extract something from the system, and you don't put it back (VisNed-Dir, personal communication, 7 April 2020; VisNed-BM, personal communication, 9 April 2020). However, you can see what the most impact has. For example, is it better for the ecosystem to discard the by-catch, or to land the non-target species? (VisNed-BM, personal communication, 9 April 2020)

Furthermore, Ecosystem-Based Management is a difficult concept, also since everyone has different opinions on what it entails. The sectors fisheries and wind energy have to be managed with EBM, but how, that is the question (VisNed-Dir, personal communication, 7 April 2020).

Stakeholder roles

- **Expert in legislation**

You will focus on all aspects of the legislation of fisheries.

- **Expert in fisheries science**

You will focus on the effects fisheries has on the marine ecosystem and how the negative effects can be minimized through sustainable fishing gear.

Nederlandse Vissersbond

The Dutch Fishing Union is the representative for Dutch professional fishermen, owners of fishery companies, and shippers and have more than 300 members. Their members are fishermen in the pelagic, coastal, domestic and shellfish fisheries, and aquaculture, mainly mussels (Nederlandse Vissersbond, 2020-d). The Union has five departments where the fishermen fall under: Department Zuidwest Nederland; Department Harlingen; Department Zoutkamp / Lauwersoog; Department Noordwest Nederland; and Department Urk (Nederlandse Vissersbond, 2020-e). The Dutch Fishing Union focusses on the sustainable development of their members and offers services that meet the specific needs of the fishermen. Since nature is of important value to the Netherlands and Europe, directives to restore, protect and maintain are implemented which causes some areas to close for fisheries. Therefore the Dutch Fishing Union has meetings with nature and environmental organisations to ensure that fishermen can keep fishing. The Union also has an active role in the certification of fishery products and methods, such as Marine Stewards Council. (Nederlandse Vissersbond, 2020-f)

The Dutch Fishing Union looks after the interests of its members on regional, national and international level. On regional level interests concern port facilities, contact with regional governments and the development of the fishermen community (Nederlandse Vissersbond, 2020-c). On national level the Union looks after interest of the crew, fishery management, spatial planning, cooperation between fisheries, technical measures and certification (Nederlandse Vissersbond, 2020-e), and on international level the Union looks after the interests concerning fishery management (common fisheries policy), development of social policy (policy for the crew), market organisation and international cooperation between the Dutch Fishing Union and other fishing unions in Europe (Nederlandse Vissersbond, 2020-a). The Dutch Fishing Union is also the contact person for Dutch politicians, policy-makers, officials and representatives of NGOs (Nederlandse Vissersbond, 2020-b) and also for politicians and officials from Brussels (Nederlandse Vissersbond, 2020-a).

Marine Spatial Planning

When it comes to spatial planning, the Dutch Fishing Union advocates to take fisheries, which is one of the oldest and traditional uses of the North Sea, into account during Marine Spatial Planning (MSP) processes. According to Johan Nooitgedagt, the chairman of the Dutch Fishing Union, the fisheries sector is too often overlooked in developments in the North Sea. Men often assume that there is enough room for the fisheries, but this is not true. The fisheries can only use a limited surface, so it is important that these areas are not used for offshore wind, or other developments. (Nederlandse Vissersbond, 2020-g)

Why does the Dutch Fishing Union want to be a part of the process

The Dutch Fishing Union wants to be a part of the process to ensure that wind farms are placed in areas where as little as possible North Sea uses receive negative effects from the development. The Union contains maps of high active fishing grounds which it is willing to share with the other stakeholders. (Nederlandse Vissersbond, 2020-g)

What are concerns of the Dutch Fishing Union

- More research needs to be done of what effect the wind farms have on the benthos and marine environment;
- Pulse fisheries are banned, but the technique reduced fuel use of fishing boats;
- Farms with solar panels (Nederlandse Vissersbond, 2020-g).

Fisheries interests during the negotiations for the North Sea Agreement

The outcome of the energy transition must also be an economically and ecologically sustainable fishery. Fishermen should be able to continue to catch the available quota of fish with a fleet that, in

terms of size, matches the new use of space in the North Sea. The fisheries advocate a transition fund to help make the sector more sustainable, for example, fishing and shipping emission-free. (OFL, 2018)

Stakeholder roles

- **Expert in fisheries transition**

You will focus on how the sector can change to a more sustainable sector, which fits the new North Sea.

- **Expert in aquaculture**

You will focus the possibility of multi-use in wind farms and how fisheries could profit from passive fishing activities.

Ministry of Agriculture, Nature and Food Quality

The ministry of Agriculture, Nature and Food Quality focusses on sustainable food, valuable nature and a vital agriculture sector (Rijksoverheid, n.d-m). The Netherlands is a global leader in agriculture and fisheries, the ambition is to maintain this position in the future. At the same time there are other social and environmental challenges the Netherlands is facing. Challenges like; soil depletion, loss of biodiversity and the Netherlands is part of the Paris Climate Agreement. (Rijksoverheid, n.d-f). The ministry aims the necessary change of the agriculture system from cost price reduction to a system takes in to account the use of scarce resources (Rijksoverheid, n.d-f). The ministry is working with core values in guiding their work:

- To connect;
- To innovate;
- Decisive;
- Reliable (Rijksoverheid, n.d-k).

