

Mapping current and future human uses and their spatial conflicts on the southern North Sea

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ABSTRACT

The North Sea is one of the busiest seas. Many users are competing with each other for the limited space. It is likely to become even more crowded in the future. However, not much is yet known of the conflicts that play between these users. The objective of this graduation thesis was to explore the potential user-user conflicts on the southern part of the North Sea, determining the spatial conflicts between the human users of the southern North Sea for two time periods are. The countries that were studied were Belgium, England, Germany and the Netherlands. To answer the question, the current situation in the North Sea and that proposed in the period 2021-2030, the objectives of various stakeholders and the conflicts should be mapped. The conflict data was divided into three classes. Eventually maps were created in ArcMap to see where the spatial conflicts appeared based on the data gathered. The map of 2016 was mapped out by using open access sources. The results showed that the coastal areas were the most crowded. The results of the objective suggested that most of the countries had many maritime uses they see as a priority, like fisheries, shipping, military and wind energy. The spatial conflicts were high between energy - fishing, energy - oil and gas, energy – cables and pipelines, fishing – oil and gas, fishing – cables and pipelines, nature conservation – cables and pipelines, nature conservation-cables and pipelines. The Belgian EEZ has relatively the most conflicts, and the German EEZ has the least. The map of 2021-2030 could not be created due to the lack of open access marine planning data. Due to this, the future component did not get researched. The amount of conflict strongly depends on the amount of activities in an area. But it also depends on the data available. No data = no 'conflict' The conflicts with the largest spatial area were: fisheries vs nature, energy vs nature, cables and pipelines vs nature and fisheries vs shipping. Another valuable conclusion is that there is a serious lack of data on this subject. Recommendations are: to research more about user-user conflicts to better define them and for stakeholders/policy-makers to publish more marine spatial data publically online.

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1 INTRODUCTION

The North Sea is one of the busiest seas in the world. Human uses will most likely increase in the future. The North Sea is surrounded by densely populated countries with expanding economies (van Tatenhove & van Leeuwen, 2015). Many maritime sectors are expanding; for instance the increasing offshore wind energy sector, the numerous pelagic, demersal and benthic fisheries, the maritime logistics sector and the growing concern for nature conservation. It means that competition for space will most likely become an even bigger issue in the future (van Tatenhove & van Leeuwen, 2015).

To ensure that the European maritime economy will continue to thrive in the future, and to tackle the growing concern around maritime governance, the Integrated Maritime Policy (IMP) was adopted in 2007 (European Parliament, 2014) (Schaefer & Barale, 2011). After the IMP, the European Commission published the Blue Growth Strategy in 2014. This initiative focuses on a vital long term action plan to support and encourage sustainable growth in the maritime sectors (European Commission, n.d. -b).

A key instrument of the integrated maritime policy is Maritime Spatial Planning (MSP). Adopted in 2014 as a transparent method for allocating human uses in maritime areas, the goal of maritime spatial planning is to encourage ecological, economic and social benefits from the marine sectors (Schaefer & Barale, 2011). The EU sees spatial planning and environmental protection as essential for a maritime economy to thrive (European Commission, 2017) It should transform the sector-based governance by the coordination of stakeholders. (Schaefer & Barale, 2011).

The European Parliament and the Council adopted legislation to create a common framework for maritime spatial planning in Europe by 2021. To limit the competition for maritime space, every member state is obligated to create a spatial plan for their part of the North Sea before 2021. Member states can contribute to the sustainable development of offshore wind energy, maritime shipping, preservation and protection of the environment, sustainable tourism, extraction, and fisheries through their maritime spatial plans (European Parliament, 2014). Therefore, nations bordering the North Sea are developing Maritime Spatial Plans to fulfill this requirement (UNESCO, 2017). One of the most important drivers for creating MSP is the increase of cooperation between countries in the renewable energy sector (NorthSEE, n.d.).

1.1 PROBLEM DESCRIPTION

All the member states surrounding the North Sea are progressing in advancing their MSP to get a better overview of all their maritime human users in their EEZ (Exclusive Economic Zone) (UNESCO, 2017). The member states need to work on a cross-border cooperation on the North Sea, however this has not yet occurred to the extent as proposed in the MSP directive (European Union Committee, 2015). Within the MSP directive it was suggested that the member states should cooperate to ensure that maritime spatial plans are coherent and coordinated across the marine region (European Parliament, 2014). But the mechanisms of cross-border cooperation and planning are underdeveloped (European Union Committee, 2015).

This is mainly because the member states around the North Sea have their own national jurisdictions and their own way of making plans for their EEZ (Degnbol & Wilson, 2008). The different countries interpret the meaning of their sea in their own way and due to different connotations on their issues collaboration is made much more difficult. These issues would be recognized better by taking the future in

account (Kannen, 2014). So far, it has been a challenge to put all the inconsistent and incompatible Maritime Spatial Plans together into a common pool to perform analysis on (European Union Committee, 2015).

Although these problems regarding the Maritime Spatial Plans in the North Sea are too big to tackle in detail during this thesis, this study can still be used as an exploratory investigation of this case.

The area that this thesis has concentrated on are the countries surrounding the southern part of the North Sea (map 1). Germany, The Netherlands, Belgium and England (as part of the United Kingdom) are the countries that have been studied. However, It was decided to not take France and Denmark into consideration, due to the lack of maritime spatial plan documentation and the language barrier. (UNESCO, 2017).

Belgium already started their spatial planning in 2003 and has published their final plan as “Marine Spatial Plan for the Belgian part of the North Sea” (Federal public service Health, Food chain safety and environment, 2014). The Netherlands has completed their Maritime Spatial Plan, set out in the National Water Plan (NWP) 2009-2015 (with a 2050 vision) and 2016-2021 (with 2030 vision in the updated document) (Noordzeeloket, n.d.-b). The NWP is evaluated and updated every 6 years. The Netherlands is currently in their second cycle. (IOC-UNESCO, n.d. -b). Germany’s spatial plans for its EEZ have been implemented in the form of legal ordinances in 2009, and these are now being revised (Jay, 2017). There is no spatial plan for the entire UK. The Marine Management Organization (MMO) has made two elaborate plans for England’s Northern and Southern EEZ, completed in 2014 and 2016 (IOC-UNESCO, n.d -a). An extended elaboration has been given in table 9 in appendix I “MSP data per Southern North Sea country”. A summary is displayed in table 1 “Summary of marine spatial plans per country” containing the researched country, authority, year of publication, the current status and revision cycle.



Map 1: Research area based on the boundaries of the Greater North Sea and the EEZ from the selected countries (ICES, 2004) (Marine Management Organisation, 2017) Self-composed.

Table 1: Summary of marine spatial plans per country

Country	Authority	Year of publication	Status	Revision
Belgium	Ministry of Environment	2014	2 th cycle	Every 6 years
England	Marine Management Organisation (MMO)	Expected in 2018	1 st cycle (plan analysis)	>Every 5 years
Germany	German Federal Maritime and Hydrographic Agency (BSH)	2009	1 st Cycle	Every 3 years
The Netherlands	Ministry of Infrastructure and Watermanagement	2009	2 nd cycle	Every 6 years

During this research Brexit has not been taken into consideration. The conflicts that have been discussed are the user-user conflicts. The compatibility between the users is low and they are often competing for the same space or resources in an area (Douve & Ehler, 2009). Maritime Spatial Planning has a big influence as an approach to deal with these issues (Jentoft & Knol, 2014). This thesis took two time periods into account.

This serves as an explorative study to highlight potential conflicts between the users operating on the southern part of the North Sea. Most of the human users have developed their own objectives that solely focus on their own interests. It is quite challenging to accommodate all desired sectoral objectives within an EEZ. Especially, when realizing all wishes and demands can put a serious strain on the ecosystem (Schaefer & Barale, 2011). This is a reason why it is harder to actualize the plans and objectives of the surrounding countries (Stelzenmüller, et al., 2013).

The many different spatial uses in a relatively small area such as the North Sea are bound to cause dispute in one way or another. Although making a conflict analysis is a useful method to get insight into all the user-user conflicts that take place at sea, only one attempt has been carried out with a conflict analysis for the German EEZ (Bundesamt für Seeschifffahrt und Hydrographie, 2009), and another attempt was limited to the coastal zone of the North Sea by the project COEXIST (Stelzenmüller, et al., 2013). No assessment could be found for the entire North Sea basin.

Not having easy and fast access to reliable and precise information, especially for marine data, has become a problem. Not having enough valuable information can cause threats to the marine environment, as human users will continue to grow without knowing of the conflicts and impacts on the environment. It is also important with the development of policy and to predict future changes. Better accessible data is necessary to further develop a healthy sustainable economy, as stated by EMODnet, a data collection initiative for European seas (EMODnet, 2011). They are not the only North Sea data collection initiatives: e.g. the Belgian '*Compendium.net*', and the German '*geoseaportal.de*' also contain spatial data for their EEZ. However, maritime data for the North sea is often not accessible for public use, or collected into one portal. Marine data collection in Europe has not been carried out in a uniform way for a long time. Most data collection was conducted in isolation from other organizations (EMODnet, 2011).

The relevance of this thesis became clear at the ICES workshop organized by WGMARS-WGINOSE on the 22nd of February 2018 in The Hague. The key topic of this meeting was identifying the Dutch objectives for

the North Sea with the use of key economic, social and institutional objectives. It was mentioned that the need for a cross-border overview of the North Sea was necessary for integrated ecosystem assessments (IEAs) to predict user-user and user-environment conflicts and to make suitable management decisions.

1.2 PROBLEM STATEMENT

To manage the human users on the North Sea in the future, every member state of the EU is required to formulate a Maritime Spatial Plan for their EEZ before 2021. Due to the differences in approach per country, there is no recent combined overview of the current and future spatial plans of The Netherlands, Belgium, England and Germany. A spatial overview is required to identify user-user conflicts.

1.3 OBJECTIVES

In order to create clarity about the current and potential future conflicts of the human uses on the North Sea, the first objective was to create a comprehensive current and potential future overview of the human uses on the southern North Sea for the year 2016 and the time period of 2021-2030. This was based on the maritime spatial plans of the four countries surrounding the southern North Sea.

This study is focused on 2016 as a moment in time with the status “current situation” to give an idea of the status on the North Sea. Although this study has been performed in 2018, the year 2016 has been used to ensure that the maps contain data as close to this period as possible whilst overcoming the delay in availability of spatial data. The period of 2021-2030 was chosen because of the many Maritime Spatial Plans based within this period.

The outcome of this research includes a report with the results, a conclusion and a recommendation for following studies. The results contain two maps of the human uses in 2016 and in the period of 2021-2030, a stakeholder inventory and interest assessment based on their spatial objectives, regulations and conflicts, a table with conflict scores and finally two thematic maps to present where the spatial conflicts for now and in the future might occur. The maps that were created and the outcomes have been uploaded to ArcGIS Online and have been added in a story map.

In the end, the method and result can be used for further research on the conflicts of the North Sea. It can also be useful as a start of a database to get some insight in the activities and conflicts of the southern North Sea area. It could also be used for the development of new management plans by organizations like the spatial planning authorities, other stakeholders and ICES, especially for their working group WGBESIO, who are working on the development of the Integrated Ecosystem Assessments (IEAs) in the North Sea (ICES, n.d.). It could be useful to make informed decisions on the future situation of the North Sea.

1.4 RESEARCH QUESTIONS

What are the spatial conflicts between the human users of the southern North Sea in the year 2016 and potentially during the period of 2021-2030?

1. What did the spatial situation in the southern North Sea look like in the year 2016?
2. What will be the situation on the southern North Sea after the implementation of the Maritime Spatial Plans for the time period 2021-2030?
3. What are the common user-user conflicts and objectives of the human users on the southern North Sea?

1.5 READING GUIDE

In the following text a description is given of the chapters and their content. The position of the description of the research countries is in alphabetical order, the level of conflicts always goes from human uses that are compatible to human uses that are compatible under certain conditions to mutually exclusive. The order of sub questions also remains the same for each chapter, and remains the same throughout this document.

Chapter 2 contains the methods and techniques. This chapter explains the steps that were carried out when the research was performed. It has been divided into the data gathering and analysis per question.

The results of the research are described in chapter 3. It contains a summary of the regulations, objectives and user-user conflicts of the human users of the Southern North Sea. It also contains an overview of the human uses on the southern part of the North Sea in 2016, a map with the combined marine spatial plans (also for the southern part of the North Sea) and the conflict analysis for 2016.

In chapter 4, the discussion is debated. Per research question, the complications, validation and reliability of the research has been discussed.

Chapter 5 contains the conclusion to the question: *“What are the spatial conflicts between the human users of the southern North Sea in the year 2016 and potentially during the period of 2021-2030?”* It contains the conclusions drawn from the results and the discussion. This shows the interpretations of the results.

Recommendations have been given in chapter 6.

The appendixes contain the following: tables, figures and maps, which are too large to be put in the text. They are displayed in order of first mention in the text.

2 METHOD AND TECHNIQUES

This chapter includes the research methods and techniques. In the following chapter the method used for answering the research question is explained. The data gathering and data analysis has been elaborated per sub question in this part.

This research can be identified as a desk study. All information gathering and analysis has been done by using online sources and spatial analysis software (ESRI ArcMap, *version 10.5.1*). This research can be divided into two parts:

- 1) Data gathering
- 2) Data analysis

Data gathering was entirely qualitative. The first objective was to collect information to understand the spatial situations on the southern part of the North Sea. The second objective was to understand the spatial regulations and objectives of, and the conflicts between the stakeholders.

A quantitative data analysis has been performed to answer the question of what the conflicts on the southern North Sea occur and where they occur. The gathered data has been quantified and displayed in user-user conflict maps and tables.

2.1 SITUATION OF THE SOUTHERN NORTH SEA FOR 2016

The first part of the research (creating maps for 2016 per southern North Sea country) was executed by using ESRI ArcMap to visualize and analyze the gathered data. For every dataset, the features, attributes and metadata has been checked. For this project a shared file folder in SharePoint has created to organize the downloaded data. To create the maps, it is necessary to make a base with spatial documents and shapefiles.

2.1.1 DATA GATHERING

Spatial data of the human uses per selected southern North Sea country needed to be collected. Spatial data is most useful in the form of shapefiles and datasets if these contain a clear metadata wherein the sources can be traced. The first approach has been to download the ArcGIS shapefiles of the current human uses playing a role on the North Sea basin. This data came from online open access data which was a requirement for the research. Often these sites are provided by the concerned marine spatial executives. The sources for open access data and the people responsible can be found in table 2 "*Table containing online spatial data sources and related contacts*". When spatial data could not be found, contact with these institutions was necessary. If the contacts were queried, the question was to get access to missing or incomplete data.

Table 2: Table containing online spatial data sources and related contacts

Belgium					
Activities	Year	Organisation (responsible person)	Email / contact number	Spatial data / Data files	Information
	2014	The Royal Belgian Institute of Natural Sciences	geocell@naturalsciences.be	http://www.marineatlas.be/en/data	The portal to the Belgian marine data and information regarding MSP
	2014	The Royal Belgian Institute of Natural Sciences	geocell@naturalsciences.be	https://www.health.belgium.be/sites/default/files/uploads/fields/geshealth_theme_file/3009275/summary%20Marine%20spatial%20Plan.ppt	
		VLIZ Vlaams Instituut voor de Zee	compendum@vliz.be / +32-0059-34 21 30	http://www.compendumcoastandsea.be/portals/0/mopmenuwrapper	
England					
Activities	Year	Organisation (responsible person)	Email / contact number	Spatial data / Data files	Information
Oil & gas/ Windfarms (cable and pipelines)		The Kingfisher Information Service The Kingfisher Information Service-SeaFish	kingfisher@seafish.co.uk / +44 (0)1472 252307	http://www.kia-orca.eu/map@WVrh40OZca	The map shows where the oil & gas platforms can be found as well as the cables and pipelines.
Wind farms turbines	2018	Renewables map	simon.mallet@gmail.com	http://www.renewables-map.co.uk/energymap.asp?status=3&technology=wind	It gives in general only a couple wind farms including some information about them but no download ma
General	2018	Dafra	John.Seabourne@decc.gov.uk	http://defra.maps.arcgis.com/home/webmap/viewer.html?useExisting=1&layers=7761b3ad16c40e4973ccc4db9b7	A lot of different information in general.
	2016	Marine Management Organisation	http://mms.marinemangement.org.uk/contact-us	http://defra.maps.arcgis.com/apps/webappviewer/index.html?id=3d94e81a2e81a6ace0bd327e4f4346	
	2018 (?)	Oil & Gas Authority	Tanya.Knowles@ogauthority.co.uk / 0300 0201038	https://ogauthority.maps.arcgis.com/apps/webappviewer/index.html?appid=5a7966e41c68f4c762ea137a682e	
	2018	Oil & Gas Authority	ogacorrespondence@ogauthority.co.uk	http://data.ogauthority.opendata.arcgis.com/	
Germany					
Activities	Year	Organisation (responsible person)	Email / contact number	Spatial data / Data files	Information
		Thunen	info@thunen.de / +49 531 296 1003	https://www.thunen.de/en/infrastructure/thunen-geo-information/spatial-data-infrastructure/	
	2015	University of Oldenburg University of Oldenburg	info@magmap.eu / +33507850010	http://www.magmap.eu/finde-maps/	
		GeoSeaPortal	Contactpage	https://www.geoseaportal.de/mapapps/7lang-en	
		Thunnen, Vanessa Steizenmuller	vanessa.steizenmuller@thunen.de	https://www.thunen.de/en/st/staff/scientific-staff/steizenmuller-vanessa.d/	
The Netherlands					
Activities	Year	Organisation (responsible person)	Email / contact number	Spatial data / Data files	Information
Different		Infoluis Marien	Nynke Westra nynke.westra@rws.nl	https://dhm-open-data.sovener.info/objects.nl/index_rd.htm	
	<2004	Noordzeeloket	Joan Staeb joan.staeb@rws.nl	https://www.noordzeeloket.nl/beheer/noordzeeloket	
		Rijkswaterstaat	servicedesk-data@rws.nl	https://geoservices.rijkswaterstaat.nl/apps/geoservices/scv/but/catalog_search?node=sequest-work&home	
		Milieu defensie		http://geo.solutions/duinegasportal/	A map with different Oil & gas
The entire North Sea					
Activities	Year	Organisation (responsible person)	Email / contact number	Spatial data / Data files	Information
Different		Christine Rockmann	christine.rockmann@seur.nl / +31 6 10 681 869 / info@ices.dk	http://www.ices.dk/marine-data/data-ports/Pages/default.aspx	
	2014			http://www.emodnet-humanactivities.eu/view-data.php	
COEXIST	2013	Torsten Schulze (Thunen)	Torsten.Schulze@ti.bund.de	http://msp-platform.eu/practices/analysis-conflict-scores	The tool of COEXIST for the conflict analysis
Different				https://regridata.rvlivson.com/Wlakes-oceans-and-other-water-sources	In case there is no data elsewhere to be found.

The goal was to find the most up-to-date information about the current situation. The step by step approach for finding the GIS data can be seen in figure 1 below. The first step was to check if there is spatial marine data available. If not than look for additional data. If no additional data could be found it has been classified as 'no data'. When there was marine spatial data, then the second step was to look from what year it is. The GIS data was preferably from the year 2016. The data has been classified as outdated when it source dates earlier as the year 2012. The reason the data from before 2012 has not be used, is because it was two years before the adaptation of the Marine Spatial Plan directive. Therefore, the relevancy to the most accreted data has been produced during the time period from 2012 until now. If there was no data available, it was allowed to use outdated data if it was mentioned in the discussion.

