Sustainable fisheries in the Trilateral Wadden Sea

Final Report

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SUMMARY

The Wadden Sea is situated along the coasts of Denmark, Germany, and The Netherlands, separated from the North Sea by small islands and sandbanks. Despite a range of anthropogenic pressures, including industrial activity, coastal development and resource exploitation, the Wadden Sea ecosystem is recognized as a biologically highly productive ecosystem of great natural, scientific, economic and social importance, and sites within the region are listed under the Ramsar Convention on Wetlands of International Importance, the EC Habitats and Birds Directives (as part of the Natura 2000 network) and the UNESCO World Heritage List. Within the Wadden Sea Area, commercial fisheries (mainly shrimp and shellfish fisheries) form an integral part of the region's traditional economic activities.

The study "Sustainable Fisheries in the Trilateral Wadden Sea" was carried out on behalf of the Wadden Sea Board by MacAlister Elliott and Partners Ltd. (MEP) in collaboration with Innovative Fisheries Management (IFM) and BioConsult SH. The study was jointly financed by the Dutch Programme "Towards a Rich Wadden Sea" (PRW), the Lower-Saxonian Ministry for Environment, Energy and Climate Protection and the Schleswig-Holstein Ministry of Agriculture, Environment and Rural Areas.

The central aim of the study is to "advise the Trilateral Cooperation on the protection of the Wadden Sea on definitions and, where applicable, concrete, understandable and measurable criteria for *strong* sustainability in Wadden Sea fisheries with a unified, trilateral approach which safeguards nature protection in line with the 2010 Wadden Sea Plan and with a special focus on the Habitats Directive and its Natura 2000 objectives."

The two objectives identified to achieve this central aim are the following:

I. Draft recommendations for sustainable fisheries in the Wadden Sea;

II. Advise how these recommendations should be taken forward in a process in which trilateral principles for sustainable fisheries are elaborated.

The requirement for this study stems from past and current difficulties in harmonising commercial fisheries management and nature protection in the Wadden Sea, with conflicts between industry representatives, nature conservation NGOs and government institutions culminating in court cases, some of which have been high-profile (e.g. the 2004 European Court case on mechanical cockle fisheries in the Dutch Wadden Sea). An added difficulty is the transboundary nature of the region, and efforts to adopt a concerted approach in Wadden Sea fisheries management and nature protection have met with difficulty despite the fact that this is not a new concept. In the 1970s, it was recognized by the Wadden Sea governments that joint cooperation was essential for comprehensive protection of the area, including the coordinated implementation of the Ramsar Convention on Wetlands and the European Birds and Habitats directives. The Joint Declaration on the Protection of the Wadden Sea, which is the formal basis of the trilateral Wadden Sea cooperation, was

adopted in 1982 and renewed in 2010. The 1997 and 2010 Trilateral Wadden Sea Plans institutionalize the aims of the cooperation (Enemark, 1998). The Common Wadden Sea Secretariat (CWSS) was established in 1987 as the Cooperation's secretariat with the primary task of supporting, initiating, facilitating and coordinating the activities of the collaboration. Recognising the past difficulties in developing a harmonised, trilateral approach in Wadden Sea fisheries management and nature protection, CWSS, on behalf of the Wadden Sea Board, commissioned this study to provide a starting point for a renewed dialogue on sustainable fisheries management between the Wadden Sea stakeholders in the three nations and provide for a decision-making tool to establish a common trilateral view for sustainable fisheries.

Over the last decade the notion of sustainable fisheries has gained in momentum on a global scale. The Wadden Sea is no exception and recent years have seen an increasing number of Wadden Sea fisheries achieve ecolabel certification, particularly against the Marine Stewardship Council (MSC) Standard for sustainable fisheries. Despite the clear, positive message associated with the MSC ecolabel, the trilateral Wadden Sea cooperation would like to further explore the coherence between MSC certified fisheries and nature protection in the Wadden Sea through the Wadden Sea Plan, national regulations as well as Natura 2000. A part of this study therefore examined how the MSC standard compares against the different benchmarks of sustainability as they are defined in this analysis.

This summary presents the key findings of the study, with the more detailed analysis available in sections 1 to 5 of this report, the structure of which follows the Tasks identified at the start of the analysis:

Task 1: Conduct an inventory of the legal framework for the implementation of the Habitats and Bird Directives in each Wadden Sea country and present an overview of the current situation of Wadden Sea fisheries (Section 2).