The ministry of ANF has responsibilities regarding the MSFD goals for the North Sea. The *Directoraat-Generaal Visserij en Landelijk Gebied* is system responsible for nature and biodiversity and makes sure the international obligations for MSFD are met, through the following responsibilities:

- Stimulating the role of nature in the process of economic and social considerations;
- Monitoring of measures taken under the Convention of Biological Diversity (CBD) and Bird and Habitat directive;
- Set-up the program *Wettelijke Onderzoekstaken voor de Natuur (WOT Natuur & Milieu)*;
- Responsible for the shaping of sustainable fisheries (sea, coast and freshwater) and sustainable aquaculture;
- Implementation of European legislation of fisheries policy;
- Monitoring of European data collection legislation on fisheries (Informatiehuis Marien, n.d).

Marine Spatial Planning

The ministry of ANF is responsible for both nature and fisheries. In practice the management of nature with fisheries is difficult, because when you want to protect for example to seabed, fishing activities should be banned. But it is very difficult to create a specific fishing area, since fish do not stay in one place (StNZ, personal communication, 16 April 2020). The ministry aims to combine those activities that can make use of the same space or even work together and tries to separate those activities that harm each other (Rijksoverheid, n.d-a). In this way the ministry tries to protect the nature and biodiversity of the North Sea and also through legislation of for example the bird and habitat directive and the MSFD (Rijksoverheid, n.d-a). In terms of fisheries the ministry aims for a sustainable fishing sector in which the fishing methods sustainable exploit fishing stock. For example, methods in which the seabed is less disturbed or there is less by-catch (Rijksoverheid, n.d-g).

The role of the ministry of ANF during the North Sea Agreement

The ministry of ANF is part of the North Sea agreement and represents nature and fisheries from the policy perspective. During the negotiations their challenge is to argue for nature protection and the preservation of the fisheries sector (LNV-Nat, personal communication, 25 April, 2020).

LNV view on Ecosystem-Based Management

The implementation of fisheries policy could be seen as Ecosystem-Based Management. When implementing EBM knowledge is needed on the whole ecosystem, this system is used in different ways. It is depending on the choices that are made if you are going to see how nature will react to changes, “because the ecosystem will adapt”. Or it can be that accepting the current ecosystem and trying to preserve that system. (LNV-VIS-2, Personal communication, 28 April, 2020)

Stakeholder roles

- **Expert in nature**

You will focus on nature legislation and protected areas.

- **Expert in fisheries**

You will focus on fisheries legislation and the transition towards more sustainable fishing methods.

Ministry of Infrastructure & Water Management

The ministry of Infrastructure & Water Management (I&W) strives for a liveable and accessible Netherlands, with a smooth flow in a safe, well designed and clean area. The ministry is working on a strong connection by road, train track, water and through the sky, and protection against flooding, care of air, water and soil quality and creating a circular economy. (Rijksoverheid, n.d-e). In the management of these important aspect's het ministry of I&W is working together is individuals and companies, civil society and local governments (Rijksoverheid, n.d-j).

The Netherlands is part of the Paris Climate agreement and for that reason is aims to produce 27% of the total energy in the Netherlands from renewable energy by 2030. By 2050 the use of renewable energy has to be at 100% of the total energy use. (Rijksoverheid, n.d-e). One of the measures to reach these goals is offshore wind energy.

In de North Sea the ministry of I&W makes sure that the North Sea is accessible, since the Netherlands is a logistical hub (Rijksoverheid, n.d-h). and the North Sea is one of the busiest shipping routes in the world (Royal Association of Netherlands Shipowners, n.d).

Marine Spatial Planning

The ministry of Infrastructure & Water Management is responsible for licensing in the North Sea, so for building an offshore windfarm the ministry has to give out a license. In addition, the ministry is responsible for the policy on (save) shipping and sand extraction. (Rijksoverheid, n,d-k)

Role of the ministry of I&W during the North Sea Agreement

The ministry is initiator of the North Sea agreement and together with the ministries of; Agriculture, Nature and Food Quality, Economic Affairs and Climate, and Interior and Kingdom Relations, gave the *Overlegorgaan Fysieke Leefomgeving (OFL)* the assignment to negotiate the North Sea Agreement with Stakeholders and the government. (OFL, 2020)

Stakeholder roles

- **Expert in legislation of offshore wind farms**

You will focus on the legislation for offshore wind farms

- **Expert in shipping**

You will focus on the safeguarding of shipping lanes and the legislation.