Table 3 "Metadata GIS" contains the metadata of the used sources. These sources are based on the data gathering table 10: "GIS data 2012-2016" that can be found

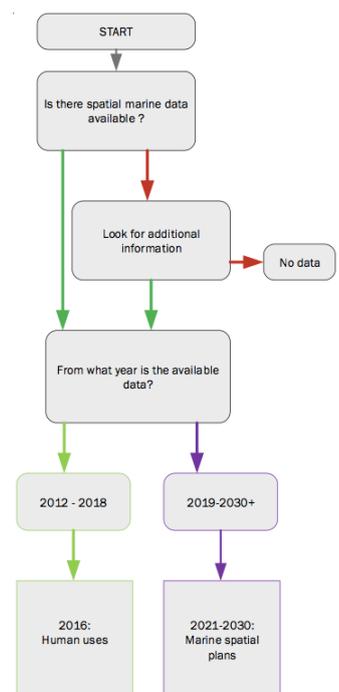


Figure 1: Step by step approach for spatial data

in appendix II. Per country all the available online sources were assessed and categorized.

Table 3: Metadata GIS

Metadata table						
Name	Type	Author	Projection	Source	Date	Website
Bottom Fishing Intensity – Subsurface	Polygon	OSPAR	EPSG:4326	OSPAR	2015	https://odims.ospar.org/odims_data_files/
Bottom Fishing Intensity – Surface	Polygon	OSPAR	EPSG:4326	OSPAR	2015	https://odims.ospar.org/odims_data_files/
Emodnet_HA_Wind_farms_20180115	Point	CETMAR	EPSG: 3034	EMODnet	2018	http://www.emodnet-humanactivities.eu/view-data.php
Emodnet_HA_Dredging_20170615	Point	AZTI- Tecnalia	WGS84	EMODnet	2017	http://www.emodnet-humanactivities.eu/view-data.php
Landing_stations_schematic_20170801	Point	Cogea srl	WGS84	EMODnet	2017	http://www.emodnet-humanactivities.eu/view-data.php
SIGCables_Submarine_Cables_Routes	Line	Cogea srl	WGS84	EMODnet	2017	http://www.emodnet-humanactivities.eu/view-data.php
Cables_schematic_20170801	Line	Cogea srl	WGS84	EMODnet	2017	http://www.emodnet-humanactivities.eu/view-data.php
Emodnet_HA_Munition_pg_20180123	Polygon	CETMAR	WGS84	EMODnet	2018	http://www.emodnet-humanactivities.eu/view-data.php
Emodnet_HA_Aggregates_20170620	Point	AZTI- Tecnalia	WGS84	EMODnet	2014	http://www.emodnet-humanactivities.eu/view-data.php
Emodnet_HA_HE_Pipelines	Line	Cogea	WGS84	EMODnet	2017	http://www.emodnet-humanactivities.eu/view-data.php
Emodnet_HA_Offshore Installations	Point	Cogea srl	WGS84	EMODnet	2017	http://www.emodnet-humanactivities.eu/view-data.php
modnet_Human_Activities_Shellfish_Areas_WGS84	Point	Euroshell	WGS84	EMODnet	2015	http://www.emodnet-humanactivities.eu/view-data.php
Emodnet_HA_Environment_End_2016_2017_0510	Polygon	Cogea srl	WGS84	EMODnet	2016	http://www.emodnet-humanactivities.eu/view-data.php
eez_v10	Polygon	VLIZ	WGS84	Marine regions	2018	http://www.marineregions.org/downloads.php
ICES_ecoregions_20171207_erase_ESRI	Polygon	H.C. Andersens	WGS 1984	ICES	2016	http://www.marineregions.org/downloads.php
MMO_Marine_Plan_Areas	Polygon	Marine Management Organization	EPSG::4258	Marine Management organization	2017	https://data.gov.uk/dataset/ceecc6a3-297b-4a72-b2ca-d430324b546f/marine-management-organisation-marine-plan-areas
Shipping_2013	Raster	-	-	-	2013	-

2.1.2 DATA ANALYSIS

First, the collected shapefiles from the part of research have been downloaded from the open access websites, and have been added to ArcMap.

When the data was added, the processing began to extract the data that was needed, and create the maps for 2016. The basic steps are recorded down below. For a more extended elaboration, check the full GIS method table in appendix III, table 11 “*GIS Method maps 2016 and conflict analysis*”. After the data from the metadata was added to the ArcMap document, most of the data was prepared. First, the research area got established by extracting the right area, containing the selected research countries, data from the shapefile “eez_v10”, “ICES_ecoregions_20171207_erase_ESRI” and “MMO_Marine_Plan_areas” all form the file called “research_area”. All human uses have been clipped by this area, speeding up the analysis. All data were projected in coordinate system WGS 1984, and subsequently altered to match the symbols to make a common file. All data were given suitable symbology based on legibility and clarity. The “research_area”, “fisheries” and “shippingroutes” data has been displayed as semi-transparent.

2.2 SITUATION ON THE SOUTHERN NORTH SEA FOR THE TIME PERIOD FROM 2021-2030.

To answer this question, ArcMap has been used as well. But for this question, the data gathering is more important than the data analysis or display.

2.2.1 DATA GATHERING

The search for the creation of these maps started with looking for dataset or portal services owned by government institutions or research institutions. The goal was to find data that could be downloaded, added and altered to ArcMap. To begin with, for the creation of these maps the data came from online and open-access databases (table 2 “*Table containing online spatial data sources and related contacts*”). But not all data seemed to be openly available, consequently, the contacts from table 2 were approached to gather the missing data. It was preferred that the data came from WFS (Web Feature Service), instead of WMS (Web Mapping Service) connections, as the features in WFS can be altered and analyzed. The data gathering method is the same as the previous sub question (as can be seen in figure 1), but divided into the second time period.

2.2.2 DATA ANALYSIS

After the collection of spatial conflict data, the connections and datasets gathered from the questions were added to ArcMap. All data needed to be put into the same coordinate system (WGS 1984) to make sure that the result was accurate. As the features were not editable, due to them being hosted on remote servers, the symbols remained the same. Once the layout of the map was created, the map could be published.

2.3 THE REGULATIONS, COMMON USER-USER CONFLICTS AND OBJECTIVES OF THE HUMAN USERS ON THE SOUTHERN NORTH SEA.

The second part of this research focused on creating a theoretical base of the situations on the North Sea. The goal was to obtain insight into the spatial user-user conflicts and objectives of the human uses on the southern North Sea.

2.3.1 DATA GATHERING

This question was answered in two parts: a stakeholder inventory and a stakeholder analysis. Secondary data such as policy briefs and online documents were the sources that have been reviewed to gather information.

The stakeholder inventory consisted out of the maritime users of the EEZ of Belgium, England, Germany and the Netherlands, based on the stakeholders mentioned in the Maritime Spatial plans of the selected countries. These can be found in table 4 “*Categories MSP*”.

Table 4: Categories MSP

Belgium	Energy production	Fossil fuel/ CO2 storage	Exploitation of non-living resources	Fisheries	Aquaculture Mariculture	Marine Conservation zones	Shipping	Military	Pipelines and submarine cables	Tourism/ recreation
(Federal public service Health, Food chain safety and environment, 2014)	Energy Storage		Disposal dredged material	Fisheries	Marine aquaculture	Nature conservation zones	Port development	Munition deposit area	Telecom/energy: Cables	Recreational activities
	Pipelines		Sand and gravel extraction			Monitoring/ research	Anchorage area	Military activities		
	Energy generation						shipping			
England	Energy production	Fossil fuel/ CO2 storage	Exploitation of non-living resources	Fisheries	Aquaculture Mariculture	Marine Conservation zones	Shipping	Military	Pipelines and submarine cables	Tourism/ recreation
(Marine Management Organisation, 2017)	Offshore wind Renewable Energy Infrastructure	OIL & Gas	Aggregates	Fisheries	Aquaculture	Marine Conservation zones	Ports and shipping	Defense and National security	Subsea Cabling and telecommunications	Tourism and Recreation
	Tidal stream and Wave	Carbon capture and storage	Dredging and Disposal							
Germany	Energy production	Fossil fuel/ CO2 storage	Exploitation of non-living resources	Fisheries	Aquaculture Mariculture	Marine Conservation zones	Shipping	Military	Pipelines and submarine cables	Tourism/ recreation
(Bundesamt für Seeschifffahrt und Hydrographie, 2009)	(Offshore wind) energy		Gravel Extraction	Fisheries	Mariculture	Marine environment	Shipping	Military use	Pipelines and submarine cables	Leisure and tourism
			Sand extraction			Research				
The Netherlands	Energy production	Fossil fuel/ CO2 storage	Exploitation of non-living resources	Fisheries	Aquaculture Mariculture	Marine Conservation zones	Shipping	Military	Pipelines and submarine cables	Tourism/ recreation
(Ministerie van Infrastructuur en Milieu, Ministerie van Economische zaken, 2015)	Renewable Energy	Oil-and gas extraction	Mineral extraction	Fisheries	Mari- and aquaculture,	Mariene ecosystem	Marine shipping	Defensie	Cables and pipelines	Tourism and Recreation
		Co2-Storage				Cultural heritage				

A stakeholder analysis has been created to determine three features of the human users:

- 1) The spatial regulations; in this feature, by the government or sector required spatial regulations have been researched to add to data of the conflict maps.
- 2) Their objectives; the goals that have been set out by the researched countries for the future of the human uses on their part of the North Sea;
- 3) The spatial conflicts that already exist with other human users; the spatial conflicts between the human users that have already been researched.

A table in Excel was used to represent these features. Most information has been collected from journal articles, research reports and online sectoral or governmental documents describing the spatial conflicts, regulations and objectives of the maritime users per sector. It was important to search for the impact of both of the human uses on each other.

The stakeholder analysis will be made with Excel, containing the stakeholders on the y-axis and the columns of the objectives and regulations on the x-axis. When the spatial conflicts, regulations and objectives were known, it was necessary to study which spatial uses might have conflicts with other ones.

2.3.2 DATA ANALYSIS

The information about the objectives has been tabulated in the stakeholder analysis. This has been presented in a cross table, containing all the human uses on the x-axis as well as on the y-axis. In between, the conflicts between human users have been added between these axes. The collected data has been quantified by three elements:

1= The activities are compatible

2= The human users are compatible under certain conditions

3= The human users are mutually exclusive

No data= No data available

The method for this analysis has been inspired by the conflict analysis tool and report performed by COEXIST study (Schulze, et al., 2013). In this study the conflict analysis has been converted in the a scheme with 3 different categories (level of horizontal scale, extent of period, level of vertical scale), and the mobility was taken into account as well. In the method of this research, the time period, mobility, vertical and horizontal scale have only been taken into account when no data of any conflicts could be found.

In figure 2, the step-by-step approach for finding and categorizing the conflicts can be found. When data could not be found, it was argued by using common sense. Five tables have been created. One combined table, containing spatial conflicts found in documents mainly from European, and international sources, and four tables containing the spatial conflicts of Belgium, England, Germany and The Netherlands.

Two of them are easy to identify by using the decision tree. If no conflict was found, than it was categorized as 'the human users are compatible'. When it was decided that interaction is possible under certain conditions, than it has been categorized as 'the human users are compatible under certain conditions'. When no conflict data could be found, and logical reasoning shows that conflicts do not meet each other on a vertical, mobile, horizontal or time scale in real life, than the conflicts get categorized under 'Mutually exclusive'. 'No Data' only applied to the tables for Belgium, England, Germany and The Netherlands. It was assigned when international information could be found, but the national information about the spatial conflict could not.

In another cross table, these 'grades' have been added between the stakeholders on the x- and y axis, as well. The objectives have been used to give an overview of the priorities by the selected countries. This has been added to the conflict tables per country. To get an abstract idea of the differences of the conflicts in square kilometer per country, an extra field was added to the final map layer. For this field the area geometry was calculated in square kilometers. With 'summary' in the attribute table, the conflicts per EEZ per conflict level was calculated and analyzed. The results have been added in the chapter results.

To visualize the conflicts on the southern North Sea, the data of the 2016 maps has been altered and processed to form a conflict analysis map. The method for this can be found in table 11, appendix III "GIS method for creating maps 2016 and conflict analysis". In the following text a small elaboration of this table

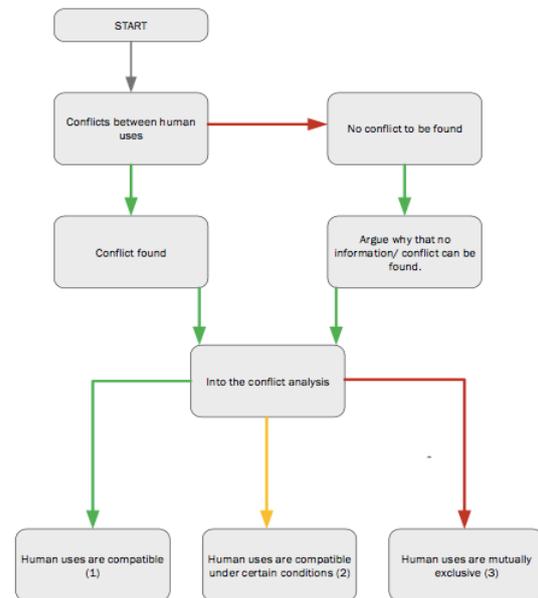


Figure 2: Conflict analysis; breakdown of conflict categorization method

has been given. First of all, the data from the 2016 maps have been grouped together (e.g. Aggregation and dredging data form the human use of exploitation of non-living resources together). Secondly, the buffers from the regulations (in table 4) was added to the human uses. Subsequently, the tables of the conflict grades were used to determine the level of conflict between the users. All users-user conflicts with either a 2 or 3 were intersected to see where these overlapped. Next, the grades were added into the attribute tables of the intersected features. All conflicts were merged into each other and afterwards a union was created of the research area (the areas graded with no conflict). This feature now contained all the possibilities of conflicts. In the layout view a decision was made about the display of the maps. A map was created of every researched country. The area of every feature was calculated with the 'calculate geometry' tool in ArcMap, and a table was created containing the percentage and total square kilometers for the conflicts per country. The human uses were also summarized in a table with the square kilometers per use, showing the uses ranked from most to less.

3 RESULTS

The following chapter contains the discovered results. They have been divided per research question. It contains a summary of the regulations, objectives and user-user conflicts of the human users of the Southern North Sea. It contains an overview of the human uses on the southern part of the North Sea in 2016, a map with the marine spatial plans (of the Southern part of the North Sea) and the conflict analysis for 2016.

3.1 THE SPATIAL SITUATION IN THE SOUTHERN NORTH SEA IN THE YEAR 2016

Although there are numerous initiatives to combine and provide spatial data on the North Sea, for instance EMODnet, compendium Kust- en Zee and MapMep, one of the biggest challenges is that it must be accepted by member states Regional Sea Conventions, ICES and by the private sector (European Union Committee, 2015).

The online open access dataset gathered for these maps can be found in table 3 "*Metadata GIS*". An overview of the available data per country per human use, can be found in table 10 appendix III. "*GIS Data for 2012-2016*". Data from the MMO and Emodnet were clearly the most complete datasets. Some data was from sectoral initiatives, like Kis-Ocra for offshore energy data. Many gaps still appeared, like proper fisheries data and shipping data.

The current situation of the entire North Sea appears, more or less as expected, extremely busy. Without the extent per country or the selection of only a few human uses it does not give a sufficient overview. The outcome of the maps can be found in map 2-6 in appendix VI, an overview can be found per selected Southern North Sea country, providing a better overview of the situation. Not all possible human uses have been added, due to the crowdedness of the maps, and the availability of data. A few of the biggest gaps in data are the tourism and recreation use, the entire military use, the pelagic fisheries areas, the shipping anchor areas, other renewable energy initiatives and CO₂-storage.

When zoomed in to 100% (and to a greater extent) it can be noticed that especially the coastal areas are very busy. The dense human users near the coast are dredging, aggregating, military activities, mariculture and shipping. If coastal defense and tourism would have been added, the coast would have appeared even more crowded. Nature, fisheries and shipping are the human uses that seem to take up the biggest surface, covering almost the entire North Sea. The largest amount of oil and gas installations seems to be concentrated in the middle of the maps. The EEZs of German and England seem to relatively be more empty than the EEZ of Dutch and Belgium. But the map of the EEZ of Belgium appears more structured. It also appears that England has the most extreme high number of oil and gas installations compared to the other EEZ areas.

3.2 THE SITUATION ON THE SOUTHERN NORTH SEA AFTER THE IMPLEMENTATION OF THE MARITIME SPATIAL PLANS

The result of the research for the existing MSP data can be found in table 14 "*GISdata MSP*", appendix VII. It shows that only the German and Belgian MSP data can be found. Eventually it turned out that the German MSP data could not be displayed, and no proper map was created. This data seems to highlight more the lack of available feature data of the marine spatial plans. Even the available data only shows the designated areas vaguely for most of the human uses.

3.3 THE REGULATIONS, COMMON USER-USER CONFLICTS AND OBJECTIVES OF THE HUMAN USERS ON THE SOUTHERN NORTH SEA

The regulations, objectives regarding the marine spatial plans and the common user-user conflicts of the human users on the southern North Sea are displayed in different tables and text below.

3.3.1 REGULATIONS

The results of the regulations are presented in the table 5 “*The spatial regulations per human use*” below. After searching the internet for regulations, the only regulations that were found were the ones that are shown in the table. The data in the table is only from Dutch sources.

Table 5: The spatial regulations per human use

Human user	Regulations
Energy production	Safety zone of 500m (Noordzeeloket, 2018)
Shipping	In the Netherlands ships to 24 m are allowed to go through the offshore wind farm Egmond aan zee, Prinses Amalia wind farm and wind farm Luchterduinen. (Noordzeeloket, 2018)
Oil & gas	Safety zone of 500m (Noordzeeloket, 2018)
Exploitation of non-living resources	Extraction of supplementation and embankment sand has a priority in the reservation zone between the main NAP-20 m line and the border of the 12-mile zone (Noordzeeloket, n.d. -e)
Fisheries	Belgian fisherman can fish on all species demersal as well as pelagic species in the 3 to 12 nautical mile zone of the Dutch continental shelf (Nederlandse vissersbond, 2016).
Marine conservation zones	Areas are closed for all other human uses for some periods a year (European commision, 2011).
Shipping	Safety zone of 500m around the shipping lanes (Noordzeeloket, n.d-a).
Military	Areas are closed for all other human uses for some periods a year (Noordzeeloket, n.d.-c).
Cables and Pipelines	The cables and pipelines need to be buried deep enough in the sand so they will not have an impact on other human uses that are passing through the same area (Noordzeeloket, n.d.-c).

3.3.2 OBJECTIVES

Every country has put their objectives for the human uses of their EEZ in the marine spatial plans. In this part the prioritized uses are presented.

Belgium MSP

The objectives for the Belgian part of the North Sea are related to different users on the EEZ. The objective for the **energy production** according to the marine spatial plan is that the entire project for the generation of wind energy in the designated area for renewable energy will be operational in 2020. The current zone for renewable energy must offer sufficient space for the generation of sustainable energy. By 2020 the sector should have approximately generated at least 2,000 MW installed capacity in the renewable energy zone (Federal public service Health, Food chain safety and environment, 2014).

Corridors for **cables and pipelines** are combined and organized with other activities and uses in the Belgian part of the North Sea (BPNS). Attention needs to be given to efficiency: the new cables and pipelines will all be laid in the corridors provided to pursue common cables as much as possible. Wherever possible, multiple use of space are encouraged (Federal public service Health, Food chain safety and environment, 2014).

For **Exploitation of non-living resources** it is important to have sufficient sand and gravel extraction zones. The goal is to achieve an optimal and sustainable extraction of sand and gravel for the construction sector as well as for the coastal defense against flood risks. But due to the environmental risk, monitoring the impact on the seafloor and the biodiversity, and limiting the amount and duration of the extraction is necessary. The maximum amount of extraction is 15.000.000 m³ per 5 years (Federal public service Health, Food chain safety and environment, 2014).

The objective for the **fisheries and aquaculture** is that all the fishing grounds continue to be reachable. Excluded from this are the designated areas for renewable energy, energy storage and transport. Additionally, some space will be saved for integrated aquaculture as a complimentary human use for the 'classic' fisheries sector. This will help to preserve the rich fishing grounds for the Belgian fisheries sector (Federal public service Health, Food chain safety and environment, 2014).