This has been achieved by:

- Exploring how the EC Habitats and Birds Directives have been interpreted and implemented in the three Wadden Sea countries (Section 2.1).
- Creating an inventory of the fisheries situation in each Wadden Sea country (Section 2.2)
- Determining to what extent fisheries management is in agreement with Natura 2000 objectives and identifying common ground and best practice between the three nations (Section 2.2 and 3.1).

Task 2: Provide recommendations of "strong" sustainability criteria for Wadden Sea fisheries (Section 3).

This has been achieved by:

- Developing a sustainability framework in order to determine how fisheries, including MSC certified fisheries, are meeting the nature protection objectives set out in the

Habitats and Birds Directives and the 2010 Wadden Sea Plan. As a part of this exercise, the applicability of the MSC standard in providing for nature protection on the long term and in the context of the Wadden Sea was examined (Section 3.2).

- Overall analysis of the sustainability of Wadden Sea fisheries through a "mapping" exercice (Section 3.3).
- Recommendations for sustainable fisheries, including identifying knowledge gaps and which main steps in fisheries management are still required to comply with EC Directives (Section 3.5).

Task 3: Provide recommendations for the further process of developing commonly shared principles for sustainable fisheries in the Wadden Sea (Section 4)

The tasks were completed through desk-based research and supplemented with targeted interviews held with representatives for each of the Wadden Sea regions discussed in this report. The following stakeholders were contacted:

Contact	Country / Region	Organisation
Dr. Paddy Walker	The Netherlands	Programma Rijke Waddenzee
Dr. Gerald Millat	Lower Saxony, Germany	Forschungskoordination und Küstenfischerei Nationalpark-verwaltung Niedersächsisches Wattenmeer
Dr. Hans-Ulrich Rösner	Schleswig-Holstein, Germany	WWF Germany
Dr. Per Sand Kristensen	Denmark	DTU Aqua

TASK 1 - NATURE PROTECTION IN THE WADDEN SEA AND FISHERIES REVIEW

The Wadden Sea area accessible to commercial fisheries is in its completeness protected under Natura 2000, subject to national nature protection legislation in accordance with the EC Habitats and Birds Directives. As part of the Natura 2000 network, special areas of conservation (SAC) and special protection areas (SPA) are designated by the Member States, under the EC Habitats Directive and the EC Birds Directive respectively.

The following Natura 2000 areas were identified for the purpose of this study. A full description for each site, including the designated habitats and fish, mammal and bird species has been provided in Section 2.1.

Site	Country / Region	Designation
Waddenzee	The Netherlands	SAC (NL1000001) and SPA (NL9801001)
Noordzeekustzone	The Netherlands	SAC (NL2003062) and SPA (NL9802001)
Nationalpark Niedersächsisches Wattenmeer	Lower Saxony, Germany	SAC (DE2306301) and SPA (DE2210401)
Nationalpark Hamburgisches Wattenmeer	Hamburg, Germany	SAC (DE2016301) and SPA (DE2016401)
NTP S-H Wattenmeer und angrenzende Küstengebiete	Schleswig-Holstein, Germany	SAC (DE0916391)
Ramsar-Gebiet S-H Wattenmeer und angrenzende Küstengebiete	Schleswig-Holstein, Germany	SPA (DE0916491)
Vadehavet med Ribe Å, Tved Å og Varde Å vest for Varde	Denmark	SAC (DK00AY176) and SPA (DK00AY057)

A range of commercial fisheries currently takes place in the Wadden Sea area. A summary is presented in the table below. A systematic desk-based study, supplemented with targeted interviews was carried out for each fishery identified. Of the fisheries identified in the review, the blue mussel, cockle and shrimp fisheries were selected as main fisheries. Although finfish and other shellfish (including native and Pacific oyster) fisheries also take place, it was considered that these were too marginal and insufficient information was available to warrant an in-depth sustainability analysis for these fisheries. There are indications however that some finfish fisheries, in particular those targeting bass and mullet are gaining in importance and it is recommended that these are subject to a targeted review.

The majority of the main Wadden Sea fisheries are coastal fisheries for which the management responsibility lies with the Member States (passed on to the Länder in the case of Germany). The shrimp fisheries, which also take place beyond the 12 nm limit off the coastal baseline are subject to the principles and practices of the EU Common Fisheries Policy (CFP). Within the 12 nm limit, the EU legislations which affect fisheries management are the Habitats and Birds Directives for those areas designated under Natura 2000 (through the appropriate assessments), the 2008 Marine Strategy Framework Directive (MSFD) which provides an overarching framework for sustainable fisheries from an ecosystem-based perspective (although this is not applied in the Dutch Wadden Sea), and the 2000 Water Framework Directive which aims at the continued improvement

in fish stocks through improved habitats and improved water quality and quantity. The Trilateral Targets for the Wadden Sea as defined in the 2010 Wadden Sea Plan encompass these different approaches of EU Directives while also covering the World Heritage Criteria. The Trilateral Targets for the Wadden Sea therefore provide the common basis for the harmonisation of the different national approaches under the EU Directives within the trilateral Wadden Sea.