Ministry of Economic Affairs and Climate

The ministry of Economic Affairs and Climate is working on a “sustainable and an entrepreneurial Netherlands” Which indicates a climate neutral society and a strong and open economy (Rijksoverheid, n.d-d). the ministry connects and innovates. In addition to a climate neutral society the ministry makes sure there is reliable and affordable energy. Economy is the main driver, for that reason the ministry strives for an open economy and a strong international competitive position. The challenge for the ministry of Economic Affairs and Climate is to make sure these two aspects of economy and sustainability co-exist. (Rijksoverheid, n.d-i)

Marine Spatial Planning

The ministry of Economic Affairs and Climate is setting in offshore wind energy for the sustainability of the Netherlands. The ministry is responsible, with regards to offshore wind energy, for the energy policy like the Law offshore wind energy (governing the method of issuing lots) and electricity law (the offshore net). Together with the ministry of I&K the ministry is responsible for the spatial planning of large energy projects. (Rijksoverheid, n.d-l)

Role of the ministry of Economic Affairs and Climate during the North Sea Agreement

Together with the ministry of ANF, I&W and I&K the North Sea consultations were initiated.

Stakeholder roles

- **Expert in finance**

You will focus on the financial part of building an offshore wind farm and other cumulative effects in the North Sea.

- **Expert in offshore wind**

You will focus on the permits that are necessary to build an offshore wind farm (together with I&K).

Ministry of Interior and Kingdom Relations

The mission of the ministry of Interior and Kingdom Relations is to preserve the core values of the democracy and a government which the citizens of the Netherlands can trust. In addition, the ministry takes care of its citizens by making sure they can live in affordable, safe and energy efficient homes. (Rijksoverheid, n.d-c). The ministry of Interior and Kingdom Relations is responsible for:

- The democratic and rule of law;
- The public administration;
- Quality of personnel and management within central government;
- The constitution and the system of constitutional government;
- The partnership with Curaçao, Sint Maarten and Aruba;
- Public housing and government buildings (Government, n.d-a).

In relation to spatial planning the ministry ensures that the implementation of EU regulations and also national legislation is kept (Government, n.d-b). Recently the ministry is involved in the development of the national water plan for the Netherlands (Helpdesk Water, n.d.). For that reason, the ministry is the responsible party when it comes to marine spatial planning. The ministry will be chair of the meetings and coordinate the different stakeholders through these meetings and facilitate where needed.

Stakeholder roles

- **Expert in offshore wind**

You will focus on the permits that are necessary to build an offshore wind farm (together with EA&C).

- **Expert in mediation**

You will focus on bringing the different stakeholder together.

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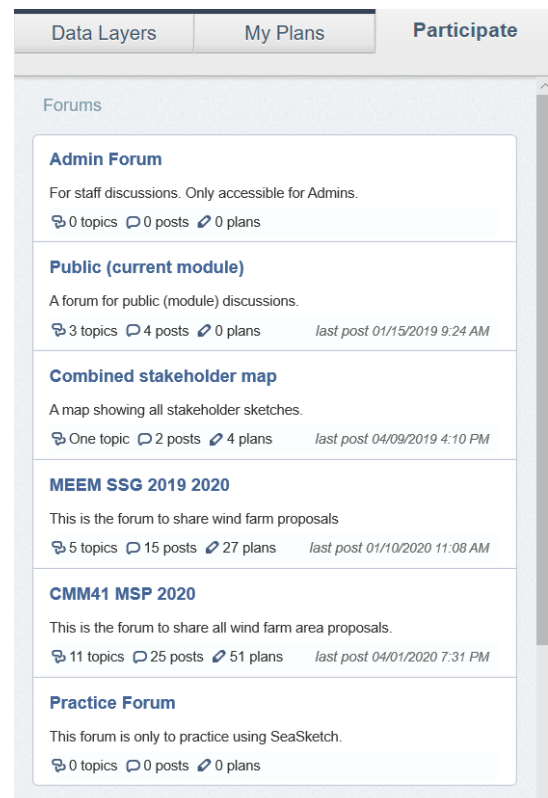
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Appendix A: Sea Sketch manual