To make sure that the **coastal defense** is in good status, a framework has been put into place (published in the Masterplan Coastal Safety) (Federal public service Health, Food chain safety and environment, 2014).

The Belgian **military** needs to be supported, and need a sufficient space for exercises and mine removal operations at sea. The vision assumes support of Belgian military (international) engagements. (Federal public service Health, Food chain safety and environment, 2014).

The vision for **marine conservation** in the BPNS is support the marine protected areas with valuable management measures. The marine protected areas should be connected in one network of international and land-sea connections. Finding multi-spatial use that has advantages for the marine environment should be taken care of (Federal public service Health, Food chain safety and environment, 2014).

The objective for the **tourism and recreation** in the marine spatial plan is to maintain the existing space at sea for recreational activities. Another objective is to have enough sustainable recreation as possible (Federal public service Health, Food chain safety and environment, 2014).

England MSP

The objectives for the England Marine Plans take the deployment of renewable energy in account, whereof **offshore wind** will be the largest contribution to this (HM Government, 2011).

The objective for the **oil industry** is to reduce the dependence on foreign import by using the UK's hydrocarbon sources. It is also important to continue explorations. These resources need to be accessed to achieve the objective of maximum economic recovery. Even though the UK plans to limit the reliance on fossil fuel to half its size, it will keep on being an important part of the UK fuel. The half will be imported, that's why investments in new gas infrastructure is needed (HM Government, 2011). To capture the emission of carbon, all new fossil fuel power stations must now be constructed Carbon Capture Ready (CCR) (HM Government, 2011).

The objective for the **exploitation of non-living resources** is to maintain the status, meaning that the marine aggregates are mainly used in beach replenishment schemes. It provides coastal protection as well as enhancing the amenity value and supporting the local economy (The crown estate, n.d.-a).

The objective for the **cables and pipelines** is to maintain the status. This is needed for the rights to lay, maintain and operate cables and pipelines on seabed. The crown estate needs be informed of cables and pipelines that transit the UK continental shelf (within the 200-nautical mile limit), as other activities may be impacted (The crown estate, n.d. -b).

The objective regarding the **shipping and fisheries** will also be to maintain the current status. The UK has a long history of fishing both inshore and offshore waters. The UK Administrations wish to see this continue. Also, the objective of the aquaculture is to get the suitable governance for the development of efficient, effective, competitive and sustainable aquaculture industries (HM Government, 2011).

The objective for the **tourism and recreation** is to protect the natural and cultural heritage and to have good facilities and services for UK's tourists (The crown estate, n.d.-c).

The primary objective for the **military** according to the Ministry of Defense (MoD) is to give military defense and security for the inhabitants of the UK. The MoD has the capability to regulate and restrict their offshore areas for other uses (HM Government, 2011).

Germany MSP

The **exploitation of non-living resources** should be carried out in one fixed area and should be very small-scale. Existing sand and gravel sites should be used as much as possible, if it is still able to be combined with environmental concerns and if there will remain a sediment layer (for benthic community recovery). An expansion of these sites should be preferred to be used in the search for new deposits (Bundesamt für Seeschifffahrt und Hydrographie, 2009).

The objective of the **shipping** has granted priority over the other spatially significant uses in the designated areas for shipping (Bundesamt für Seeschifffahrt und Hydrographie, 2009).

The objective for the **tourism and recreation** (mostly regarding shipwrecks) is that when an unknown heritage is discovered while exploring for non-living resources, the cultural heritage will be preserved and protected (Bundesamt für Seeschifffahrt und Hydrographie, 2009).

The Netherlands MSP

For **energy production** the Dutch government would like to increase the renewable energy share to 14% in 2020 and to 16% in 2023. It is likely that due to this the future of the **oil and gas industry** will stagnate (Ministerie van Infrastructuur en Milieu & Ministerie van Economische Zaken, 2015). The ambition is to achieve a balanced energy supply. The goal for the storage of CO₂ should be sufficient and used as a temporary tool for the development of renewable energy (Ministerie van Infrastructuur en Milieu & Ministerie van Economische Zaken, 2015). For the realization of these objectives the sector of cables and pipelines are involved as well, and the objectives are to use the space on the North Sea for pipelines, electricity- and telecommunication cables in the most efficient way. Scrapped cables and pipes will be cleaned up as much as possible (Ministerie van Infrastructuur en Milieu & Ministerie van Economische Zaken, 2015).

Besides the energy production and storage of CO₂ the **exploitation of non-living resources** (sand and gravel extraction) are important human uses on the Dutch part of the North Sea. The availability of

sufficient and affordable sand is mostly important for the coastal security, construction and infrastructure, especially for long term planning (Ministerie van Infrastructuur en Milieu & Ministerie van Economische Zaken, 2015). The Dutch government expects that for the next period (up to 2021) the required amount of supplementation of sand remains the same (12 million m³ per year). Connected to the exploitation is the dredging of shipping lanes.

For **shipping** the objective is that the sector will stay the same in the future and will be stable and durable (Ministerie van Infrastructuur en Milieu & Ministerie van Economische Zaken, 2015).

Other important human uses are the **fisheries** and **aqua and mariculture** sectors. The objectives for these human uses are related to the transition to sustainable forms of fishing and fish-breeding.

Fishing remains a socio-economic basis for parts of the coastal regions. Sustainable economic development in balance with the marine environment is crucial. To achieve this, it is important to keep the continuation of dialogue going (Ministerie van Infrastructuur en Milieu & Ministerie van Economische Zaken, 2015). For the development of aquaculture within the EU, the focus is mainly on the increase of production and marketing, in particular by stimulating innovation, collaboration and the accessibility of available knowledge (Ministerie van Infrastructuur en Milieu & Ministerie van Economische Zaken, 2015).

Besides the major economic human uses, the **military** is another human activity of big significance for the Dutch government. Offshore military (practice) areas are required to the operational readiness of the armed forces (Ministerie van Infrastructuur en Milieu & Ministerie van Economische Zaken, 2015).

The objective for the **marine conservation** is to turn the Dutch EEZ into a clean, healthy and a productive sea. Ideally, the ecosystem will function optimally and will be resilient, the water will clean and the use of the North Sea will be sustainable. And thus, creating perspectives for both nature, environment and economic activities.

And finally, the **tourism and recreation** will most likely increase in the coming years. The spatial development of the North Sea is marine and coastal recreation, and are an important factor that should be well coordinated (Ministerie van Infrastructuur en Milieu & Ministerie van Economische Zaken, 2015). The North Sea also has an important socio-cultural and historical significance for the Netherlands and is a source of knowledge. The vision is to plan the North Sea in a way that the spatial cultural heritage have the possibility to develop on the North Sea. The challenge is to preserve archaeological values (Ministerie van Infrastructuur en Milieu & Ministerie van Economische Zaken, 2015).

These objectives for the research area of this report will give an overview where the focus of the different countries lays. It will help to understand the conflicts that will be described below.

To summarize, the Belgian government has set out multiple objectives for their human uses on the southern North Sea. Generating a capacity of at least 2,000 MW of renewable energy is a priority. Cables and pipelines should only be installed in already-used corridors and should be combined with other North Sea uses as much as possible. Sufficient areas should be designated for sand and gravel extraction. The sector should be optimal and sustainable. For fisheries the objective is to have a clear gateways to the important fishing grounds. Additionally, aquaculture areas are designated to complement the fisheries industry and to preserve the fishing grounds. The military is quite a big priority, as they need enough space for their offshore exercise operation. Sufficient international management measures should be put into place for the protected areas at sea. Multiple use is encouraged. Maintaining the space designated at sea for recreation is a priority. Tourism and recreation should be as sustainable as possible (Federal public service Health, Food chain safety and environment, 2014).

In the English EEZ energy production is very important. The dependence on foreign import oil should be reduced by using the UK's hydrocarbon sources. All new fossil fuel stations should be able to store captured carbon. The continuation of explorations is seen as essential for the economic recovery, however, the UK plans to reduce the reliance on fossil fuel by half its size. Hence why the deployment of renewable energy is very important, especially offshore wind energy. The objective for the exploitation of non-living resources, cables and pipelines, shipping and fisheries is to maintain the current status are described from different sources (The crown estate, n.d. -b); (The crown estate, n.d. -b); (HM Government, 2011). The long history of fishing and shipping is important to the UK administrations. Additionally, the aquaculture sector should get the suitable governance for the development of this industry. The tourists that come to the UK should be provided good facilities and services. Protecting the natural and cultural heritage is a priority (HM Government, 2011). The military can regulate and restrict their offshore areas from other uses.

The exploitation of non-living resources of the German EEZ should only be very small-scale. Existing sand and gravel sites should be exploited as much as possible. An expansion of these sites should be preferred to be used in the search for new deposits. The areas for shipping have granted priority over the other spatially significant uses in the designated areas for shipping. When cultural heritage is discovered while exploring for non-living resources, it will be preserved and protected (Bundesamt für Seeschifffahrt und Hydrographie, 2009).

For energy production the Dutch government would like to increase the renewable energy share to 14% in 2020 and to 16% in 2023. It is likely that due to this the future of the oil and gas industry will stagnate. For the realization of these objectives the space of cables and pipelines should be used in the most efficient way. Exploitation of non-living resources are important human uses on the Dutch part of the North Sea. For shipping the objective is that the sector will stay the same in the future and will be stable and durable. The aim for aquaculture is to transition to suitable forms of fishing and fish-breeding. However, fishing does remain as a socio-economic basis for parts of the coastal regions. A balance between the marine environment and fisheries is crucial. The military is another human activity of big significance for the Dutch government. Offshore military (practice) areas are required to the operational readiness of the armed forces. The objective for the marine conservation is to turn the Dutch EEZ into a clean, healthy and a productive sea. And thus, creating perspectives for both nature, environment and economic activities. And finally, the tourism and recreation will most likely increase in the coming years. It should be well coordinated. The vision is to plan the North Sea in a way that the spatial cultural heritage have the possibility to develop on the North Sea. The challenge is to preserve archaeological values (Ministerie van Infrastructuur en Milieu & Ministerie van Economische Zaken, 2015). These objectives for the research area of this report will give an overview where the focus of the different countries lays. It will help to understand the conflicts that will be described below.

3.3.3 CONFLICTS ANALYSIS

The results from the conflict analysis are presented in the text, tables and figures below. It shows what user-user conflicts take place between the human uses on the North Sea. Within this chapter, the conflicts are displayed in a text, divided per level of conflict (human uses area compatible – human uses are compatible under certain conditions- human uses are mutually exclusive) All the graded human uses from the conflict analysis can be seen in table 6. With the table and description of the grades. The complete conflict analysis can be found in table 12 “*conflict analysis*”, appendix IV. The conflicts are focused on the entire North Sea instead of every country separately, however, differences per country were found, and displayed in table 14, appendix VII.

3.3.3.1 COMPATIBLE HUMAN USES

The following human uses do not have any conflicts.

Energy production VS coastal defense

No conflicts could be found. This is most likely due to the different zones these North Sea users operate in. The coastal defense is focused on the dikes and dunes. The energy production sector is required to be outside the 12-nm zone (RVO, 2015).

Energy production VS tourism and recreation

In case of the Netherlands there is a strong dependence on tourism. Many of the coastal municipalities are strongly against constructing offshore wind farms close by areas, due to their fear of losing tourist and horizon pollution/spoilage. However, in recent research it has come to light that this is not the case: the numbers are stable and the tourist do not care (Hoefsloot, Pater, Gent, & Boer, 2016).

Energy production VS exploitation of non-living resources

No conflicts could be found. This is most likely due to the different zones these North Sea users operate in. In the Netherlands the exploitation of non-living resources is concentrated within the 12-nm, and the energy production sector is required to be outside the 12-nm zone (Bode, 2015).

Fisheries VS coastal defense

No conflicts could be found. This is most likely due to the different zones these North Sea users operate in. Coastal defense is focused on the dikes and dunes. Fisheries stay out of the coastal zones of the Netherlands (Nederlandse vissersbond, 2016).

Fisheries VS tourism and recreation

There can be some conflicts between tourism and recreation, because the fisheries gear can be destroyed by passing ships. However, this can easily be solved if fishers do not come too close (Miljodirektoratet, 2013). The reason why this is categorized as 'no conflict' is because both human uses are very mobile. Conflict is easily avoided.

Fisheries VS exploitation of non-living resources

There are no conflicts between fisheries and extraction of non-living resources. Fisheries are mobile and can maneuver around the safety zones of the extraction activity (Miljodirektoratet, 2013).

Shipping VS oil and gas

There are no real conflicts, since shipping activity is mobile and can maneuver around the safety zones around oil platforms. Additionally, the big shipping lanes have a safety zone (Miljodirektoratet, 2013).

Shipping VS coastal defense

No conflicts could be found. This is most likely due to the different zones these North Sea users operate in. The coastal defense is focused on the dikes and dunes. Shipping has no conflict, because they will move to the ports and not to the coast.

Shipping VS tourism and recreation

There is an increase of recreation sailing boats, but as long as the regulations are clear, there will be no conflicts because of the safety zone of 500m on each side of the shipping routes. Additionally, both uses are very mobile (Tettero, 2017).

Shipping VS exploitation of non-living resources

The current legislation is sufficient to deal with any conflict that occurs in the shipping lanes in combination with the safety zones of both human uses (Miljodirektoratet, 2013).

Oil and gas VS coastal defense

No conflicts could be found. This is most likely due to the different zones these North Sea users operate in. The coastal defense is focused on the dikes and dunes. Oil and gas constructions are spread out in the deep sea.

Oil and gas VS tourism and recreation

No conflicts could be found. This is most likely due to the different zones these North Sea users operate in. The oil and gas is further out of the coast and has a safety zone of 500m (Ministerie van Infrastructuur en Milieu, Ministerie van Economische Zaken, 2014).

Oil and gas VS aqua- and mariculture

No conflicts could be found. This is most likely due to the different zones these North Sea users operate in. There would be no real conflict due to the difference in placement. Oil and gas is further out of the coast. Due to the safety zone it will not cause any conflicts.

Oil and gas VS exploitation of non-living resources

There is no conflict because of the clear regulations regarding the safety zones (500m) of the oil and gas platforms. (Ministerie van Infrastructuur en Milieu, Ministerie van Economische Zaken, 2014)

Military use VS cables and pipelines

Maps with new cables and pipelines are constantly updated. This way the military can avoid interactions (Veum, Cameron, & Hekkenberg, 2012). Both uses are quite stationary as well, which is why there is no big conflict.

Cables and pipelines VS tourism and recreation

The cable routes have been designed to avoid all wrecks. (NorthSeaLink, 2018) The vertical and horizontal use difference in use, make that the onshore and offshore tourism and recreational activities will most likely not conflict.

Cables and pipelines VS aqua- and mariculture

There would be no conflict during the operational phase of the cables. It would only occur when the cables are being placed due to the vertical difference in use of the water column.

Cables and pipelines VS exploitation of non-living resources

There is no conflict. In order to spare the sand extraction areas as much as possible and to keep the sand supplies available for the Dutch coast, preferred routes have been designated by these areas where the cables and pipelines must be laid in bundled as much as possible. If a route is nevertheless chosen by a potential sand extraction area, financial compensation can be requested for this. This compensates the additional costs for the extra fuel cost made by the sand extraction sector (Noordzeeloket, n.d.-f).

Nature conservation zones VS coastal defense

In the Netherlands certain zones in the dunes are used for coastal defense purposes or reserved for drinking water supply which shows that there are no spatial conflicts (Ruig, 1998). Additionally, when constructed, coastal defense is stationary.

Nature conservation zones VS tourism and recreation

There are no conflicts when these two uses meet outside of the coast. Close to the coast, tourism could affect the quality, availability and accessibility of natural resources for local users (Wageningen University & research, n.d).

Coastal defense VS tourism and recreation

There are no conflicts when these human uses meet further out of the coast. However closer to the coast tourism could affect the quality, availability and accessibility of natural resources for local users (Wageningen University & research, n.d).

Coastal defense VS aqua- and mariculture

No conflicts could be found in relation between the coastal defense and aquaculture.

Coastal defense VS exploitation of non-living resources

No conflicts could be found in relation between the coastal defense and the exploitation of non-living resources.

Tourism and recreation VS aqua- and mariculture

There are no spatial conflicts (Scibior, n.d).

Tourism and recreation VS exploitation of non-living resources

There are no conflicts, since the exploitation of non-living resources are more localized further away from the coast. Tourism is more concentrated at the coast.

Aqua- and mariculture VS exploitation of non-living resources

No conflicts be found in with these two human uses.

Energy production VS exploitation of non-living resources

No conflicts could be found. This is most likely due to the different zones these North Sea users operate in. In the Netherlands the exploitation of non-living resources is concentrated within the 12 nm, and the energy production sector is required to be outside the 12 nm zone (Bode, 2015).

3.3.3.2 THE HUMAN USES THAT ARE COMPATIBLE UNDER CERTAIN CONDITIONS

The human uses that are presented below contain a small conflict. With the right conditions they might be compatible in some way. These can differ for each conflict.

Energy production VS shipping

The International Maritime Organization has set out some of the shipping lanes and separation zones in the North Sea. These shipping lanes exist mostly of international shipping lanes. However, the national shipping lanes are also of importance. The national shipping lane can more easily be changed which can cause a small conflict in terms of the placement of the wind farms as well as for the maintenance. It is of importance to know where the shipping lanes are (Miljodirektoratet, 2013). In the Netherlands ships up to 24m are allowed to go through the offshore windfarms 'Egmond aan zee', 'Prinses Amalia' and 'Luchterduinen' (Noordzeeloket, n.d-a).

Energy production VS military use

The spatial compatibility of energy production and military use is depending on the type of area. For shooting and flight area, the offshore windfarms are possible with some additional safety regulations. It is under no condition possible for mine testing or dumping sites (Jacques, Kreutzkamp, & Joseph, 2011).

Fisheries VS shipping

There can be some conflicts between fisheries and shipping, because the gear can be destroyed by the passing ships. This would be solved as long as the fishers do not go too close to the shipping lanes so they cannot come across each other (Miljodirektoratet, 2013).

Fisheries VS military use

The military areas are a few times per year completely closed off from all the other human uses (Noordzeeloket, n.d.-c). However, due to the large period that the area is still open to fisheries, it counts as compatible under certain conditions.

Fisheries VS nature conservation zones

The management approaches are different for the birds directive (*also known as Special Protection Area - SPA*) and habitat directive areas (*also known as Site of Community Interest - SCI*). In birds directive areas the fisheries are partly closed for pelagic fisheries during the entire year. In areas where the habitat directive is implemented, the fisheries are only allowed to use pelagic gear. They are not allowed to use gear for the demersal fisheries (bottom trawlers, beam trawlers). In the areas where both the birds- and habitat directive are implemented the areas are closed off for all kind of fisheries (European commission, n.d.-a).

Fisheries VS aqua- and mariculture

There are some small conflicts between the fisheries and aquaculture regarding the demersal fisheries. However, they could use the same fishing grounds (Miljodirektoratet, 2013).

Shipping VS military use

The military areas are a few times per year completely closed off from all the other human uses (Noordzeeloket, n.d.-c). However, due to the large period that the area is still open to shipping, it counts as compatible (under certain conditions).

Shipping VS cables and pipelines

Germany: There are no big conflicts regarding the interaction. Only when ships want to drop an anchor. Therefore, it is of utmost importance that it is clear where the cables and pipelines are located (Scibior, n.d).

Shipping VS nature conservation zones

Due to dredging there could be some potential conflicts with the obligation to preserve Natura 2000 sites come up for the habitat directive. For the birds directive it will mostly be in the coastal zones with the estuary (European commission, 2011).

Shipping VS aqua- and mariculture

The level of conflict might increase if aquaculture facilities are sited in more exposed areas, close to established shipping routes. However, current legislation will be sufficient to deal with such problems in the foreseeable future (Miljodirektoratet, 2013).