TASK 2 - RECOMMENDATIONS OF STRONG SUSTAINABILITY CRITERIA FOR WADDEN SEA FISHERIES

This task of the study centered on the development of an indicator-based framework for fisheries sustainability criteria, which is based on the core fisheries sustainability issues that affect or are likely to affect the Wadden Sea ecosystem. As a first step in the identification of these sustainability issues, an impact assessment was carried out for the mussel, cockle and shrimp fisheries in relation to the Wadden Sea ecosystem, including those habitats and species designated under the Habitats and Birds Directive, as well as habitats and species identified in the Trilateral Targets (defined in the Wadden Sea Plan 2010). The results of the impact analysis are not discussed in this summary, but are presented in detail in Section 3.1. The impact analysis addressed the following four criteria: status of target species and population; bycatch and discards; habitat impacts; and protected species.

The results of the impact analysis were then fed into the indicator-based framework for sustainability criteria (Section 3.2). The sustainability framework provides a structure in which the level of sustainability of Wadden Sea fisheries can be assessed along a gradient of weak to strong sustainability, and compared to the existing MSC performance indicators and Trilateral Targets for the Wadden Sea. In this way, the level of sustainability is determined against each of the key Natura 2000 qualifying features identified in Task 1, and recommendations for moving the fisheries towards stronger sustainability or towards improved coherence with nature protection requirements can be made.

Prior to establishing sustainability criteria, a review was carried out of some of the theoretic literature addressing the concept of weak and strong sustainability. The team's understanding of the difference between strong and weak sustainability is, in simplistic terms, that weak sustainability accepts substitutability between forms of capital, while strong sustainability holds that fundamental services provided by nature cannot be substituted by man-made capital. Applying the strong sustainability concept to commercial fisheries is not straightforward and there is a lack of literature about the application of the concept in practise. Part of the objective of the Common Wadden Sea Secretariat is to engage with the fishing industry to improve the sustainability of fisheries in the Wadden Sea. In the team's experience, it is critical that practicality rather than theory is at the forefront of efforts to engage with the industry if an inclusive transition towards greater sustainability is to be achieved. An attempt was therefore made to broaden the review of literature to enable sustainability criteria to be developed that could be practically applied in a fisheries context. At the basis of this more practical approach is

the notion that any ecological approach would require that the fundamental services underpinning the production of a system be maintained, i.e., it is necessary to maintain a minimum level of different types of natural capital. From a fisheries perspective, we consider that fisheries are dependent on the biophysical system they exist within, therefore for a fishery to be 'weakly sustainable' requires that the capacity of the fish stock to maintain production into the future is not compromised. Our definition of weak sustainability does take into account substitutability, whereby natural systems can be replaced by man-made systems (see definition below), whereas strong sustainability acknowledges that different types of 'capital' should be independently maintained if a system aims to be sustainable.

On the basis of these considerations and following instructions from CWSS to develop definitions for weak, medium and strong sustainability, we applied the concept of sustainability within the boundaries of natural capital and derived the following definitions:

Weak sustainability: **full and unlimited substitution of ecosystem services between ecosystem components is acceptable, on condition that the overall productivity of the ecosystem is non-diminishing over time**. This definition assumes that certain types of man-made habitats may deliver the same level of ecosystem services as natural habitats (e.g. cultured mussel beds vs natural beds). This definition also assumes that because impacts on certain ecosystem components are reversible[1] weak sustainability can be met.

Medium sustainability: **all discrete ecosystem components are not safeguarded, but measures are in place, which prevent full and unlimited substitution of ecosystem services between ecosystem components**. The level of substitution allowed must be based on best available scientific advice and must preserve an appropriate condition of ecosystem services to maintain ecosystem integrity and function.

Strong sustainability: **no substitution of ecosystem services between ecosystem components is acceptable and all ecosystem services must be fully protected**. This means that fishing under this form of sustainability is only possible if it can be demonstrated that impacts cannot be reasonably expected to and are not likely to negatively affect the integrity and function of individual ecosystem components.

Where the available data are not sufficient to accurately assess impacts, it is assumed that the precautionary principle is applied.

It is emphasised that in this context, 'weak' and 'strong' are technical terms relating to how sustainability is defined, rather than value judgments.