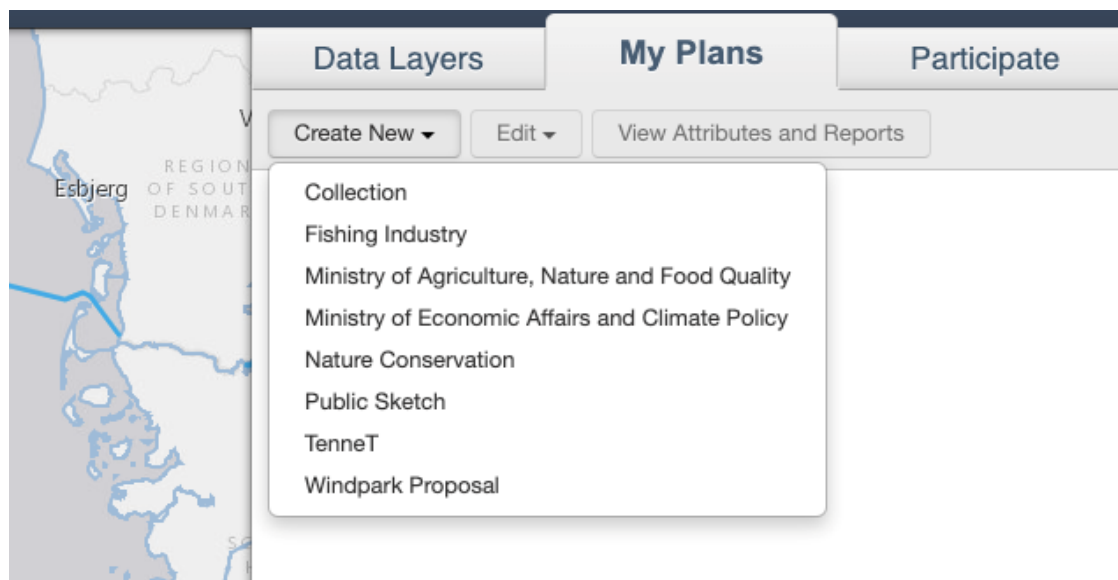
To discuss or share ideas with other stakeholders of the serious game, a “forum” can be used. This is a private workspace and is a controlled environment in which you can share your work. Forums are places where messages, plans and ideas can be shared. They can, for example, be used to share proposed locations with other stakeholders. A forum can be made when stakeholders ask this, and new forums can be added as well. When, for instance, stakeholders form a collaboration and want to share plans and supporting evidence with each other through Sea Sketch. This forum is only available for participants that have been added to the forum.

To find the forums, click on the “Participate” tab (see Appendix I. Figure 1). There are several forums, the first one (Admin Forum), only project administrators have write-access. However, everyone can read these messages. The other forums are available to all participants to discuss and share their plans. As mentioned, if a collaboration wishes to have its own forum to discuss the plans, this forum can be created by a project administrator.



Appendix I. Figure 1. The current forums in Sea Sketch which are available for all participants. New forums for a specific collaborations can be

To create the proposed wind farm areas in Sea Sketch go to the ‘my plans’ tab and click on ‘Create New’ in the top left corner. This will give an option menu, in which you can choose your own stakeholder to draw the proposal, see Appendix I. Figure 2. By selecting your own stakeholder, the proposal will only be visible for your stakeholder, if it is not shared with the whole group. By

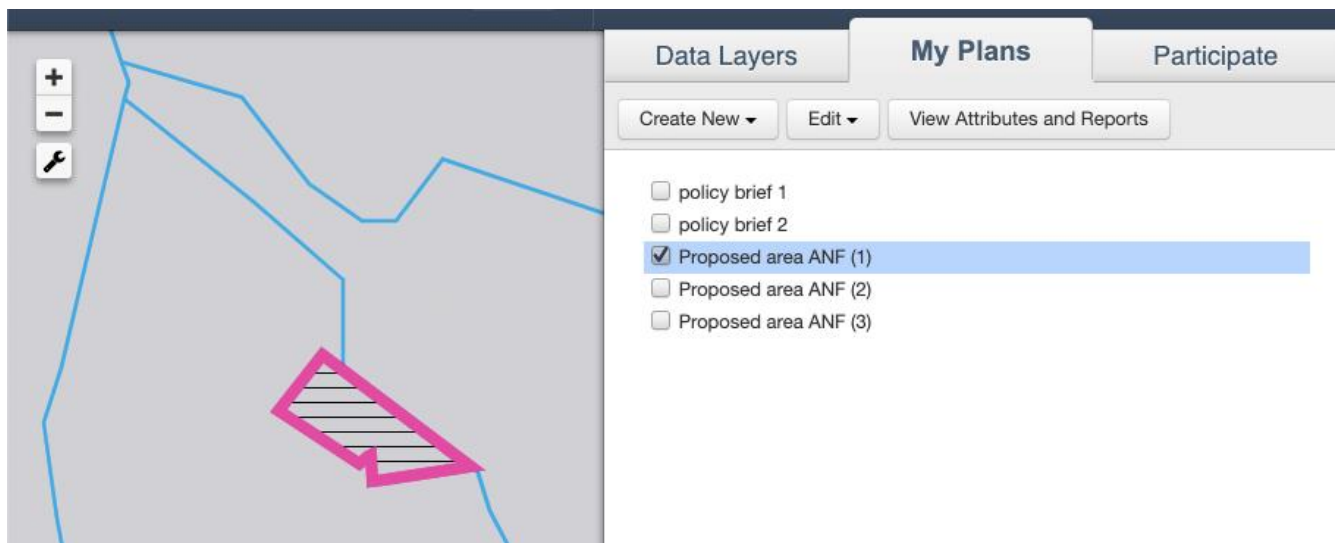


Appendix I. Figure 2. Overview of ‘my plans’ tab, in which new ‘sketches’ can be drawn.

selecting ‘Public Sketch’ the proposal will be visible for all group members.