Oil and gas VS cables and pipelines

It will be important that the oil and gas collaborate. One cannot exist without the other. With a good planning on where the platforms will be built so there is no interaction with the existing cables/ pipelines) (Holmager, 2011). The existing cables and pipelines are no-go zones for new oil and gas platforms (Jacques, Kreutzkamp, & Joseph, 2011).

Oil and gas VS nature conservation zones

The aim is to let the oil and gas industry operate independent. It has a low impact on the North sea. And without spilling oil if and when the platforms are dismantled (Stichting de Noordzee, n.d.).

Military use VS nature conservation zones

The Belgium military authority, in accordance with the Minister of Environmental Affairs, will take all the necessary measures to prevent damage and environmental disturbance, without compromising the effective work of the defense units. There are also exceptions on the prohibition statements concerning the marine nature reserves made for military activities (Derous, n.d).

In Germany, there are important overlaps military areas, sand extraction areas and nature conservation areas (Veum, Cameron, & Hekkenberg, 2012).

Military use VS coastal defense

These areas are for some periods completely closed off from all of the other human uses than the military (Noordzeeloket, n.d.-c). Also coast areas are used (Jacques, Kreutzkamp, & Joseph, 2011).

Military use VS tourism and recreation

The military areas are a few times per year completely closed off from all the other human uses (Noordzeeloket, n.d.-c). However, due to the large period that the area is still open to tourism, it counts as compatible (under certain conditions).

Military use VS aqua-and mariculture

The military areas are a few times per year completely closed off from all the other human uses (Noordzeeloket, n.d.-c). However, due to the large period that the area is still open to mariculture, it counts as compatible (under certain conditions).

Military use VS exploitation of non-living resources

The military areas are a few times per year completely closed off from all the other human uses (Noordzeeloket, n.d.-c). However, due to the large period that the area is still open to extraction of non-living resources, it counts as compatible (under certain conditions).

Military VS oil and gas

The military areas are a few times per year completely closed off from all the other human uses (Noordzeeloket, n.d.-c). However, due to the large period that the area is still open to oil and gas exploration it counts as compatible (under certain conditions).

Cables and pipelines VS coastal defense

In England the cable installation can cause slipway that will result in a temporary exclusion period in the area whilst work is carried out. There are no other adverse impacts to recreation and tourism as a result of the cables (NorthSeaLink, 2018).

Nature conservation zones VS exploitation of non-living resources

For the Dutch part the sand extraction is a limited conflict, since the exploitation will be temporary.

The result of the human uses are compatible under certain conditions

The energy production and shipping have a small conflict with the placement of the energy production because the areas where the wind farms are have a safety zone of 500m around them. But due to new developments. The government of the Netherlands for instance is trying to come up with regulations so it would be possible to go through the wind farms with ships till 24m in certain wind farms (Noordzeeloket, n.d-a). Aquaculture and mariculture also will have a small conflict with the energy production. Only in the installation phase.

Most of the conflicts that are related to the fisheries are in relation to the fishing gear. For instance, with the shipping lanes, gear could become entangled or damaged. Besides the nature the aquaculture and mariculture are also in a conflict due to the placement near the important fishing grounds.

For the military it depends on the timeframe in which the areas are partially or completely closed. For cables there is not any conflict due to no interruption by military uses to the seafloor

The cables and pipelines can have a bit of an impact by the coastal defense because the cables can cause slipways in the coastal defenses.

Most of the extraction of non-living resources are further away from the coastal defense but the impact on the dynamic sand balance will be in a good condition for later exploitation of non-living resources.

In case of the shipping there is no notable conflict between the coming human users. But in case of the interaction between the pipelines and the shipping for instance it will be important that the maps with the cables and pipelines are updated so that there are no interactions between ships at anchor or entering exiting ports and the cables. It is similar to the nature conservation zones. More important is the

conflict that could be with the birds directive zones. In principle should this not be a big conflict due to the regulations that say that there is a safety zone of 500m around the big shipping routes (which are also not close to the big shipping lanes). The same with the safety zone is for the aqua and mariculture. But it would be possible that the conflict increases when the aquaculture and mariculture are close to the shipping lanes.

For the oil and gas it is important that they collaborate well. When there is a cable the oil and gas platforms cannot be placed. But it will still be important that there are cables and pipelines connected to the platform as well.

3.3.3.3 THE HUMAN USES ARE MUTUALLY EXCLUSIVE

The human uses presented below do contain conflicts. These are not able to be in the same spatial area.

Energy production VS Fishing

All of the researched countries see a conflict with the fishing industry and the offshore wind power development. This is because of the safety zones between the turbines, and the cables (Miljodirektoratet, 2013); (Bolongaro, 2017).

Energy production VS oil and gas

Other aspects to consider when planning offshore wind park near oil and gas platforms are requirements for access to the platforms, not only with vessels that supply equipment but also with helicopters. All of these need space to operate and navigate safely (Netherlands Wind Energy Association, 2016). If a wind farm is established, further exploration for and extraction of petroleum resources will be difficult because of the safety zones of 500m for the windfarms as well as the oil and gas (Ministerie van Infrastructuur en Milieu, Ministerie van Economische Zaken, 2014).

Energy production VS cables and pipelines

The existing cables and pipelines are no go zones for new wind production parks (Jacques, Kreutzkamp, & Joseph, 2011).

Energy production VS nature conservation zones

In the Netherlands, Belgium and Germany the nature conservation zones excluded for wind energy production (Jacques, Kreutzkamp, & Joseph, 2011). In the United Kingdom it depends: several companies are allowed to build in these zones (Wood, 2010).

Fisheries VS oil & gas

There are already conflicts between the fisheries and the oil and gas industries for several years. The main conflict is that the installation is often in or near important fishing areas which can cause disturbance with the fishing grounds (Miljodirektoratet, 2013).

Fisheries VS cables and pipelines

There are a lot of conflicts with the demersal fisheries, because the fishing gear can get stuck behind the cables or pipelines. In case of the pelagic fisheries the conflict is less (Drew & Hopper, 2009); (NorthSeaLink, 2018).

Cables and pipelines VS nature conservation zones

Cables are often designated to avoid the most sensitive nature areas, areas with potential reef habitat and birdlife (NorthSeaLink, 2018). In the Netherlands: Under- or above ground installation of cables, pipes and pipes are particularly disruptive in the construction phase. There may be disruption of the soil, loss of habitat, disturbance of animals due to various causes (Ministerie van Landbouw, natuur en voedselkwaliteit, n.d).

Nature conservation zones VS aqua- and mariculture

Proactive spatial planning is essential for successful and sustainable mariculture development, because many of the interactions between aquaculture farms and the surrounding ecosystem vary significantly with

location. These interactions can have strong impacts on both the mariculture operation and on other uses and values in the marine environment; in some instances, ecosystem effects of mariculture can be seen far beyond the footprint of the farm (Gentry, et al., 2017).

Result of the human uses that are mutually exclusive

The results of the conflict analysis shows that there are spatial conflicts between the energy production (mainly wind turbines) and nature conservation, the benthic fisheries, the oil and gas installations and the cable- and pipeline structures. The main issues with these human uses are the safety regulations of 500m around each human activity, as well as the spatial area of the human uses, banning out most other uses. For the benthic fisheries it is also the cable- and pipeline structures that cause a problem. Nature conservation has more impact on the placement of windfarms, since it is not allowed natura2000 areas, due to the disturbance.

The conflict between the fisheries and the oil and gas installations was difficult to categorize, because they do not seem to have a problem whenever the oil and gas installations are operational. The oil and gas installations have a safety zones of 500 meters around them. The fisheries sector does not agree with the sites where oil and gas carry out their explorations, as it closes their important fishing grounds.

The cables and pipelines are usually placed on soil outside nature conservation zones. They cause little to no harm to nature conservation zones. However, the cable and pipelines can start moving with the current after being placed, and could create a bigger impact on nature conservation.

The impact of the aquaculture and mariculture on the nature conservation zone was hard to determine. The impact scored as 'mutually exclusive', due to the significant possibility of high impact that aquaculture can have on the ecosystem.

The oil and gas platforms are excluded out of the nature conservation zones, and have been graded as 'mutually exclusive' however they do not have a big impact on the nature conservation zones.

The combined table below (table 6) shows the outcomes of the conflict analysis. It is clear that there are not that many real conflicts between the uses. The ones that are categorized as 'mutually exclusive' conflicts (3, red) are the ones that cannot be combined in the same area. For human uses that are compatible with certain conditions (2, yellow), combination of uses might be possible. For human uses that are compatible (1, green), the uses can be combined without any problems.

Table 6 Overall conflict analysis numbers

Combined	Energy production	Fishing	Shipping	Oil & gas	Military use	Cables and pipelines	Nature conservation zone	Coastal defence	Tourism and recreation	Aqua- and mari-culture	Exploitation of non-living resources
Energy production											
Fisheries	3										
Shipping	2	2									
Oil & gas	3	3	1								
Military use	2	2	2	2							
Cables and pipelines	3	3	2	2	1						
Nature conservation	2	2	2	2	2	3					
Coastal defence	1	1	1	1	2	2	1				
Tourism and recreation	1	1	1	1	2	1	1	1			
Aqua- and mari-culture	2	2	2	1	2	1	3	1	1		
Exploitation of non-living resources	1	1	1	1	2	1	2	1	1	1	

Table 7: Legend description

Value	Color	Description
1	Green	The human uses are compatible
2	Yellow	The human uses are compatible under certain conditions
3	Orange	The human uses are mutually exclusive
No data	Grey	No data available

The table 13 in appendix V “The conflict analysis with numbers split for each selected country” show the results of the conflict analysis per selected country. It shows that the conflicts for Belgium, Germany, England and the Netherlands are not always the same. This does not mean that there are no conflicts with these human users but it only means that they could not be found. Or that the conflicts were found for another selected country. Due to the fact that the numbers are based on a more general based sources.

3.3.4 CONFLICT ANALYSIS MAPS

The results of the spatial conflicts are displayed per country in map 7 in appendix VIII.

When glancing over the conflict maps it appears that the amount of mutual exclusive user-user conflicts is quite low. This might be due to the fact that a lot of things are already regulated quite well. However the maps are not conflict free. Especially when zoomed in to the coast, numerous small-scale conflicts appear. These reflect the earlier observation of the busy coastal areas perfectly, as it can be reasoned that with the increase of activity, there will be an increase in conflict as well (only if not managed properly). Many of them are concentrated near the boundary of the Dutch-English EEZ, and near the coast of the Dutch EEZ. This might be a result of the combination that fisheries and shipping data take in a large area, and the many other activities that are concentrated there. The ‘compatible under certain conditions’ category takes in a lot more space. Again in the English EEZ it seems most crowded. This is mainly due to the large nature protection areas that exist, but do not have strict regulations regarding most human uses. It appears that many of the cables and pipelines have a conflict with the other areas in the Southern North Sea basin. Another observation that can be made, based on the area calculations (can be found in table 8). England’s

EEZ contains the most areas with mutually exclusive conflicts, however compared to the size of their EEZ it is a much smaller percentage (3.6%). Of overall conflicts it is 26.4%. Germany has almost the same amount of conflicts on half the size of the EEZ. That gives a percentage of 7.3%. The amount of total conflicts is 22.1%. The Dutch EEZ comes in at third place with the areas of mutually conflicts. Relatively, it is only 3,1%. The total conflicts are 13% of the entire Dutch EEZ. The Belgian amount of square km² is 605. This translates to a percentage of 15.6 percent. The overall conflicts rise over 50% on their EEZ.

Table 8: Area calculations per countries

	COUNTRY	CONFLICT AREA(KM ²) OF MUTUALLY EXCLUSIVE	TOTAL CONFLICT AREA(KM ²)	TOTAL EEZ AREA (KM ²)	RELATIVE CONFLICT AREA (CONFLICT AREA OF MUTUALLY EXCLUSIVE/TOTAL EEZ AREA) (IN %)	RELATIVE TOTAL CONFLICT AREA (TOTAL CONFLICT AREA/TOTAL EEZ AREA) (IN %)
1.	Belgium	604.9185	2001.9487	3876.0096	15.6	51.7
2.	England	3351.1122	24586.7247	93034.5348	3.6	26.4
3.	Germany	3200.6223	9758.8627	44122.1799	7.3	22.1
4.	The Netherlands	2109.2312	9101.6177	70019.9597	3.0	13.0

The pie chart below (figure 3) shows the activities with the biggest surface. Fisheries-nature, energy-nature, shipping-nature and nature-cables and pipelines ended up clearly on top. The bottom features are energy-military, fisheries-military, nature-mariculture, shipping-military and exploitation of non-living resources.

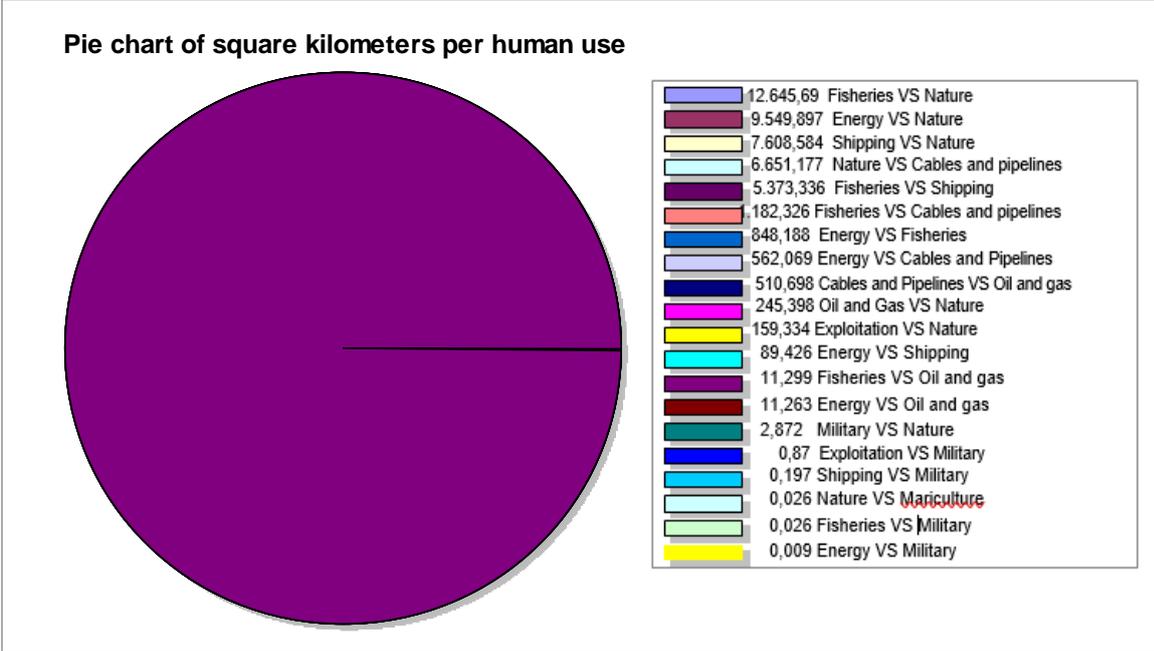


Figure 3: Pie chart of square kilometers per human use

4 DISCUSSION

During the desk study it was necessary to make some hard decision regarding method of data collection and analysis. For the entire research, the question to compare the differences between the conflicts of 2016 and 2021-2030 could not be answered as there was a lack in time and available data.

4.1 THE SPATIAL SITUATION IN THE SOUTHERN NORTH SEA IN THE YEAR 2016

The maps of 2016 do not perfectly display their name. Although it was stated in the methods that the maps were allowed to contain data from 2013 to 2018, not much of the data actually displays information of the situation in 2016. This is because there was so little data available. If there was more time for the gathering of data, efforts could have been made to contact institutions, or gather the data per country, instead of altogether.

The map for 2016 does not contain all human uses that occur in the southern North Sea. A decision was made to only use the classes selected for the conflict analysis. Additionally, data for coastal defense, tourism and recreation, the military area data for the entire basin, pelagic fisheries intensity and alternative renewable energy project were not added, as these datasets could not be found from online sources. An attempt has been made to contact data administrators to make use of their data, but no actual conversation has occurred. Although the map does not depict the exact situation, a positive effect is that it seems less cluttered (especially the coastal area) than could have been.

Additionally, the fisheries and shipping data comes from a raster. The researcher has made the decision, whether based on the original categories, at which swept area ratio the (sub)surface got divided into. It is the same story with the shipping data. The category of density was based on the number of ships that seemed close to the official shipping separation lanes. Due to this, the routes might be a bit broader than the reality.

Not all symbols can be seen properly on the maps, especially the aggregates, dredging, oil and gas symbols. To solve this, the maps have been uploaded onto ArcGIS online. This problem does not occur here, since there is a zoom function.

The reason why some maps seem to have more clarity than others (E.g. Belgium; quite clear, The Netherlands; busy), is due to the differences in extent. A decision could have been made to divide the southern North Sea map up into same size pieces, but that would have cluttered the appendices with unnecessary maps. The solution for this problem was to add the maps to ArcGIS Online so that every piece of the maps can be examined.

4.2 THE SITUATION ON THE SOUTHERN NORTH SEA AFTER THE IMPLEMENTATION OF THE MARITIME SPATIAL PLANS FOR THE TIME PERIOD 2021-2030

This research has been conducted years before the EU deadline for the marine spatial plans of 2021, it should be noted that many countries do not have their spatial plan in order and/or not available for public use. For example, England does not have their spatial plan ready yet and the Netherlands do not have any spatial data available from online sources. With the creation of the maps, only the spatial plans have been considered. Future governmental projects, sectoral plans or any other prospects were supposed to be pointed out, but due to the lack of time this aim has unfortunately not been realized. Due to time constraints England's South offshore and east inshore bare plans could not be added. Eventually, this sub question was probably a bit too ambitious for this research.

4.3 THE COMMON USER-USER CONFLICTS AND OBJECTIVES OF THE HUMAN USERS ON THE SOUTHERN NORTH SEA

To begin with, it was very important to find the right regulations. An effort was made to create a list of spatial regulations per human use, however information from this table originates mainly from Dutch sources. This was because only one regulation was found from outside the Netherlands. There was also only little time to look up the regulations per country. Eventually the spatial regulations were added to the maps of the entire research area.

It took some time to find out where to look for the objectives that each country had set out for the human users of their EEZ. Not all the four researched countries focus on the same human uses. To deal with this problem, and to look forward to analyzing the data for the marine spatial plan overview, it was decided that the human uses of all spatial plan had to be divided into the same classes. This created the problem that some uses were inappropriately grouped together, such as all forms of fisheries, coastal defense and extraction of non-living resources. It would have been resulted in a more valid research if these were combined differently or had been kept separately, however it did save a lot of time because of the reduced classes. In particular the categories: fisheries (which should have ideally split up into demersal, beam trawling, fly shoot, artisanal and pelagic), nature conservation (where a distinction between the SCI, SPA and national protected areas should have been made), the military (which could have been divided into trainings areas, munition dumping sites and shooting areas) and exploitation of non-living resources (which could have split up in dredging, sand and gravel). Because of these categories it was much harder to find organize the discovered information in the conflict analysis table. However, it has been said before that the result is supposed to be a general first overview, which is not necessary to be specific for now. Not all data could be found, which was not originally anticipated. This caused gaps. The class 'energy production' should have contained all sources of renewable energy, but due to the lack of overall data, it was not feasible to add. Additionally, this class should have been called 'renewable energy', as oil and gas also produce energy. The class of 'extraction of non-living resources' should have contained all forms of extraction (including oil and gas), if it would live up to the name.

It was a challenging and sometimes even impossible, task to find the right data for each human activity, as well as for each individual country. Many spaces have been honestly left open, as no data could be found. Another problem of the conflict analysis is that it looks only in one direction. This was necessary to add the data into ArcMap. It would have been a lot more challenging, if not time-consuming if both conflicts needed to be researched and added into a conflict analysis maps.