This exercise is also not intended to pass definitive judgement on the sustainability or otherwise of Wadden Sea fisheries – it is a comparative and subjective exercise,

[1] Reversible is used here in the context when a fishing activity ceases, the affected ecosystem can recover to the state it was in prior to the disturbance.

clarifying the starting position of nature protection authorities in the dialogue with the fisheries sector and other involved stakeholders.

The resulting indicator-based sustainability framework presented in Section 3.2 was used in two ways:

- To map the Trilateral Targets for the Wadden Sea and the MSC standard for sustainable fisheries onto the sustainability gradient against the key Natura 2000 qualifying features identified in Task; and

- To map the three main Wadden Sea fisheries, taking into consideration their respective fishing methods, onto the same gradient.

From these mapping exercises, the following general observations were made. Note that that a more in-depth discussion has been provided in Section 3.2.2.

- The MSC standard was generally on the 'weaker' end of the gradient than the Trilateral Targets for the Wadden Sea. This stemmed from the fact that the MSC standard is specific to fisheries, not nature protection per se. This approach implies almost immediately a weak to medium approach to sustainability (at least under the definitions proposed in this study), since fishing is by definition an activity that is extractive from the marine environment. Trilateral Targets, conversely, start from the desired overall outcome of high nature protection and therefore generally meet he strong sustainability criteria.

- Some of the Trilateral Targets may not be met even if all Wadden Sea fisheries meet the strong criteria. This is due to the fact that in some cases fishing activities are not the limiting factor for meeting the Trilateral Targets, but other natural or anthropogenic factors are.

- For the mussel fisheries, DK met the strong sustainability criteria by default as the mussel fishery in that part of the Wadden Sea is currently closed. In NL, most of the components met the strong criteria and this is mainly due to the closure of the intertidal to the mussel fishery, the presence of a comprehensive harvest strategy, the gradual phasing out of the wild seed fishery and the use of annual appropriate assessments. DE, where neither SH or LS use annual appropriate assessments and where area closures are the main harvest control tool, strong sustainability was rarely met.

- Among the three main fisheries, the Wadden Sea cockle fisheries achieved the highest sustainability overall. DE met strong sustainability for all components as no cockle fisheries are allowed in any of the national parks and none take place outside the conservation areas. For the remaining NL and DK cockle fisheries, the achievement of strong sustainability was in most cases based on the annual use of appropriate assessments (NL) or Environmental Impact Assessments (DK) which ought to identify any negative impacts on designated habitats and species and therefore ought to ensure the protection of those features.

- The strong sustainability criteria for Wadden Sea shrimp fisheries were generally not met and both the weak and medium criteria could be met on only some occasions. The most significant obstacles to meeting strong sustainability were the absence of annual appropriate assessments in the case of NL and DE, the overall lack of fleet-specific quantitative data on bycatch and discards and the uncertainty as to the ecosystem effects this fishery may have.

- Although significant measures are already in place (TAC, food reservation policy for birds, area closures) to minimise any impact on the food availability for birds in the general Wadden Sea, strong sustainability cannot be met as long as a wild mussel and cockle fishery takes place.

- The incomplete knowledge base with regards to the occurrence and distribution of *Sabellaria* reefs meant that none of the assessed fisheries could meet the strong sustainability criteria.

- The lack of protection measures for subtidal *Zostera* beds meant that none of the assessed fisheries could meet the strong sustainability criteria.

These observations, in addition to the review undertaken in Task 1 and the series of case studies for shellfish fisheries in The Wash (UK), River Exe (UK) and Ria d'Etel (France) (Section 3.4) have led to a number of recommendations of which the key points are presented below:

- The use of annual appropriate assessments (or equivalent impact assessments) which are scientifically robust and which are adopted by all Wadden Sea regions and applied to all licensed fisheries is absolutely central in the concept of strong sustainability from the perspective of nature protection in the Wadden Sea as defined under the Habitats and Birds Directives. The use of regular (if possible annual) impact assessments by all Wadden Sea regions would also level the playing field and may facilitate the dialogue between the fishery managers, the industry and environmental NGOs at a trilateral level.

- In the case of the DE mussel fisheries, the team advocates the use of a comprehensive harvest control mechanism which is based on annual stock assessments and takes into account the feeding requirements for birds.