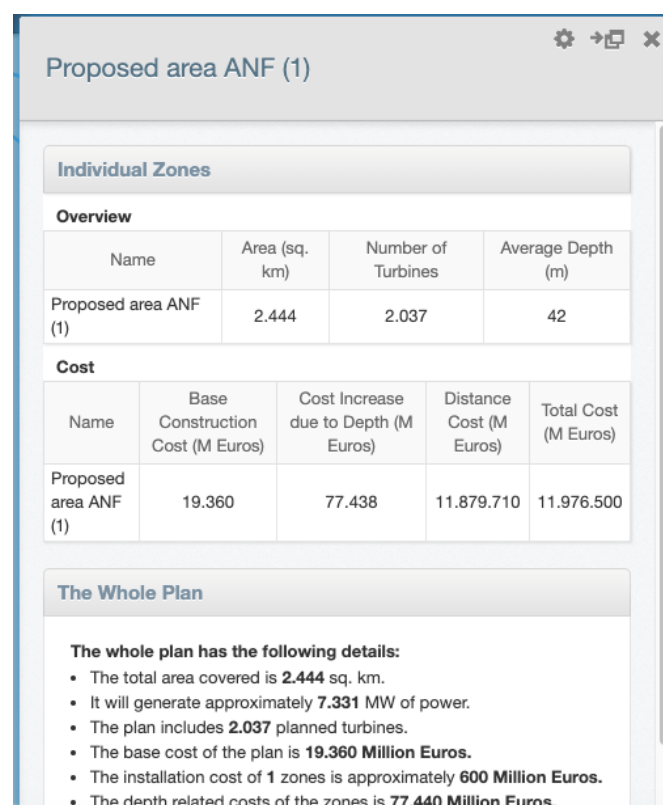
Next you can draw a ‘sketch’ on the map, in which you can choose on what map layer the proposal will be drawn. Double-click on the map to finish the ‘sketch’. Add a clear name to your ‘sketch’, which

makes clear what stakeholder you represent and for what purpose the 'sketch' was drawn. In order to analyse the proposed area, select a 'sketch' and click on 'View Attributes and Reports' in the top right corner, see Appendix I. Figure 3.



Appendix I. Figure 3. Overview of 'my plans' tab, the selected proposal is visible in the pink polygon.

The 'sketch' is tied to a geoprocessing script and can show what the consequences are of the proposed area. In Appendix I. Figure 4 one of these analysis is shown. Sea Sketch analyses the area size, number of turbines and average depth of that part of the North Sea. In addition, a number of cost analysis are given, based on the location. This analysis can help decide the most suitable location and can be used during the meetings to substantiate your proposal.



Appendix I. Figure 4. Overview of the 'Attributes and Reports' option in Sea Sketch, the analysis shows different attributes of the proposed wind farm location like; size, number of turbines, average depth and costs.

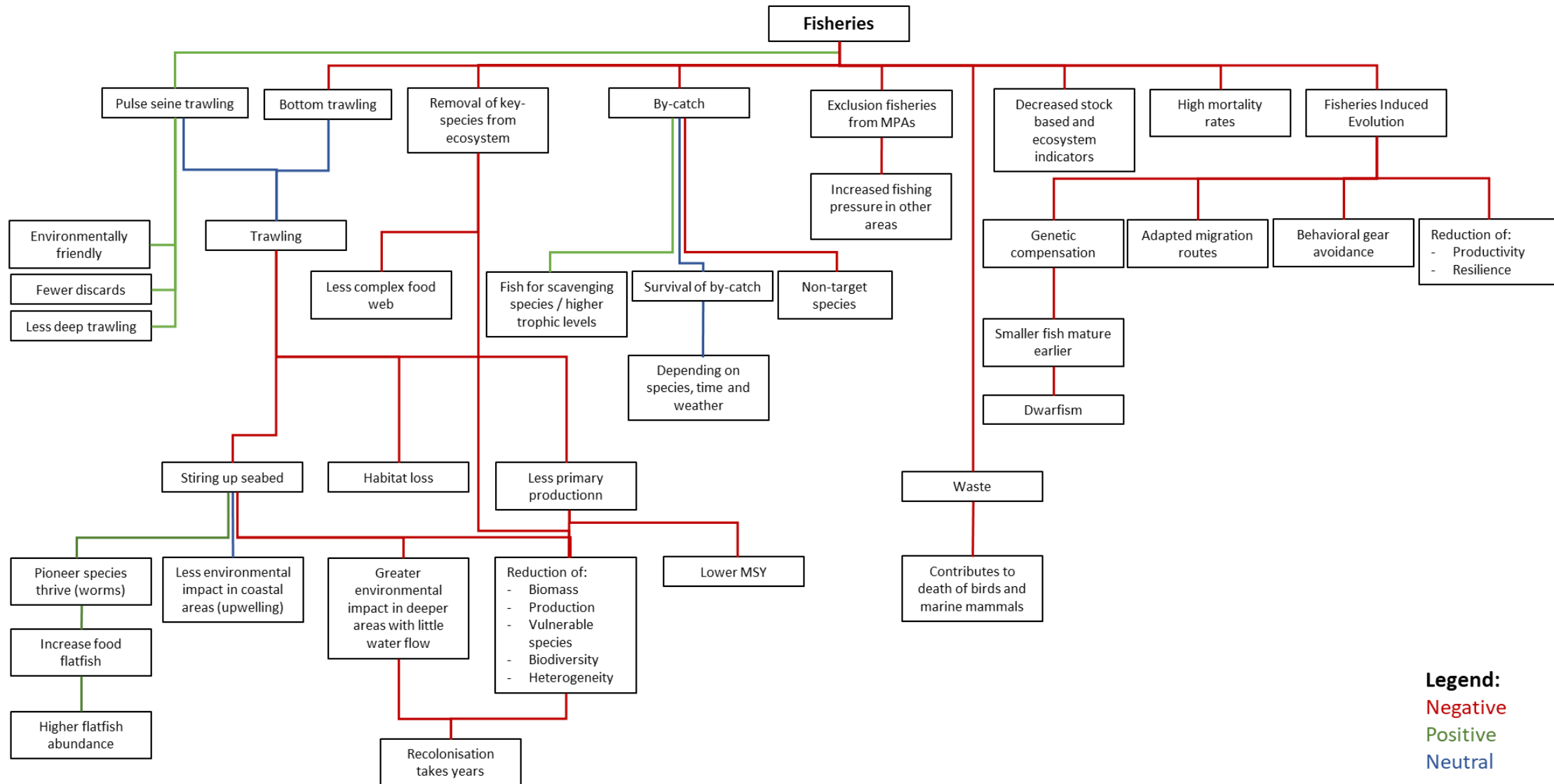
Appendix I. Table 1. Overview of the existing Sea Sketch layers and what layers are newly added