Due to the lack of data of the conflicts between the human uses, the choice was made to look at older documents than was originally anticipated. Sometimes, the data comes from sources that either only take into account one country on the North Sea in account, or a completely different area outside of the research extent. But this was done within reason. Data might come from the Baltic or Irish sea, but will not cross the borders outside Western Europe.

The grades that were given to the conflicts in the conflict-number tables, are categorized by the researchers. This loses a bit of the transparency, validation and trustworthy of the research. As this method is open for human bias and interpretation differences. There are several conflicts in which it was hard to categorize them with the right number. An example is shipping vs cables and pipelines. It does not have a conflict in general (passing over a cable with a ship does not do much harm), but when a ship makes use of its anchor, it could cause a conflict. A way this could have been solved was to perform the analysis with anchor areas instead of shipping routes. The pie chart of the conflict analysis does not say very much. It is common sense that the areas with a greater surface, have a bigger change to conflict with other areas with big surfaces.

Using Arcmap did not always go as planned. The program was often slow, which took up a lot of time. The extent of the conflict maps doesn't properly display the actual conflicts analyzed.

5 CONCLUSION

This chapter gives an answer to the research question: "What are the spatial conflicts between the human users of the southern North Sea in the year 2016 and potentially during the period of 2021-2030?" It contains the conclusions drawn from the results and the discussion. Below the main interpretations can be found, divided into the sub questions.

5.1 THE SPATIAL SITUATION IN THE SOUTHERN NORTH SEA IN THE YEAR 2016

There are multiple online dataset for the human uses on the North Sea, such as Mapmep, compendium Kust en Zee and Emodned. However, these do not contain all data necessary for this research. There is really a lack of data for all countries. Although there is a common portal, it does not contain all data. This was quite shocking, as it was expected that there would be an abundance of spatial data of every year available. An overview could more or less be created for the Southern part of the North Sea. However, it does not contain all data. The maps appear quite busy, depending on the extent of the EEZ that it's focused on. Especially the coastal areas are very busy. The dense human users near the coast are dredging, aggregating, military activities, mariculture and more or less shipping. Nature, fisheries and shipping are the human uses that seem to take up the biggest surface, covering almost the entire North Sea. The largest amount of oil and gas installations seems to be concentrated in the middle of the maps. The EEZ of German and England seems to relatively be more empty than the EEZ of Dutch and Belgium. But the map of the EEZ of Belgium appears more structured.

5.2 THE SITUATION ON THE SOUTHERN NORTH SEA AFTER THE IMPLEMENTATION OF THE MARITIME SPATIAL PLANS FOR THE TIME PERIOD 2021-2030

No conclusion could be given out from the analysis of the situation in 2020-2030. Only the Belgian spatial plan was available. The German BSH had data available in WMS, however, it was not possible to alter or perform any analysis on them. It was again somewhat unexpected that no spatial data of any kind was available of the other member states.

5.3 THE COMMON USER-USER CONFLICTS AND OBJECTIVES OF THE HUMAN USERS ON THE SOUTHERN NORTH SEA

The main objectives that were found during this study were related to the human activities of the oil and gas installations, the extraction of non-living resources, fisheries and aquaculture and mariculture. The main outcome is that in general the oil and gas industry continues to explore for oil and gas, but will not grow in the coming years. The Netherlands and England want to slowly switch from fossil fuel to renewable energy. For the exploitation of non-living resources, the objective to maintain the number of activities, and the places where they are extracting. For the fisheries sector, the main objective is to let them transition towards a more sustainable way of harvesting fish. Special areas for aquaculture should be established.

The results of the conflict analysis shows that there are spatial conflicts between the energy production - fisheries, energy production-oil and gas, energy production-(mainly wind turbines) and nature conservation, the benthic fisheries, the oil and gas installations and the cable- and pipeline structures. The conflicts that have been categorized as 'mutually exclusive' are of interest to the future, because unless better management or tactics will be introduced, the conflict will remain. These conflicts will mostly

increase during the next years due to the increase of energy production. The conflict between the energy production and shipping will most likely increase. Shipping and energy production only have a small conflict during the construction phase of the energy production, due to the safety zones around the wind farms. But due to new developments the government of the Netherlands is trying to come up with regulations that will make it possible to go through the wind farms with ships up to 24 meter in certain wind farms (Noordzeeloket, n.d-a).

For conflicts between the fisheries and the oil and gas industries it can be harder to predict whether they will increase it in the coming years. The objectives from the marine spatial plans show that the countries are not planning to increase the amount of oil and gas industries in the coming years. That means that the industries will not have as much of a conflict with the fisheries any more.

Some of the conflicts related to the fisheries are in relation to the fishing gear(e.g.: shipping, tourism and recreation, cables and pipelines), but is well regulated with safety zones. This is not the only conflict that has already been well regulated. The conflicts between fisheries and nature conservation zones, and aqua- and mariculture are already well regulated. Therefore, there is no real big conflict.

For the military it depends on the time frame the military areas are partly closed during the year. Only for cables and pipelines do not have a conflict with the military, because they will not be interrupted by the military activities.

In case of the shipping there is no real big conflict between the other human users. In case of the interaction between the pipelines and the shipping it is important that the maps with the cables and pipelines are updated to have no problems when there are ships to get to the ports that want to be on an anchor accidentally place them on top of a cable of pipeline. The same is with the nature conservation zones. But more importantly is the conflict that could be with the bird's directive zones. In principle should this not be a big conflict due to the regulations that say that there is a safety zone of 500m around the big shipping routes (which are also not close to the big shipping lanes). The same with the safety zone for the aqua- and mariculture. But it would be possible that the conflict increases when the aquaculture and mariculture are close to the shipping lanes.

There are certainly some conflicts present in Belgium, the Netherlands, Germany and England. Even though not all human uses are available, it gives an impression of the already conflicting human uses. Although barely visible, most conflicts occur near the coast, where fisheries, dredging, aggregates, nature and shipping all intersect. Pipelines and cables seem to jump out as areas with lots of conflicts, mainly when intersecting with nature, fisheries areas and windfarms. .

The EEZ where the conflicts are most concentrated is England. That is probably due to the small area that they have for their activities to take place. Fisheries-nature, energy-nature, shipping-nature and nature-cables and pipelines ended up clearly on top of biggest conflict surface. The bottom features are energy-military, fisheries-military, nature-mariculture, shipping-military and exploitation of non-living resources ended up at last place. This is most likely due to the differences in surface area.

6 RECOMMENDATIONS

This research was done in a short amount of time, and could not contain everything that should be research. It is advised that in a future research the following aspects get included:

It is important to look to an entire North Sea basin and not only to focus on one country. When this gets researched, it is important to look at the differences in management, conflicts, objectives and human uses per country. This is to better understand the impact of the national governance.

As soon as all data is available, an overview map of the marine spatial plans and sectoral plans should be created to give an essential overview of the maritime spatial plans on the North Sea. Every government, sector and individual should have access to these maps. Additionally, more data should be made available of the human users on the North Sea. Organizations such as the English MMO and the Dutch IHM, do have data available, but the it is sometimes outdated or not properly maintained. Initiatives as EMODnet should continue to add more data, as time passes. Also central governments could provide a service to show the distribution of activities and to encourage transparency to its citizens.

It would be interesting to see what would happen if you would ask the human North Sea users in how they see the conflicts. Or what conflicts will come up. Having more contacts and voices in a research like this will only strengthen the result. It can also help with gathering data.

In terms of the conflicts, not the entire water column was considered consequently in this research. Nor was the period or the fixed-temporal element added to the conflict analysis. It would be useful to divide the conflicts in temporal-fixed and vertical conflict/horizontal conflicts in a future research of this kind.

To really understand the activities on the North Sea, the user-user conflicts and the user-environment conflicts should combined in a follow-up research to create cumulated impact assessments.

This study should be repeated on a greater and more professional scale to map out every human use (especially pelagic fisheries data) and its spatial conflicts. There are so many spatial conflicts that could become clear by mapping them out in an organized, complete and comprehensible way. To know in advance what the spatial conflicts are, could prevent rash and unsubstantiated governmental decisions and could help bring order to the crowded North Sea.

7 REFERENCES

- Bode, C. (2015). Energy Extraction From Wind: Marine Re-territorialization in the North Sea. *Scenario Journal*(5). Retrieved 05 23, 2018, from <https://scenariojournal.com/article/energy-extraction-from-wind/>
- Bolongaro, K. (2017, 12 29). *Fishermen and wind farms struggle to share the sea*. Retrieved 05 16, 2018, from Politico: <https://www.politico.eu/article/fishermen-offshore-wind-farms-struggle-to-share-sea/>
- Bundesamt für Seeschifffahrt und Hydrographie. (2009). *Spatial Plan for the German Exclusive Economic Zone in the North Sea*. Hamburg: Bundesamt für Seeschifffahrt und Hydrographie. Retrieved 04 28, 2018, from http://www.bsh.de/en/Marine_uses/Spatial_Planning_in_the_German_EEZ/documents2/Spatial_Plan_North_Sea.pdf
- Degnbol, D., & Wilson, D. C. (2008, 03 23). Spatial planning on the North Sea: A case of cross-scale linkages. *Marine Policy*, 32(2), 189-200. Retrieved 03 20, 2018, from <https://www.sciencedirect.com/science/article/pii/S0308597X0700111X>
- Derous, S. (n.d). *GAUFRE: Towards a spatial structure plan for the Belgian part of the North Sea*. Retrieved 05 15, 2018, from www.vliz.be/imisdocs/publications/76052.pdf
- Douvere, F., & Ehler, C. N. (2009). New perspectives on sea use management: Initial findings from European experience with marine spatial planning. *Journal of Environmental Management*, 90(1), 77-88. Retrieved 04 12, 2018, from <https://www.sciencedirect.com/science/article/pii/S0301479708001606>
- Drew, S. C., & Hopper, A. G. (2009). *FISHING AND SUBMARINE CABLES*. Retrieved 05 24, 2018, from <https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0ahUKEwjlgZvGspzbAhUCPFAKHZiODrsQFggoMAA&url=https%3A%2F%2Fwww.iscpc.org%2Fdocuments%2F%3Fid%3D142&usg=AOvVaw3HfLGY113bG1r4AvqL7soo>
- EMODnet. (2011). *Your gateway to Marine Data in Europe*. Retrieved 04 5, 2018, from http://www.emodnet.eu/sites/emodnet.eu/files/public/pamflet/EMODnet_leaflet_Jan14_lores.pdf
- European Commission. (2011, January). *The implementation of the Birds and Habitats Directives in estuaries and coastal zones*. Retrieved 05 18, 2018, from http://ec.europa.eu/environment/nature/natura2000/management/docs/guidance_doc.pdf
- European Commission. (n.d.-a). *Natura 2000 in the Marine Environment*. Retrieved 05 17, 2018, from Environment: http://ec.europa.eu/environment/nature/natura2000/marine/index_en.htm
- European Commission. (2017). *Report on the Blue Growth Strategy towards more sustainable growth and jobs in the blue economy*. Brussels: European Commission. Retrieved 04 25, 2018, from https://ec.europa.eu/maritimeaffairs/sites/maritimeaffairs/files/swd-2017-128_en.pdf
- European Commission. (n.d. -b). *Blue Growth*. Retrieved 04 5, 2018, from Maritime Affairs: https://ec.europa.eu/maritimeaffairs/policy/blue_growth_en

- European Parliament. (2014). Directive 2014/89/EU of the European Parliament and of the council; Establishing a framework for maritime spatial planning. *Official Journal of the European Union*. Retrieved 04 5, 2018, from http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2014.257.01.0135.01.ENG
- European Union Committee. (2015). *The North Sea under pressure: is regional marine co-operation the answer? - European Union*. European Union Committee, London. Retrieved 04 05, 2018, from <https://publications.parliament.uk/pa/ld201415/ldselect/ldcom/137/13704.htm>
- Federal public service Health, Food chain safety and environment. (2014). *Marine Spatial Plan for the Belgian part of the North Sea*. Brussels: Federal public service Health, Food chain safety and environment. Retrieved 03 5, 2018, from https://www.health.belgium.be/sites/default/files/uploads/fields/fpshealth_theme_file/19094275/Summary%20Marine%20Spatial%20Plan.pdf
- Gentry, R. R., Lester, S. E., Kappel, C. V., White, C., Bell, T. W., Stevens, J., & Gaines, a. S. (2017). Offshore aquaculture: Spatial planning principles for sustainable development. *Ecology and Evolution*, 7(2), 733-743. doi:10.1002/ece3.2637
- HM Government. (2011). *UK Marine Policy statement*. The stationery Office. London: TSO. Retrieved 05 18, 2018, from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69322/pb3654-marine-policy-statement-110316.pdf
- Hoefsloot, N., Pater, M. d., Gent, D. v., & Boer, S. d. (2016). *Regionale effecten windmolenparken op zee*. Retrieved 05 13, 2018, from <https://www.rijksoverheid.nl/documenten/rapporten/2016/02/12/regionale-effecten-windmolenparken-op-zee>
- Holmager, M. (2011). *Cooperation between the offshore wind industry and Offshore Wind Construction and Installation*. Retrieved 04 30, 2018, from <http://www.offshorecenter.dk/filer/files/OCD%20nyheder/2011/20110208.pdf>
- ICES. (2004). Marine ecoregions. *Marine Regions*. ICES. Retrieved 02 12, 2018, from <http://gis.ices.dk/sf/index.html>
- ICES. (n.d.). *Action Areas*. Retrieved 04 16, 2018, from ICES: <http://www.ices.dk/explore-us/Action%20Areas/Pages/Integrated-ecosystem-assessments.aspx>
- IOC-UNESCO. (n.d -a). *UK (England)*. Retrieved 03 14, 2018, from Marine Spatial Planning Programme: <http://msp.ioc-unesco.org/world-applications/europe/uk/england/>
- IOC-UNESCO. (n.d -c). *Germany (North/Baltic Seas)*. Retrieved 03 14, 2018, from Marine Spatial Planning Programme: <http://msp.ioc-unesco.org/world-applications/europe/germany/northbaltic-seas/>
- IOC-UNESCO. (n.d -d). *Belgium*. Retrieved 03 14, 2018, from Marine Spatial Planning Programme: <http://msp.ioc-unesco.org/world-applications/europe/belgium/>
- IOC-UNESCO. (n.d. -b). *The Netherlands*. Retrieved 03 14, 2018, from Marine Spatial Planning Programme: <http://msp.ioc-unesco.org/world-applications/europe/the-netherlands/>

- Jacques, S., Kreutzkamp, P., & Joseph, P. (2011). *Seanergy 2020 Offshore Renewable Energy and Maritime Spatial Planning*. Retrieved 05 30, 2018, from http://www.seanergy2020.eu/wp-content/uploads/2011/11/111020_Seanergy2020_Deliverable3.2_Final.pdf
- Jay, S. (2017). *Marine Spatial Planning; assessing net benefits and improving effectiveness*. OECD. Liverpool: University of Liverpool. Retrieved 04 08, 2018, from https://www.oecd.org/greengrowth/GGSD_2017_Issue%20Paper_Marine%20Spatial%20Planning.pdf
- Jentoft, S., & Knol, M. (2014, 01). Marine spatial planning: risk or opportunity for fisheries in the North Sea? *Maritime Studies*, 12(1), 13. Retrieved 04 12, 2018, from <https://link.springer.com/article/10.1186/2212-9790-12-13>
- Kannen, A. (2014, 12). Challenges for marine spatial planning in the context of multiple sea uses, policy arenas and actors based on experiences from the German North Sea. *Regional Environmental Change*, 14(6), 2139-2150. Retrieved 04 25, 2018, from <https://link.springer.com/article/10.1007/s10113-012-0349-7>
- Marine Management Organisation. (2017, 12 4). MMO Marine Plan Areas. *Marine Management Organisation Marine Plan Areas*. Retrieved 02 20, 2018, from <https://data.gov.uk/dataset/marine-management-organisation-marine-plan-areas1>
- Miljødirektoratet. (2013). *Scientific basis for an integrated management plan for the North sea and Skagerrak*. Retrieved 05 12, 2018, from <http://www.miljodirektoratet.no/old/klif/publikasjoner/2929/ta2929.pdf>
- Ministerie van Infrastructuur en Milieu & Ministerie van Economische Zaken. (2015). *Nationaal Water plan 2016-2021*. Den Haag. Retrieved 05 12, 2018, from <https://www.rijksoverheid.nl/documenten/beleidsnota-s/2015/12/14/nationaal-waterplan-2016-2021>
- Ministerie van Infrastructuur en Milieu, Ministerie van Economische Zaken. (2014). *Rijksstructuurvisie*. Den Haag. Retrieved 05 15, 2018, from <https://www.google.nl/url?sa=t&rct=j&q=&esrc=s&source=web&cd=3&cad=rja&uact=8&ved=0ahUKEwi-k53issPaAhVE46QKHWerABcQFggzMAI&url=https%3A%2F%2Fwww.rijksoverheid.nl%2Fbinaries%2Frijksoverheid%2Fdocumenten%2Fbeleidsnota-s%2F2014%2F09%2F26%2FRijksstructuurvisie>
- Ministerie van Landbouw, natuur en voedselkwaliteit. (n.d). *Effectenindicator*. Retrieved 04 30, 2018, from *Beschermende natuur in Nederland: soorten en gebieden in wetgeving en beleid*: <https://www.synbiosys.alterra.nl/natura2000/effectenindicatorappl.aspx?selectGebied=164&selectActiviteit=Kabelsenleidingen&submit=Toon+effecten&subj=effectenmatrix>
- Nederlandse vissersbond. (2016, 12 8). *Akkoord garnalenvisserij kustzone*. Retrieved 05 12, 2018, from *Nederlandse vissersbond*: <https://www.vissersbond.nl/akkoord-garnalenvisserij-kustzone/>
- Netherlands Wind Energy Association. (2016). *NWEA Visie 2030*. Utrecht. Retrieved 04 11, 2018, from <http://www.nwea.nl/images/PDFs/NWEA-Visie-2030.pdf>
- Noordzeeloket. (n.d. -e). *Baggerspecie*. Retrieved 05 12, 2018, from *Noordzeeloket*: <https://www.noordzeeloket.nl/functies-en-gebruik/baggerspecie/>