Existing Sea Sketch layers	New added layers
Gas and oil fields	North Sea habitat map (DISCLOSE)
EEZ boundary line	North Sea map Olsen, 1883
Currents <ul style="list-style-type: none"> Global_Arrowhead_Rotation Subsurface_Arrowhead_Rotation Surface_Arrowhead_Rotation Global_Currents Surface_Currents Subsurface_Currents 	
Pipelines Safety Zone	
Pipelines	
Cables	
Morus bassanus (northern gannet)	
Phoca vitulina (harbour seal)	
Herring Spawning Areas	
Phocoena phocoena (harbour porpoise)	
Oil and Gas Platforms (WUR/Alterra 2004)	
Cables Safety Zone	
Countries	
12 nautical mile zone	
eez_poly_Germany_Project	
Potential harbour extensions	
Beach evolution (erosion)	
Hard coastal defences	
Weak areas of coastal defence	
Soft coastal defences	
Former aquaculture locations	
Fishing points	
Significant Discoveries (DECC)	
Fishing areas	
Special protection zones	
Fishing ports	
Operational turbines	
Windparks by company	
Windpark cables	
Wind energy designated area	
Measuring_poles_radar_tower	
Marine reserve: Baai van Heist	
Aquaculture zone	
Energy atolls	
Dredging areas	
Sand and gravel extraction	
Shipping	
Pipelines and cables corridor	
Military areas	
Environmental status (vision)	

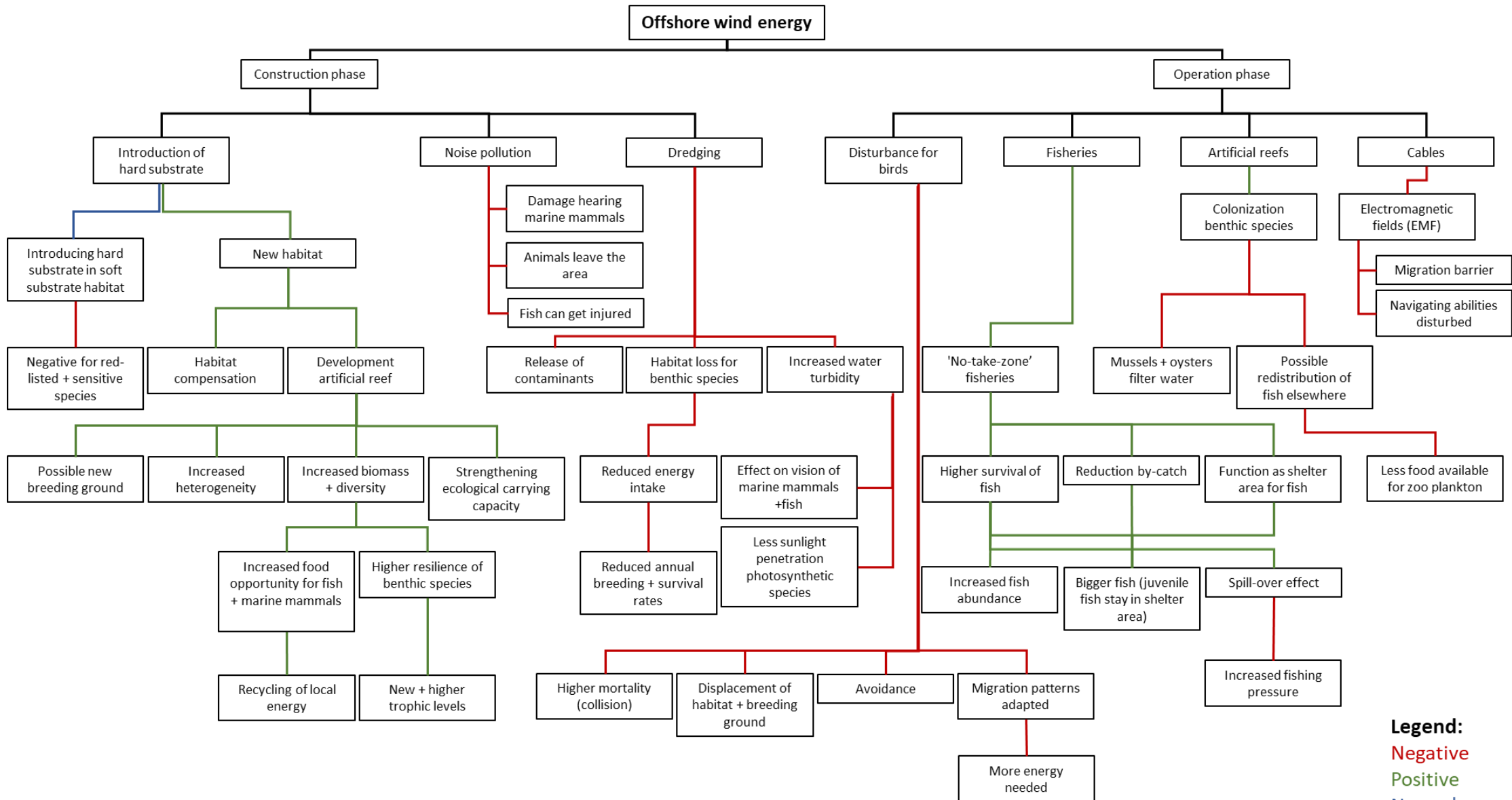
Areas with special ecological value
Offshore windfarms in the OSPAE region 2013 (North Sea)
Shipwreck s with ecological value
Shipwrecks
Sand/shell/limestone extraction licence areas
Sand supplementation
Mariculture
Shipping gullies and approach areas
Gas and oil fields
Quadrants: UK Offshore (DEAL)
eez_poly_United_Kingdom_
eez_poly_Netherlands_Projec
EEZ
10 nautical mile zone
Power_hubs_indicative
Power_hub_cables_indicative
Outline
DECC_Offshore_Licences
eez_poly_Denmark_Project
OHVS
Turbines
Vergunde windparken
Vergunde winparken veiligheidszones
Windparks - existing and designated
Sediment
Shipping separation lanes
Shipping routes and anchorage areas
Mariculture shellfish
Gas and oil production licence zones
Beam 1997 - 2000
Beam 2001 - 2004
OtterFish 1997 - 2000
OtterFish 2001 - 2004
OtterNeph 2001 - 2004
Seine 1997 - 2000
Military areas
Natura2000
Designated wind energy areas (NWP II)
Other wind energy study areas
OWI_windparken_20170815_wgs84
Boomkor - Over 300HP
Bathymetry
Water depth Contour
Catch_value_2008_non_dutch
Catch_weight_2008_non_dutch
Effor_2006_non_dutch
Effort_2008_non_dutch
Catch_value_2006_non_dutch
Catch_value_2007_non_dutch

Catch_weight_2006_non_dutch
Catch_wight_2007_non_dutch
Effort_2007_non_dutch
Catch_value_2006_dutch_reupload
Catch_value_2007_dutch_reupload
Catch_value_2008_BEAMTRAWL
Catch_value_2008_dutch
Fishing_services
Catch_value_2008_SHRIMP
Catch_weight_2006_dutch_reupload
Catch_weight_2007_dutch_reupload
Catch_weight_2008_dutch
Effort_2006_dutch
Effort_2007_dutch_reupload
Effort_2008_BEAMTRAWL
Effort_2008_dutch_reupload
Effort_2008_OTTERTWINTRAWLERS
Effort_2008_SHRIMP
FishingBottom2007
Seabed_substrate_1M
Seabed_substrate_250K
Extrapolated chlorophyll data from Waterbase (EEA)
Chlorophyll data points from Waterbase (EEA)
SAHFOS CPR standard areas
Annual means Phytoplankton Colour Index 1958 - 2006
Total Eyecount copepods (copepods > 2 mm), Grid
Annual mean abundance Diatoms 1958 - 2006
Annual means Dinoflagellates 1958 - 2006
Annual anomalies of total copepod abundance, SAHFOS CPR Survey 1948 - 2005
Arba alba (white furrow shell)
EuSeaMap Habitats Harmonised