- Noordzeeloket. (n.d.-b). *Development of the 2030 North Sea Strategy*. Retrieved 05 15, 2018, from Website Noordzeeloket: <https://www.noordzeeloket.nl/en/policy/development-2030/>
- Noordzeeloket. (n.d.-c). *Militair gebruik*. Retrieved 04 30, 2018, from Noordzeeloket: <https://www.noordzeeloket.nl/functies-en-gebruik/militair-gebruik/>
- Noordzeeloket. (n.d.-d). *Visserij*. Retrieved 05 14, 2018, from Noordzeeloket: <https://www.noordzeeloket.nl/functies-en-gebruik/visserij/>
- Noordzeeloket. (n.d.-f). *Kabels en leidingen*. Retrieved 05 24, 2018, from Noordzeeloket: <https://www.noordzeeloket.nl/functies-en-gebruik/kabels-leidingen/>
- Noordzeeloket. (n.d.-a). *Doorvaart en medegebruik*. Retrieved 05 30, 2018, from Noordzeeloket: <https://www.noordzeeloket.nl/functies-en-gebruik/windenergie/doorvaart/>
- NorthSeaLink. (2018). *Marine impact in the UK*. Retrieved 05 16, 2018, from NorthSeaLink: <http://northsealink.com/en/cables/marine-impact-in-the-uk/>
- NorthSEE. (n.d.). *Transnational energy cooperation between North Sea countries*. Retrieved 13 06, 2018, from NorthSEE: <http://www.northsearegion.eu/northsee/e-energy/transnational-energy-cooperation-between-north-sea-countries/>
- Phua, C., Akker, S. V., Barretta, M., & Dalfsen, J. v. (2002). *Ecological Effects of Sand Extraction in the North Sea*. Retrieved 05 24, 2018, from http://www.google.nl/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0ahUKewiG4szsIK3bAhVI_qQKHbAqC7IQFggUAAA&url=http%3A%2F%2Fwww.vliz.be%2Fimisdocs%2Fpublications%2F154975.pdf&usq=AOvVaw3OZ9kc7KEXSenpDlnXoS8P
- Ruig, J. d. (1998). Coastline management in The Netherlands: human use versus natural dynamics. *Journal of Coastal Conservation*, 4(2), 127-134. doi:10.1007/BF02806504
- RVO. (2015). *Windenergie op Zee realisatie*. Retrieved 05 15, 2018, from https://www.rvo.nl/sites/default/files/2016/04/A4-Posters%20Rijk_WoZ_februari%202016.pdf
- Schaefer, N., & Barale, V. (2011, 05 03). Maritime spatial planning: opportunities & challenges in the framework of the EU integrated maritime policy. *Journal of Coastal conservation*, 15(2), 237-245. Retrieved 03 20, 2018, from <https://link.springer.com/article/10.1007/s11852-011-0154-3>
- Schulze, T., Saurel, C., Vazquez, F., Grati, F., Gramolini, R., Sell, A., . . . Kloppmann, M. (2013). *COEXIST: Interaction in coastal waters: A roadmap to sustainable integration of aquaculture and fisheries*. Thünen Institute of Sea Fisheries. Retrieved 05 12, 2018, from http://www.coexistproject.eu/images/COEXIST/Tools/ConflictScores_FINAL.pdf
- Scibior, K. (n.d). *Main potentials and conflicts in the German sea space*. Retrieved 05 20, 2018, from http://www.vasab.org/east-west-window/documents/WG3_MainPotentialsConflicts_Germany.pdf
- Stelzenmüller, V., Schulze, T., Gimpel, A., Bartelings, H., Bello, E., Bergh, O., . . . Verner- Jeffreys, D. (2013). *Guidance on a Better Integration of Aquaculture, Fisheries, and other Activities in the Coastal Zone: From tools to practical examples*. COEXIST Project. doi:<http://doi.org/ISBN:978-0-9926602-0-8>

- Stichting de Noordzee. (n.d.). *Olie- en gaswinning*. Retrieved 05 12, 2018, from Stichting de Noordzee: <https://www.noordzee.nl/olie-en-gaswinning>
- Tettero, S. (2017, 02 08). *De nieuwe scheepsvaartroutes langs de Noordzeekust*. Retrieved 05 11, 2018, from Zeilen: <https://www.zeilen.nl/nieuws/nieuwe-scheepvaartroutes-belgische-nederlandse-noordzeekust/>
- The crown estate. (n.d. -b). *Cables and pipelines*. Consulté le 05 23, 2018, sur The crown estate: <https://www.thecrownestate.co.uk/energy-minerals-and-infrastructure/cables-and-pipelines/>
- The crown estate. (n.d.-a). *Aggregates*. Retrieved 05 23, 2018, from The crown estate: <https://www.thecrownestate.co.uk/energy-minerals-and-infrastructure/aggregates/>
- The crown estate. (n.d.-c). *Tourism*. Retrieved 05 23, 2018, from The crown estate: <https://www.thecrownestate.co.uk/rural-and-coastal/tourism/>
- The crown estate. (n.d.-d). *What we do*. Retrieved 05 23, 2018, from The crown estate: <https://www.thecrownestate.co.uk/energy-minerals-and-infrastructure/natural-gas-storage/>
- UNESCO. (2017, June). *Status of MSP*. Retrieved 04 5, 2018, from http://msp.ioc-unesco.org/world-applications/status_of_msp/
- van Tatenhove, J. P., & van Leeuwen, J. (2015). Marine Governance of the North Sea: Patterns of Regionalization. In M. Gilek, K. Kern, & K. K. Michael Gilek (Ed.), *Governing Europe's Marine Environment; Europeanisation of Regional Seas or Regionalization of EU policies* (pp. 183-202). Ashgate Publishing. Retrieved 02 15, 2018, from https://www.researchgate.net/publication/272150632_Marine_Governance_of_the_North_Sea_Patterns_of_Regionalization
- Veum, K., Cameron, L., & Hekkenberg, M. (2012). *Assessment of spatial demands in European sea basins*. Retrieved 05 12, 2018, from http://www.seanergy2020.eu/wp-content/uploads/2012/07/120713_Seenergy_D4-2_Spatial_Demand.pdf
- Wageningen University & research. (n.d). *The case of Tourism & natural resources*. Retrieved 05 13, 2018, from Wageningen University & research: <https://www.wur.nl/en/Education-Programmes/master/MSc-programmes/MSc-Leisure-Tourism-and-Environment/Read-more-about/Tourism-Natural-Resources.htm>
- Wood, A. (2010). *Making space for renewable energy: assessing on-shore wind energy development*. Natural England. Retrieved 05 12, 2018, from <http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&ved=0ahUKEwiE-NCY0qrbAhVGwxQKHUOZD8oQFgg4MAE&url=http%3A%2F%2Fpublications.naturalengland.org.uk%2Ffile%2F97013&usq=AOvVaw2hUxECTnKDY6dUmjOxgCnx>
- Yttervik, W. H., Ostvik, I., Jimenez, C., Impelluso, T., Schouten, J., & Belloti, G. (2015). *A case study of multi-use platform: Aquaculture in offshore wind farms*. Copenhagen. Retrieved 05 24, 2018, from http://www.vliz.be/projects/mermaidproject/images/PDFs/EWEA_PO054_FinalSubmission15022015.pdf

APPENDIX I MSP PLANS PER COUNTRY

Table 9: MSP information per southern North Sea countries.

General information per land about the MSP plans						
Country	Authorities (responsible for MSP)	Status	Revision of the plans	Drivers	Legislaton	publication
Belgium	Ministry of Environment (UNESCO, IOC, n.d.-d)	3rd cycle (UNESCO, IOC, n.d.-d)	6 years (UNESCO, IOC, n.d.-d)	The EEZ of Belgium has already been heavily over-used. The key driver for Belgium is finding space for wind farms, sand and gravel mining, and marine conservation areas. (UNESCO, IOC, n.d.-d)	The Belgian EEZ Act of 1999 and the Marine Protection Act of 1999; a Royal decree on MSP is being prepared. (UNESCO, IOC, n.d.-d)	2014 (UNESCO, IOC, n.d.-d)
England	Marine Management Organisation (MMO) (UNESCO, IOC, n.d.-a)	Non (UNESCO, IOC, n.d.-a)	More than every 5 years (UNESCO, IOC, n.d.-a)	For England the new and emerging uses of the marine area, e.g., wind energy, aquaculture; Climate Protection Policy are key drivers to come up with a MSP plan. (UNESCO, IOC, n.d.-a)	National legislation (Marine and Coastal Access Act of 2009) (UNESCO, IOC, n.d.-a)	Not published (UNESCO, IOC, n.d.-a)
Germany	German Federal Maritime and Hydrographic Agency (BSH) (UNESCO, IOC, n.d.-c)	1st cycle (UNESCO, IOC, n.d.-c)	Every 3 years (UNESCO, IOC, n.d.-c)	Germany is in need for a more integrated approach to deal with new and emerging uses of the marine area, e.g., wind energy, aquaculture; Marine conservation or biodiversity concerns; Further more transparency in marine decision-making for coastal stakeholders. More future perspective. Perceived conflicts between uses and nature conservation, e.g., marine protected areas; e.g., marine mining v. fishing; (UNESCO, IOC, n.d.-c)	Federal Spatial Planning Act of 1997 and 2004 amendments establishing spatial plans for the EEZ (UNESCO, IOC, n.d.-c)	2009 (UNESCO, IOC, n.d.-c)
The Netherlands	Interdepartmental Directors' Consultative Committee North Sea or (Interdepartementaal Directeurenoverleg Noordzee—IDON) led by the Ministry of Infrastructure and Water Management (UNESCO, IOC, n.d.-b)	2rd cycle (UNESCO, IOC, n.d.-b)	6 years (UNESCO, IOC, n.d.-b)	A key driver for the Netherlands to come with MSP is because of space conflicts between projected wind farms, sand and gravel extraction, marine transport, port development, nature conservation, and climate change (UNESCO, IOC, n.d.-b)	Within the Netherlands Initiative of the Central Government of the Netherlands (UNESCO, IOC, n.d.-b)	2015 (UNESCO, IOC, n.d.-b)

Table 10: GIS data for 2012-2016

GIS data for 2012 - 2016													
	Belgium			Germany			England				The Netherlands		
	Option 1	Option 2	Option 3	Option 1	Option 2	Option 3	Option 1	Option 2	Option 3	Option 4	Option 1	Option 2	Option 3
Energy production	EmodNed	Kis-orca.eu**	MapMep	geoportal.de	geoseaportal.de	MapMep	Kis-orca.eu**	DECC*	MMO	MapMep	Kis-orca.eu**	MapMep	IHM
Fossil fuel/ CO2 storage	EmodNed	Kis-orca.eu**	~	geoportal.de	geoseaportal.de	~	Kis-orca.eu**	DECC*	MMO	Oil and gas	Kis-orca.eu**	~	Noordzeeloket
Exploitation of non-living resources	EmodNed	Kis-orca.eu**	~	geoportal.de	geoseaportal.de	~	Kis-orca.eu**	~	MMO	~	Kis-orca.eu**	~	IHM
Fisheries	ICES data?	~	~	geoportal.de	ICES data?	~	ICES datasets	~	MMO	~	ICES data?	~	IHM
Aquaculture Mariculture	EmodNed	~	~	geoportal.de	~	~	~	~	MMO	~	~	~	~
Marine Conservation zones	EmodNed	~	~	geoportal.de	~	~	~	~	MMO	~	~	~	IHM
Shipping	EmodNed	~	~	geoportal.de	geoseaportal.de	~	~	~	MMO	~	~	~	IHM
Military	EmodNed	~	~	geoportal.de	geoseaportal.de	~	~	~	MMO	~	~	~	IHM
Pipelines and submarine cables	EmodNed	Kis-orca.eu**	~	geoportal.de	geoseaportal.de	Kis-orca.eu**	Kis-orca.eu**	~	MMO	~	Kis-orca.eu**	~	IHM
Tourism/ recreation	EmodNed	~	~	geoportal.de	~	~	~	~	MMO	~	~	~	~

* Not very clear

** Seems not downloadable, contact them.

APPENDIX III: GIS METHODS

In some cases, steps have been combined (grey background), as the tool was executed as 'batch' (meaning tool repeated multiple times per feature).

Table 11 : GIS method maps 2016 and conflict analysis

GIS Method				
Method creating maps for 2016				
Step	Input Features	Tool	Settings	Output
1	MMO_Marine_Plan_Areas	Select	Expression; "INFO"='South offshore' OR "INFO"='South Inshore' OR "INFO"='East inshore' OR "INFO"='East offshore' OR "INFO"='South Seast inshore'	England_EEZ_NorthSea.shp
2	Eez_v10	Select	"GeoName"='Dutch Economic Zone' OR "GeoName"='German Economic Zone' OR "GeoName"='Belgian Economic Zone'	Selected_coutries_EEZ
3	Selected_countries_EEZ England_EEZ_NorthSea	Union		EEZ_Selected_countries
4	ICES_ecoregions_20171207_erase_ESRI	Select	"Ecoregion"='Greater North Sea'	Greater_NorthSea
5	Greater_NorthSea EEZ_Selectedcountries	Intersect		Research__area
6	Bottom Fishing Intensity - Subsurface Bottom Fishing Intensity - Surface	???		Fisheries_bottom
7	Fisheries_bottom	Add Field(2x) Calculate field(2x)	"Bottom_fisheries" – Long integer "Bottom_fisheries"=Subsurface + SurfaceSAR	Fisheries
8	SIGCables_Submarine_Cables_Routes Cables_schematic_20170801	Merge		Cables
9	Emodnet_HA_Environment_End_2016_2017_0510	Select	"SITEDESC"='SCI(special conservation Interest)' OR "SITEDESC"='SPA (Special Protection Areas)' OR "SITEDESC"='BOTH SPA and SCI'	Natura2000
10	Shipping_2013(tiff.)	Int		Shipping_raster
11	(Batch) Fisheries Emodnet_HA_Wind_farms_20180115 Emodnet_HA_Dredging_20170615 Landing_stations_schematic_20170801	Clip (11x)	(Clip feature) Research__area	Fisheries_clip Clip_windfarms Clip_Dredging_areas Clip_Landing_stations Clip_military_area

	Emodnet_HA_Munition_pg_20180123 Emodnet_HA_Aggregates_20170620 Emodnet_HA_HE_Pipelines Emodnet_HA_Offshore_Installations Emodnet_Human_Activities_Shellfish_Areas_WGS84 Shipping_raster Natura2000			Clip_Aggregate_areas Clip_pipelines Clip_Oilngas Clip_Mariculture Ship Clip_Natura2000 Clip_cables
12	Clip_windfarms	Select	"STATUS"= 'Operational' OR "STATUS"= 'Under Construction' OR "STATUS"='Production'	Windfarms
Method Conflict analysis				
Step	Input features	Tool	Settings	Output
1	Clip_cables Clip_pipelines	Merge		Cables_pipelines
2	Clip_aggregates_areas Clip_dredging_areas	Merge		Non_living_resources
3	Ship	Rastercalculat or (2x)	1: (float)ship=>20000 2: (float)ship=>11000 & <20000	Shippingseperationzones
4	Shippingseperationzones	Raster to polygon	Field: "Count"	Shippingroutes
5	(Batch) Cables_pipelines Clip_mariculture Clip_oilngas Clip_Non_living_resources	Buffer(4x)	1: Linear unit: 500m; end type: ROUND; Method;PLANAR 2: Linear unit: 50m end type: ROUND; Method;PLANAR 3: Linear unit: 500m ; end type: ROUND; Method;PLANAR 4: Linear unit: 500m ; end type: ROUND; Method;PLANAR	Cables_pipelines_safetyzone Mariculture_safetyzone Oilngas_safetyzone Nonlivingresources_safetyzone
6	(Batch) Shippingroutes Fisheries_clip Oilngas_safetyzone Clip_military_area Cables_pipelines_safetyzone Mariculture_safetyzone Natura2000	Intersect(7x)	(Second intersect-feature) Windfarms	Windfarms_shippingroutes Windfarms_fisheries Windfarms_oilngas Windfarms_military_area Windfarms_cablesnpipelines Windfarms_mariculture Windfarms_nature

7	(Batch) Shippingroutes Oilngas_safetyzone Clip_military_area Cables_pipelines_safetyzone Natura2000 Mariculture_safetyzone	Intersect(6X)	(Second intersect-feature) Fisheries	Fisheries_shipping Fisheries_oilngas Fisheries_military Fisheries_pipelines Fisheries_Natura2000 Fisheries_Mariculture
8	(Batch) Clip_military_area Cables_pipelines_safetyzone Natura2000 Mariculture_safetyzone	Intersect(4)	(Second intersect-feature) Shippingroutes	Shipping_Military Shipping_cablespipelines Shipping_Natura2000 Shipping_Mariculture
9	(Batch) Clip_military_area Cables_pipelines_safetyzone Natura2000	Intersect(3)	(Second intersect-feature) Oilngas_safetyzones	Oilngas_military Oilngas_cablespipelines Oilngas_Natura2000
10	(Batch) Natura2000 Mariculture_safetyzone Nonlivingresources_safetyzone	Intersect(3)	(Second intersect-feature) Military	Military_nature Military_Safetyzone Military_nonlivingresources
11	Natura2000 Cablespipeline_safetyzone	Intersect		Cablespipeline_Nature
12	(Batch) Mariculture_safetyzone Nonlivingresources_safetyzone	Intersect(2)	(Second intersect-feature) Natura2000	Nature_mariculture Nature_nonlivingresources
13	(Batch) Windfarms_shippingroutes Windfarms_oilngas	Add Field + Calculate Field(7x)	Field: "Conflicts" – Long Integer Expression:3	Same as input

	<p>Windfarms_cablesnpipelines</p> <p>Fisheries_oilngas</p> <p>Fisheries_pipelines</p> <p>Cablespipeline_Nature</p> <p>Nature_mariculture</p>			
14	<p>(Batch)</p> <p>Windfarms_shippingroutes</p> <p>Windfarms_military_area</p> <p>Windfarms_mariculture</p> <p>Windfarms_nature</p> <p>Fisheries_shipping</p> <p>Fisheries_military</p> <p>Fisheries_Natura2000</p> <p>Fisheries_Mariculture</p> <p>Shipping_Military</p> <p>Shipping_cablesnpipelines</p> <p>Shipping_Natura2000</p> <p>Shipping_Mariculture</p> <p>Oilngas_military</p> <p>Oilngas_cablesnpipelines</p> <p>Oilngas_Natura2000</p> <p>Military_nature</p> <p>Military_Safetyzone</p> <p>Military_nonlivingresources</p> <p>Nature_nonlivingresources</p>	<p>Add Field + Calculate Field (19x)</p>	<p>Field: "Conflicts" – Long Integer</p> <p>Expression: 2</p>	<p>Same as input</p>
15	<p>Windfarms_shippingroutes</p> <p>Windfarms_fisheries</p> <p>Windfarms_oilngas</p> <p>Windfarms_military_area</p> <p>Windfarms_cablesnpipelines</p> <p>Windfarms_mariculture</p> <p>Windfarms_nature</p> <p>Fisheries_shipping</p> <p>Fisheries_oilngas</p> <p>Fisheries_military</p> <p>Fisheries_pipelines</p>	<p>Add Field + Calculation</p>	<p>Field: "Activities" – Text</p> <p>Expression: "Windfarms_shippingroutes" "Windfarms_fisheries" "Windfarms_oilngas" "Windfarms_military_area" "Windfarms_cablesnpipelines" "Windfarms_mariculture" "Windfarms_nature" "Fisheries_shipping" "Fisheries_oilngas"</p>	

	Fisheries_Natura2000 Fisheries_Mariculture Shipping_Military Shipping_cablespipelines Shipping_Natura2000 Shipping_Mariculture Oilgas_military Oilgas_cablespipelines Oilgas_Natura2000 Military_nature Military_Safetyzone Military_nonlivingresources Cablespipeline_Nature Nature_mariculture Nature_nonlivingresources		"Fisheries_military" "Fisheries_pipelines" "Fisheries_Natura2000" "Fisheries_Mariculture" "Shipping_Military" "Shipping_cablespipelines" "Shipping_Natura2000" "Shipping_Mariculture" "Oilgas_military" "Oilgas_cablespipelines" "Oilgas_Natura2000" "Military_nature" "Military_Safetyzone" "Military_nonlivingresources" "Cablespipeline_Nature" "Nature_mariculture" "Nature_nonlivingresources"	
16	Windfarms_shippingroutes Windfarms_fisheries Windfarms_oilgas Windfarms_military_area Windfarms_cablesnpipelines Windfarms_mariculture Windfarms_nature Fisheries_shipping Fisheries_oilgas Fisheries_military Fisheries_pipelines Fisheries_Natura2000 Fisheries_Mariculture Shipping_Military Shipping_cablespipelines Shipping_Natura2000 Shipping_Mariculture Oilgas_military Oilgas_cablespipelines Oilgas_Natura2000	Merge	Fields: "Activities"; Conflicts	Combined_activities

	Military_nature Military_Safetyzone Military_nonlivingresources Cablespipeline_Nature Nature_mariculture Nature_nonlivingresources			
17	Combined_conflicts Research__area	Union		Conflict_analysis_final
18	Conflict_analysis	Select by Attribute + Calculate Field	Expression selection: 'Conflicts'=' ' Expression calculate field: 1	

APPENDIX IV: CONFLICT ANALYSIS

Table 12 : Conflict analysis

Conflicts	Energy production	Fisheries	Shipping	Oil and gas	Military use	Cables & pipelines	Nature conservation	Coastal defense	Tourism and recreation	Aquaculture and mariculture
Energy production										
Fisheries	All of the researched countries see a conflict with the fishing industry and the offshore wind power development. This is because of the safety zones between the turbines, and the cables (Miljodirektoratet, 2013) (Bolongaro, 2017).									
Shipping	The International Maritime Organization has set out some of the shipping lanes and separation zones in the North Sea. These shipping lanes exist mostly of international shipping lanes. However, the national shipping lanes are also of importance. The national shipping lane can more easily be changed which can cause a small conflict in terms of the placement of the wind farms as well as for the maintenance. It is of importance to know where the shipping lanes are (Miljodirektoratet, 2013). In the Netherlands ships up to 24 m are allowed to go through the offshore windfarms	There can be some conflicts between fisheries and shipping, because the gear can be destroyed by the passing ships. This would be solved as long as the fishers do not go to close to the shipping lanes so they cannot come across each other (Miljodirektoratet, 2013).								
Oil and gas	Netherlands: Other aspects to consider when planning offshore wind park near oil and gas platforms are requirements for access to the platforms, not only with vessels that supply equipment but also with helicopters. All of these need space to operate and navigate safely (Netherlands Wind Energy Association, 2016). If a wind farm is established, further exploration for and extraction of petroleum resources will be difficult because of the safety zones of 500m for the windfarms as well as the oil & gas. (Ministerie	There are already conflicts between the fisheries and the oil and gas industries for several years. The main conflict is that the installation is often in or near important fishing areas which can cause disturbance with the fishing grounds (Miljodirektoratet, 2013).	Potential conflicts over the use of areas are well regulated in existing legislation and procedures (Miljodirektoratet, 2013).							
Military use	The spatial compatibility of energy production and military use is depending on the type of area. For shooting and flight area, the offshore windfarms are possible with some additional safety regulations. It is under no condition possible for mine testing or dumping sites (Jacques, Kreutzkamp, & Joseph, 2011).	The areas are for some periods completely closed off from all of the other activities than the military (Jacques, Kreutzkamp, & Joseph, 2011).	The military areas are a few times per year completely closed off from all the other human uses (Noordzeeloket, n.d.-c). However, due to the large period that the area is still open to shipping, it counts as compatible (under certain conditions).	The military areas are a few times per year completely closed off from all the other human uses (Noordzeeloket, n.d.-c). However, due to the large period that the area is still open to oil and gas exploration it counts as compatible (under						
Cables and pipelines	The existing cables and pipelines are no go zones for new wind production parks (Jacques, Kreutzkamp, & Joseph, 2011).	There are a lot of conflicts with the demersal fisheries, because the fishing gear can get stuck behind the cables or pipelines. In case of the pelagic fisheries the conflict is less. (Drew & Hopper, 2009) (NorthSeaLink, 2018)	Germany: There are no big conflicts regarding the interaction. Only when ships want to drop an anchor. Therefore it is of big importance that it clear is where the cables and pipelines are located (Söbior, n.d).	It will be important that the oil and gas will collaborate. One cannot exist without the other. With a good planning on were the platforms will be built so there is no interaction with the existing cables/ pipelines) (Holmager, 2011) The is why there is no big conflict. existing cables and pipelines are no go zones for	Maps with new cables and pipelines are constantly updated. This way the military knows that there are no interactions (Veum, Cameron, & Hekkenberg, 2012). Both uses are quite stationary as well, which is why there is no big conflict.					
Nature conservation	In the Netherlands, Belgium and Germany the nature conservation zones excluded for wind energy production (Jacques, Kreutzkamp, & Joseph, 2011). In the United Kingdom it depends: several companies are allowed to build in these zones. (Wood, 2010).	The management approaches are different for the birds directive (<i>also known as Special Protection Area - SPA</i>) and habitat directive areas (<i>also known as Site of Community Interest - SCI</i>). In birds directive areas the fisheries are partly closed for pelagic fisheries during the entire year. In areas where the habitat directive is implemented, the fisheries are only allowed to use pelagic gear. They are not allowed to use gear for the demersal fisheries (bottom trawlers, beam trawlers). In the areas where both the birds- and habitat directive are implemented the areas are closed off for all kind of fisheries. (European comission, n.d.-a)	Due to dredging there could potential be some conflicts with the obligation to preserve Natura 2000 sites come up for the habitat directive. For the birds directive it will mostly be in the coastal zones with the estuary (European comission, 2011).	The aim is to let the oil and gas industry do their thing but in a way that has a low impact on the North sea. And without spilling oil the moment the organizations are planning to dismantle the oil and gas platform (Stichting de Noordzee, n.d.)	(The Belgium military authority, in accordance with the Minister of Environmental Affairs, will take all the necessary measures to prevent damage and environmental disturbance, without compromising the effective work of the defense units. There are also exceptions on the prohibition statements concerning the marine nature reserves made for military activities (Derous, n.d) In Germany, there are important overlaps military areas, sand extraction areas and nature conservation areas. (Veum, Cameron, & Hekkenberg, 2012)		Netherlands: When cables are built in a nature conservation area, they can be bundled in corridors and laid at the same time in order to reduce the environmental impact. The route has been designed to avoid the most sensitive areas, including areas of potential reef habitat, and areas of the greatest importance for bird life (NorthSeaLink, 2018).			
Coastal defense	Netherlands: No conflicts could be found. This is most likely due to the different zones these North Sea users operate in. The coastal defense is focused on the dikes and dunes. The energy production sector is required to be outside the 12 nm zone. (RVO, 2015)	No conflicts could be found. This is most likely due to the different zones these North Sea users operate in. Coastal defense is focused on the dikes and dunes. Fisheries stay out of the coastal zones of the Netherlands (Nederlandse vissersbond, 2016)	No conflicts could be found. This is most likely due to the different zones these North Sea users operate in. The coastal defense is focused on the dikes and dunes. Shipping has no conflict, because they will move to the ports and not to the coast.	No conflicts could be found. This is most likely due to the different zones these North Sea users operate in. The coastal defense is focused on the dikes and dunes. Oil and gas constructions are spread out in the deep sea.	The areas are for some periods completely closed off from all of the other human uses than the military (Noordzeeloket, n.d.-c) Also coast areas are used (Jacques, Kreutzkamp, & Joseph, 2011).	In England the cable installation can cause slipway that will result in a temporary exclusion period in the area during labor. There are no other adverse impacts to recreation and tourism as a result of the cables. (NorthSeaLink, 2018)	In the Netherlands certain zones in the dunes are used for coastal defense purposes or reserved for drinking water supply which shows that there are no spatial conflicts (Ruig, 1998). Additionally, when constructed, coastal defense is stationary.			
Tourism and recreation	In case of the Netherlands there is a strong dependence on tourism. Many	There can be some conflicts between tourism and recreation, because the fisheries gear can be destroyed long as the regulations are clear, there will be no by passing ships. However, this can easily be solved if fishers do not come to close. (Miljodirektoratet, 2013). The reason why this is categorized as 'no conflict' is because both human uses are very mobile. Conflict is easily avoided.	There is an increase of recreation sailing boats, but as long as the regulations are clear, there will be no conflicts because of the safety zone of 500m on each sites of the shipping routes. Additionally, both uses are very mobile. (Tettero, 2017)	There are no conflicts to be found due to the different zones. The oil and gas is further out of the coast and has a safety zone of 500 m around. (Ministerie van Infrastructuur en Milieu, Ministerie van Economische Zaken, 2014)	The military areas are a few times per year completely closed off from all the other human uses (Noordzeeloket, n.d.-c). However, due to the large period that the area is still open to tourism, it counts as compatible (under certain conditions).	The cable routes have been designed to avoid all wrecks. (NorthSeaLink, 2018) The vertical and horizontal use difference in use, make that the onshore and offshore tourism and recreational activities will most likely not conflict.	There are no conflicts when these two uses meet outside of the coast. Close to the coast, the tourism could affect the quality, availability and accessibility of natural resources for local users (Wageningen University & research, n.d).	There are no conflicts when these human uses meet further out of the coast. However closer to the coast tourism could affect the quality, availability and accessibility of natural resources for local users (Wageningen University & research, n.d).		
Aquaculture and mariculture	No conflicts could be found. This is most likely due to the different zones these North Sea users operate in. In the Netherlands the exploitation of non-living resources is concentrated within the 12 nm, and the energy production sector is required to be outside the 12 nm zone. (Bode, 2015)	There are some small conflicts between the fisheries and aquaculture regarding the demersal fisheries. However, they could use the same fishing grounds (Miljodirektoratet, 2013).	The level of conflict might increase if aquaculture facilities are sited in more exposed areas, close to established shipping routes. However, current legislation will be sufficient to deal with such problems in the foreseeable future (Miljodirektoratet, 2013).	There are no conflicts to be found due to the different zones. There would be no real conflict due to the difference in placement. Oil and gas is further out of the coast. And due to the safety zone around it will not cause any conflicts.	The military areas are a few times per year completely closed off from all the other human uses (Noordzeeloket, n.d.-c). However, due to the large period that the area is still open to mariculture, it counts as compatible (under certain conditions).	There would be no conflict during the operational phase of the cables. It would only occur when the cables are being placed due to the vertical difference in use of the water column.	Proactive spatial planning is essential for successful and sustainable mariculture development, because many of the interactions between aquaculture farms and the surrounding ecosystem vary significantly with location. These interactions can have strong impacts on both the mariculture operation and on other uses and values in the marine environment; in some instances, ecosystem effects of mariculture can be seen.	There are no conflicts between coastal defence and aquaculture.	There are no spatial conflicts (Söbior, n.d).	
Exploitation of non-living resources	No conflicts could be found. This is most likely due to the different zones these North Sea users operate in. In the Netherlands the exploitation of non-living resources is concentrated within the 12 nm, and the energy production sector is required to be outside the 12 nm zone. (Bode, 2015)	There are no conflicts between fisheries and extraction of non-living resources. Fisheries are mobile and can maneuver around the safety zones of the extraction activity. (Miljodirektoratet, 2013).	The current legislation is sufficient to deal with any conflict that occurs in the shipping lanes in combination with the safety zones of both human uses. (Miljodirektoratet, 2013).	There is no conflict because of the clear regulations regarding the safety zones (500m) of the oil and gas platforms. (Ministerie van Infrastructuur en Milieu, Ministerie van Economische Zaken, 2014)	The military areas are a few times per year completely closed off from all the other human uses (Noordzeeloket, n.d.-c). However, due to the large period that the area is still open to extraction of non-living resources, it counts as compatible (under certain conditions).	There is no conflict. In order to spare the sand extraction areas as much as possible and to keep the sand supplies available for the Dutch coast, preferred routes have been designated by these areas where the cables and pipelines must be laid in bundled as much as possible. If a route is nevertheless chosen by a potential sand extraction area, financial compensation can be requested for this. This compensates the additional costs for the extra fuel cost made by the sand extraction sector. (Noordzeeloket, n.d.-f)	For the Dutch part the sand extraction is a limited conflict, since the exploitation will be temporary.	There could no conflicts be found in relation between the coastal defense and the exploitation of non-living resources.	There are no conflicts since the exploitation of non-living resources are more localized further away from the coast. And tourism is more at the coast.	There could no conflicts be found in relation

APPENDIX V : THE CONFLICT ANALYSIS WITH NUMBERS SPLIT FOR EACH SELECTED COUNTRY

Table 13 : Conflicts per sector for Belgium (upper left), England(upper right), Germany (lower left) and The Netherlands (Lower right)

Belgium	Energy production	Fishing	Shipping	Oil & gas	Military use	Cables and pipelines	Nature conservation	Coastal defence	Tourism and recreation	Aqua- and mari- culture	Exploitation of non- living resources
Energy production	3										
Fisheries	2	2									
Shipping	No data	3	1								
Oil & gas	2	2	2	2							
Military use	3	3	2	2	1						
Cables and pipelines	2	2	1	No data	No data	No data					
Nature conservation	1	1	1	1	2	No data	No data				
Coastal defence	No data	1	1	1	2	1	1	1			
Tourism and recreation	No data	2	3	1	2	1	3	1	1		
Aqua- and mari- culture	No data	1	1	1	2	1	No data	1	1	1	
Exploitation of non- living resources											

England	Energy production	Fishing	Shipping	Oil & gas	Military use	Cables and pipelines	Nature conservation	Coastal defence	Tourism and recreation	Aqua- and mari- culture	Exploitation of non- living resources
Energy production	3										
Fisheries	2	2									
Shipping	No data	3	1								
Oil & gas	2	2	2	2							
Military use	3	3	2	2	1						
Cables and pipelines	2	2	2	No data	No data	No data					
Nature conservation	1	1	1	1	2	2	No data				
Coastal defence	No data	1	1	1	2	1	1	1			
Tourism and recreation	2	2	3	1	2	1	3	1	1		
Aqua- and mari- culture	No data	1	1	1	2	1	No data	1	1	1	
Exploitation of non- living resources											

Germany	Energy production	Fishing	Shipping	Oil & gas	Military use	Cables and pipelines	Nature conservation	Coastal defence	Tourism and recreation	Aqua- and mari- culture	Exploitation of non- living resources
Energy production	3										
Fisheries	2	2									
Shipping	No data	3	1								
Oil & gas	2	2	2	2							
Military use	3	3	2	2	1						
Cables and pipelines	2	2	2	No data	2	No data					
Nature conservation	1	1	1	1	2	No data	No data				
Coastal defence	No data	1	1	1	2	1	1	1			
Tourism and recreation	No data	2	3	1	2	1	3	1	1		
Aqua- and mari- culture	No data	1	1	1	2	1	No data	1	1	1	
Exploitation of non- living resources											

The Netherlands	Energy production	Fishing	Shipping	Oil & gas	Military use	Cables and pipelines	Nature conservation	Coastal defence	Tourism and recreation	Aqua- and mari- culture	Exploitation of non- living resources
Energy production	3										
Fisheries	2	2									
Shipping	No data	3	1								
Oil & gas	2	2	2	2							
Military use	3	3	No data	2	1						
Cables and pipelines	2	2	2	2	No data	3					
Nature conservation	1	1	1	1	2	No data	1				
Coastal defence	1	1	1	1	2	1	1	1			
Tourism and recreation	No data	2	3	1	2	1	3	1	1		
Aqua- and mari- culture	1	1	1	1	2	1	2	1	1	1	
Exploitation of non- living resources											

Map 2 Belgian activities 2016

Legend

-  Research Area
-  Cables
-  Mariculture sites
- Sort**
-  Dredging areas
-  Aggregate areas
-  Conventional munition dumping ground
-  Landing Station

Shipping zones

Density

-  11000-20000 ships
-  > 20000 ships

Oil and Gas sites

Production

-  Oil and Gas
-  Gas
-  Oil

Offshore windfarms

Status

-  Operational
-  Under Construction
-  Production
-  Pipelines

(sub) surface bottomfishery

Intensity

-  High intensity
-  moderate-high intensity
-  moderate intensity
-  Military munition practice area

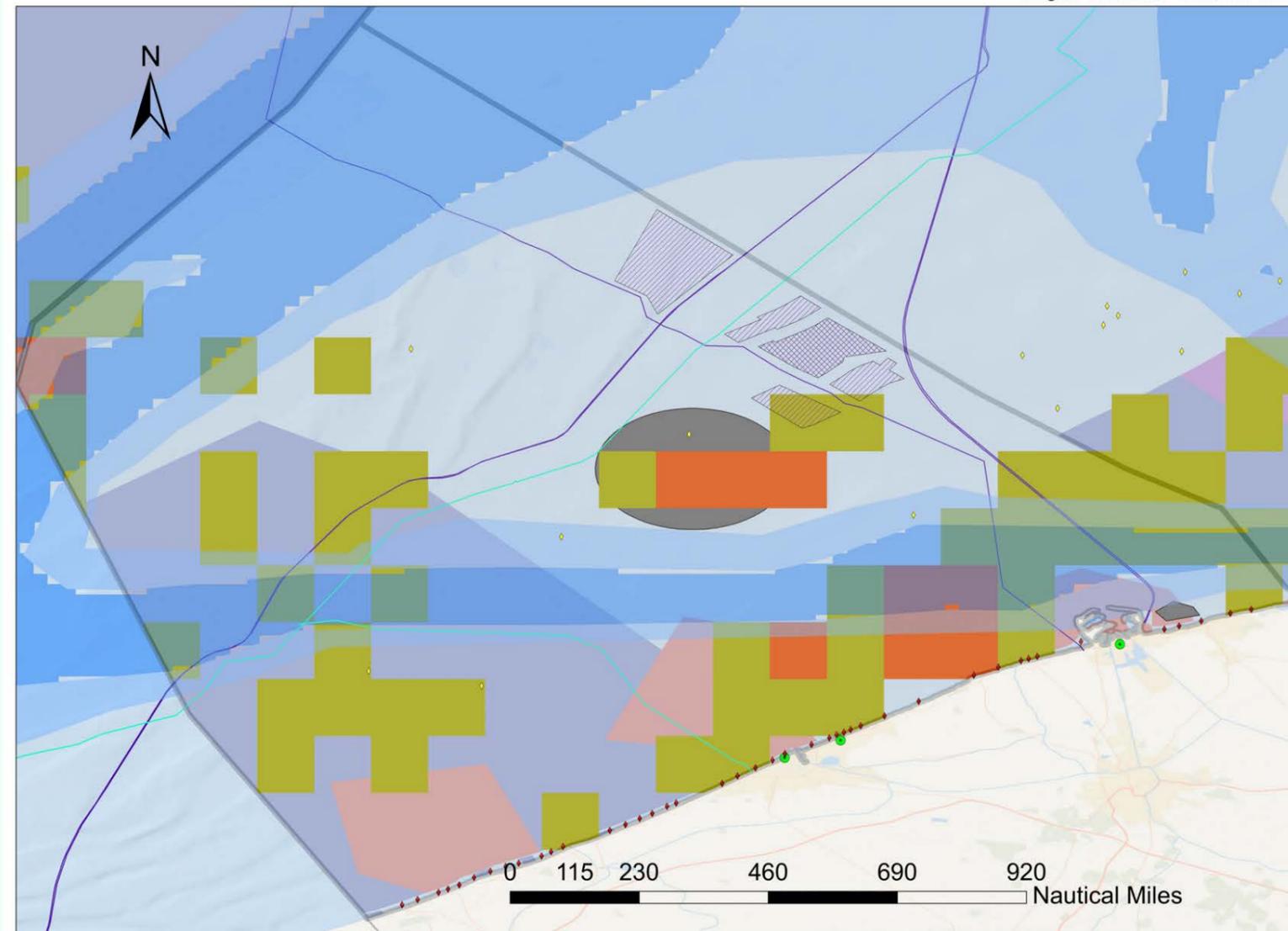
Natura2000 areas

Site designation

-  Both SPA and SCI
-  SCI (Special Conservation Interest)
-  SPA (Special Protection Areas)