Appendix B: Conceptual model effects of fisheries on the marine ecosystem



Appendix C: Conceptual model effects of offshore wind on the marine ecosystem



Appendix D: Interaction triangle

Offshore Energy for Nature

- + Introduction of hard substrate (D6)
 - + New habitat (D6)
 - + Artificial reef (D1, D2, D6)
- + Possible new breeding grounds (D1)
- + Increased heterogeneity (D1)
- + Increased biomass + diversity (D1, D4)
- + Increased food opportunities for fish + marine mammals (D1, D4)
- + Higher resilience of benthic species (D1, D6)
- + Strengthening ecological carrying capacity (D1, D3, D4)
- + Colonization of benthic species (D1, D2)
 - Possible redistribution of fish elsewhere (D1, D2)
 - Less food available for zoo plankton (D1, D4)
- Red-listed + sensitive species (D1, D2)
- + "No-take-zones" fisheries (D1, D3)
 - + Reduction of by-catch (D1, D3, D4)
 - + Function as shelter areas for fish (D1, D4)
- + Increased fish abundance (D1, D3, D4)
 - + Bigger fish (juvenile fish stay in shelter area) (D1, D3, D4)
- + Spill-over effect (D1, D3)
 - Increased fishing pressure (D3)
- Electromagnetic fields (EMF) (D11)
 - Migration barrier (D1)
 - Navigation abilities (D1)
- Disturbance for birds
 - Collision
 - Habitat + breeding ground displacement
 - Avoidance
 - Migration patterns
- Noise pollution (D11)
 - Avoidance (D1)
 - Hearing damage marine mammals (D1)
- Dredging (D6)
 - Habitat loss benthic species (D6)
 - Release of contaminants (D11)
 - Increased water turbidity (D11)

Nature for Offshore Energy

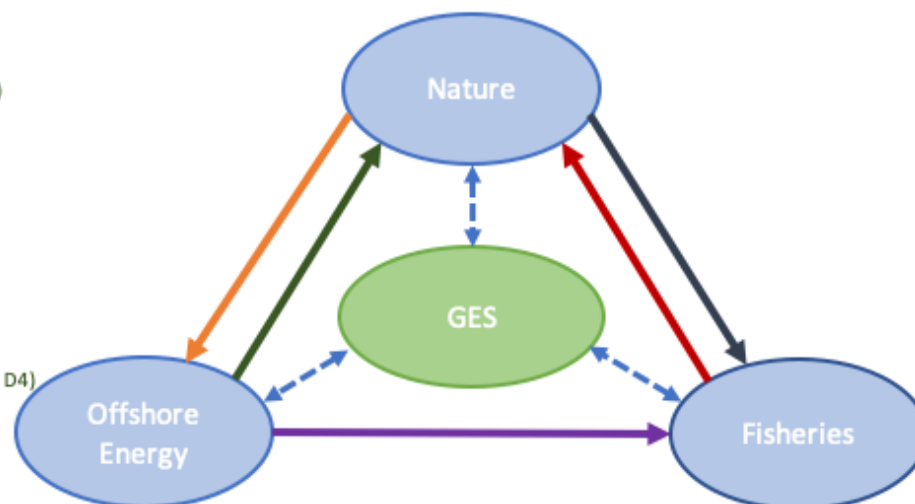
- + Renewable energy extraction (wind) (D11)
- + Offers spatial area for offshore wind farms

Nature for Fisheries

- + Extration of biomass

Fisheries for Nature

- Trawling (D3)
 - + Pulse Seine trawling (D3)
 - + Less deep trawling (D6)
 - + Fewer discards (D1, D3, D4)
 - + Environmentally friendly
- Stirring up seabed (D6)
 - + Pioneer species thrive (worms) (D1, D4)
 - + More food for flatfish (D1, D3, D4)
 - + Higher flatfish abundance (D1, D3)
 - Reduction of: biomass, production, vulnerable species, biodiversity, heterogeneity (D1)
 - Areas with little water flow (D6)
- Removal of key-species from ecosystem (D1, D3, D4)
 - less complex food web (D4)
- Habitat loss (D6)
- High mortality rates (D1)
- Fisheries induced evolution (D1, D3)
 - Smaller fish mature earlier (D1)
 - Adapted migration routes
 - Behavioral gear avoidance
 - Reduction of: productivity, resilience (D1)
- Waste
 - Contribute to death of birds + marine mammals (D1)
- Decrease stock-based + ecosystem indicators (D1)
- By-catch (D1, D3, D4)
 - Non-target species (D1, D4)
 - + Fish for scavenging species (D4)
 - + Survival of by-catch (D1, D4)



Offshore Energy for Fisheries

- + Spillover (D1, D3)
- + Passive fishing gear (D3)
- Exclusion of fisheries from wind farm (D3)
- Adapted migration routes of fish (D1, D3)

MSFD descriptors

- | | |
|--|---|
| D1. Biological Diversity | D4. Food webs |
| D2. Non-indigenous species | D6. Sea-floor integrity |
| D3. Commercially- exploited fish and shellfish | D11. Introduction of energy, including underwater noise |

Appendix E: Interactive Pie Chart



Interactive_triangle
.xlsx