The main human uses within the Southern North Sea

Belgian Exclusive Economic Zone



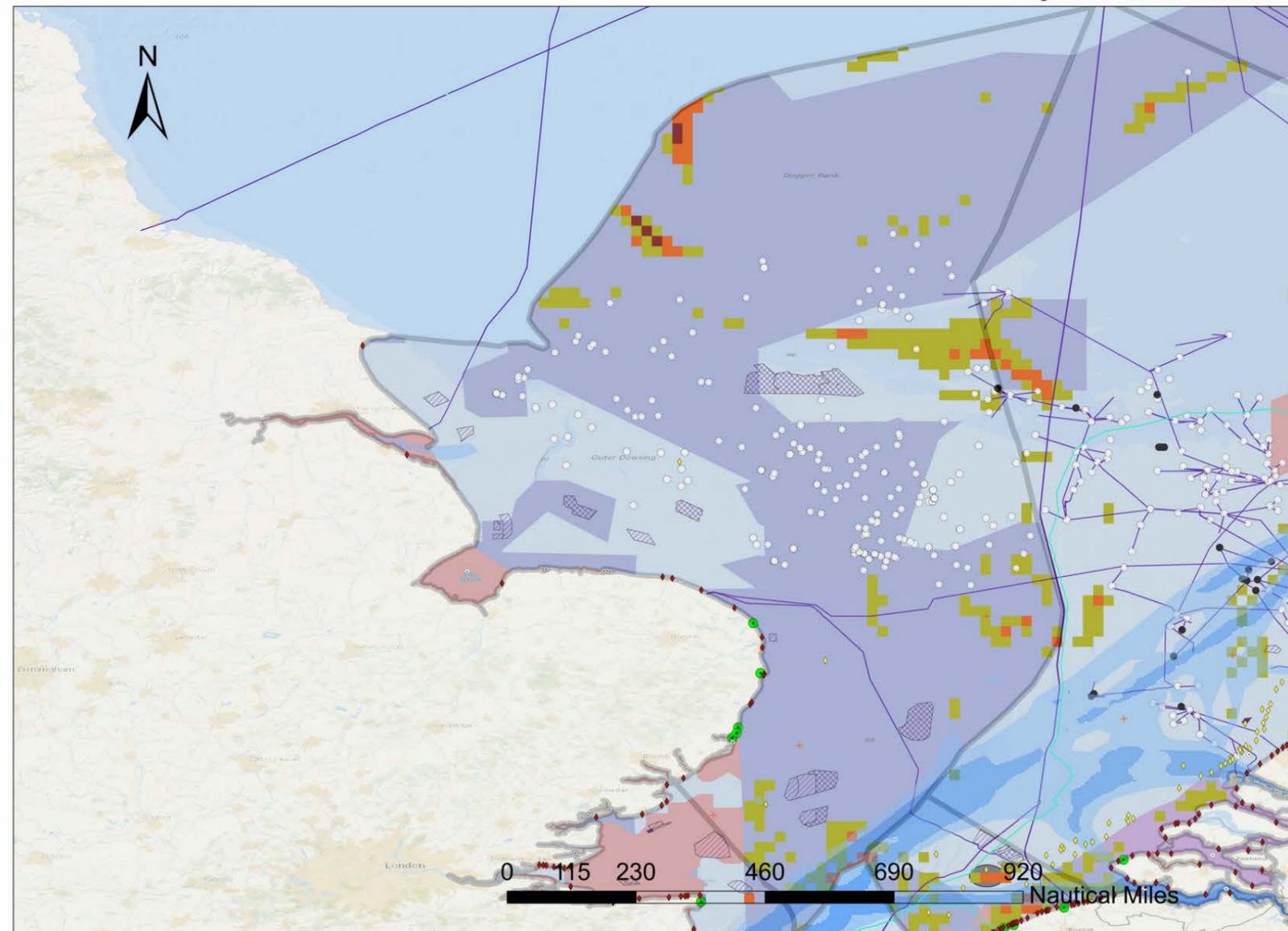
Authors: De Vries, Maartje & Seldenrath, Arya
 Date: 14-05-2018

Legend

-  Research Area
-  Cables
-  Mariculture sites
- Sort**
-  Dredging areas
-  Aggregate areas
-  Conventional munition dumping ground
-  Landing Station
- Shipping zones**
- Density**
-  11000-20000 ships
- > 20000 ships symbol" data-bbox="68 370 88 382"/> > 20000 ships
- Oil and Gas sites**
- Production**
-  Oil and Gas
-  Gas
-  Oil
- Offshore windfarms**
- Status**
-  Operational
-  Under Construction
-  Production
-  Pipelines
- (sub) surface bottomfishery**
- Intensity**
-  High intensity
-  moderate-high intensity
-  moderate intensity
-  Military munition practice area
- Natura2000 areas**
- Site designation**
-  Both SPA and SCI
-  SCI (Special Conservation Interest)
-  SPA (Special Protection Areas)

The main human uses within the Southern North Sea

England East Marine Plan Area



Authors: De Vries, Maartje & Seldenrath, Arya

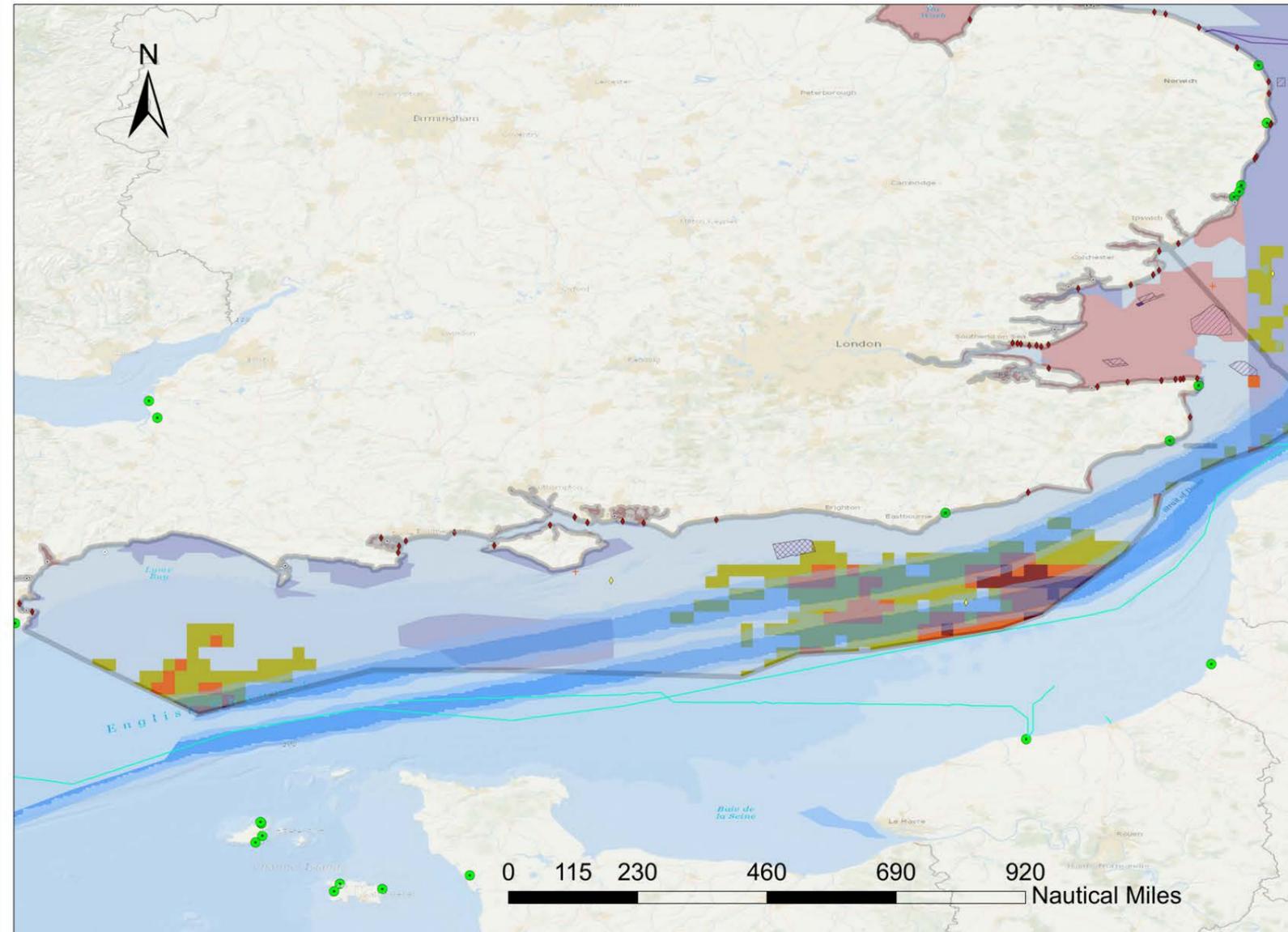
Date: 14-05-2018

Legend

-  Research Area
-  Cables
-  Mariculture sites
- Sort**
-  Dredging areas
-  Aggregate areas
-  Conventional munition dumping ground
-  Landing Station
- Shipping zones**
- Density**
-  11000-20000 ships
- > 20000 ships symbol" data-bbox="68 370 88 382"/> > 20000 ships
- Oil and Gas sites**
- Production**
-  Oil and Gas
-  Gas
-  Oil
- Offshore windfarms**
- Status**
-  Operational
-  Under Construction
-  Production
-  Pipelines
- (sub) surface bottomfishery**
- Intensity**
-  High intensity
-  moderate-high intensity
-  moderate intensity
-  Military munition practice area
- Natura2000 areas**
- Site designation**
-  Both SPA and SCI
-  SCI (Special Conservation Interest)
-  SPA (Special Protection Areas)

The main human uses within the Southern North Sea

England South Marine Plan Area



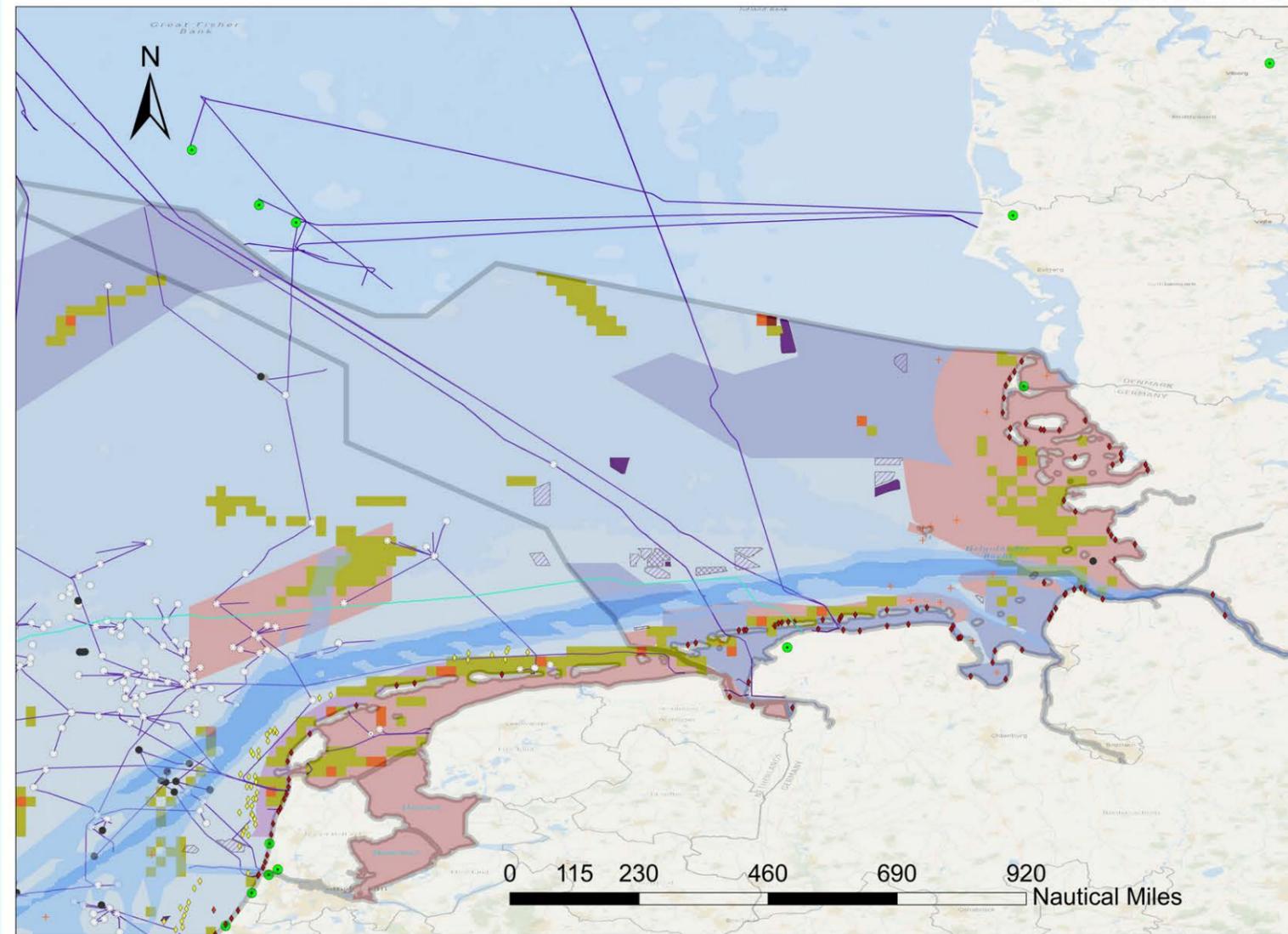
Authors: De Vries, Maartje & Seldenrath, Arya
 Date: 14-05-2018

Legend

-  Research Area
-  Cables
-  Mariculture sites
- Sort**
-  Dredging areas
-  Conventional munition dumping ground
-  Landing Station
- Shipping zones**
- Density**
-  11000-20000 ships
-  > 20000 ships
- Oil and Gas sites**
- Production**
-  Oil and Gas
-  Gas
-  Oil
- Offshore windfarms**
- Status**
-  Operational
-  Under Construction
-  Production
-  Pipelines
- (sub) surface bottomfishery**
- Intensity**
-  High intensity
-  moderate-high intensity
-  moderate intensity
-  Military munition practice area
- Natura2000 areas**
- Site designation**
-  Both SPA and SCI
-  SCI (Special Conservation Interest)
-  SPA (Special Protection Areas)

The main human uses within the Southern North Sea

German Exclusive Economic Zone



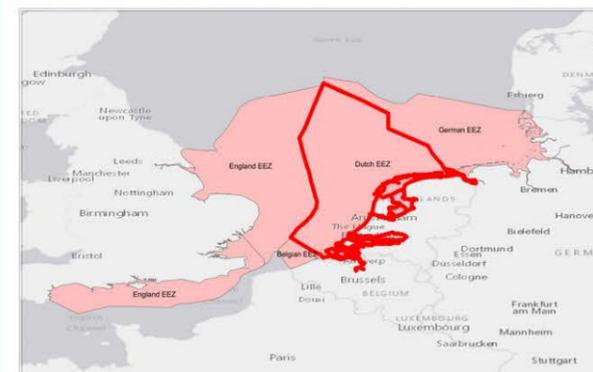
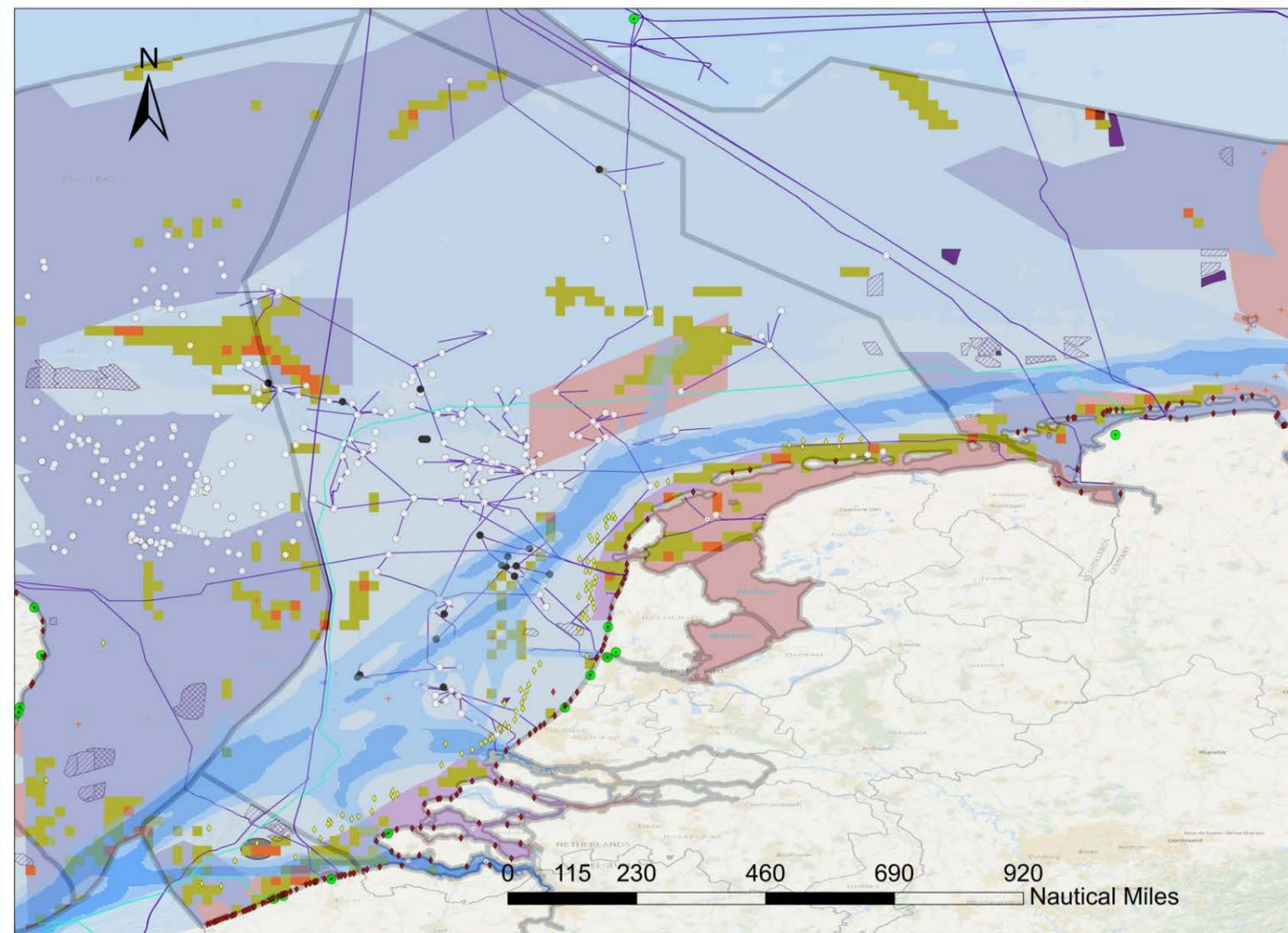
Authors: De Vries, Maartje & Seldenrath, Arya
 Date: 14-05-2018

Legend

-  Research Area
-  Cables
-  Mariculture sites
- Sort**
-  Dredging areas
-  Aggregate areas
-  Conventional munition dumping ground
-  Landing Station
- Shipping zones**
- Density**
-  11000-20000 ships
-  > 20000 ships
- Oil and Gas sites**
- Production**
-  Oil and Gas
-  Gas
-  Oil
- Offshore windfarms**
- Status**
-  Operational
-  Under Construction
-  Production
-  Pipelines
- (sub) surface bottomfishery**
- Intensity**
-  High intensity
-  moderate-high intensity
-  moderate intensity
-  Military munition practice area
- Natura2000 areas**
- Site designation**
-  Both SPA and SCI
-  SCI (Special Conservation Interest)
-  SPA (Special Protection Areas)

The main human uses within the Southern North Sea

Dutch Exclusive Economic Zone



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 Date: 14-05-2018

Table 14 GISdata for MSP

GIS data for MSP				
	Belgium	Germany	England	The Netherlands
Energy production	Marineatlas.be	Germany Spatial Plan/geoportal.de *offshore		
Fossil fuel/ CO2 storage		Germany Spatial Plan/geoportal.de *offshore		
Exploitation of non-living resources	Marineatlas.be	Germany Spatial Plan/geoportal.de *offshore		
Fisheries	Marineatlas.be *	Germany Spatial Plan/geoportal.de *offshore		
Aquaculture Mariculture	Marineatlas.be	Germany Spatial Plan/geoportal.de *offshore		
Marine Conservation zones	Marineatlas.be	Germany Spatial Plan/geoportal.de *offshore		
Shipping	Marineatlas.be	Germany Spatial Plan/geoportal.de *offshore		
Military	Marineatlas.be	Germany Spatial Plan/geoportal.de *offshore		
Pipelines and submarine cables	Marineatlas.be	Germany Spatial Plan/geoportal.de *offshore		
Tourism/ recreation	Marineatlas.be **	Germany Spatial Plan/geoportal.de *offshore		

* Only Fishery management areas

** Not very elaborate

Map 7 Spatial conflict analysis