- Where no data are available on the distribution and occurrence of *Sabellaria* reefs and/or *Zostera* fields, the precautionary principle should be applied by all Wadden Sea regions concerned. This could involve a systematic recording and knowledge sharing system for reports of *Sabellaria* or *Zostera* occurrence by local actors so that areas of known occurrence can be actively avoided. It is also recommended that a routine monitoring programme is put in place and that this is a concerted effort between the various Wadden Sea regions (under for example the Trilateral Monitoring and Assessment Programme which is further discussed below). Once the distribution of *Sabellaria* and *Zostera* in the Wadden Sea is known (if any) protection measures should be put in place.

- It is anticipated that ASC installations in the Wadden Sea will expand significantly in the near future. It is important that cumulative impacts are considered in the appropriate assessments for each separate ASC installation. This is of particular importance from the perspective of general disturbance to birds and mammals and from the perspective of ecosystem carrying capacity.

- VMS currently only allows the surveillance of vessels of over 15 m length. Smaller vessels which have the potential to reach fishing or shrimping grounds closer inshore are not monitored. It is recommended that a vessel monitoring system for all fishing vessels (including shrimp vessels) is developed, thus providing information on all fishing locations and fishing effort, allowing more strict surveillance and informing on the establishment of future management actions such as zoning.

- It is recommended that a trilateral and strategic approach to develop and implement a research plan for the Wadden Sea ecosystem from the perpective of sustainable fisheries is adopted, including the use of both scientific and quantitative data collection and traditional or local ecological knowledge. A list of suggested research topics has been provided in the report.

- Even when data gaps are filled, it is recommended that monitoring is continued on a systematic basis. TMAP provides the ideal framework to implement a systematic and trilateral monitoring programme for the Wadden Sea. We fully agree with the recommendations put forward in the 2010 Wadden Sea Plan (CWSS, 2010) on harmonisation, knowledge sharing, parameters and ecological research. A significant amount of work remains to be done, but it is only through these efforts that the existing knowledge gaps can be filled and appropriate management measures can be taken.

- The VIBEG agreement, discussed in Section 2.2.4, provides proof that progress can be made by reaching compromise between fisheries stakeholders through a structured and well-informed dialogue. A similar approach would certainly seem the way forward for sustainable Wadden Sea fisheries at a trilateral level. For this to even have a chance of success, however, a first step would be to create a level playing field – particularly how fisheries are regarded by the respective nations in relation to the Habitats and Birds Directives – in particular, this relates to the use of the appropriate assessments which has been discussed previously.

- Natura 2000 provides a static basis for management which is potentially unsuitable in a changing environment of which a key driver is climate change. One means of addressing this issue would be a process of ‘adaptive management’ where the baseline situation is constantly assessed. This type of adaptive management however is not straightforward. It starts with a detailed understanding of how the ecosystem functions, and how the ecosystem is changing over time. The TMAP framework as well as the appropriate assessments would be valuable tools in answering questions on the impacts of environmental change in the Wadden Sea and sharing those with

relevant stakeholders, including the fisheries sector, and the various jurisdictions can be supported in working towards adaptive management.

TASK 3 - RECOMMENDATIONS FOR DEVELOPING COMMONLY SHARED PRINCIPLES FOR SUSTAINABLE FISHERIES IN THE WADDEN SEA

The objective of task 3 was to provide recommendations for a process in which shared principles for sustainable fisheries in the Wadden Sea can be elaborated jointly with stakeholders.

In the light of changing fisheries practices with today's abilities to detect and fish any resource with high efficiency and the changing function of the Wadden Sea there can be no doubt that regulation of the fisheries is needed in order to assure both future yields of the fisheries and to maintain ecological functions of the area. It is the understanding of the team that this is common sense amongst all interest groups of the Wadden Sea. Still, there have been intense disputes on which kinds of regulations to apply and who has the legal authority to regulate. While some conflicts are somehow natural and hard to avoid as they represent competition for a limited resource, others are the result of insufficient communication between interest groups, lack of knowledge and inconsistent decision-making processes between countries and regions. Some sources of conflict are:

- Competition for limited and decreasing resources
- Different perceptions of the problem
- Need to adapt to a changing world
- Knowledge gaps
- Different approaches in different regions
- Unclear decision processes

For the Wadden Sea region there seems to be a lack of an institution which could facilitate a discussion between interest groups which could solve or at least mediate such conflicts. Although the Wadden Sea Forum already provides a framework for stakeholder engagement in environmental issues in the Wadden Sea, the team identified a key missing element to be an effective and constructive communication link between nature conservationists and the fisheries sector. It is therefore proposed that a discussion and negotiation platform which is solely dedicated to Wadden Sea fisheries is established, in which CWSS plays a central, facilitating role, focussing on the implementation of legal requirements for fisheries management and the transition towards strong sustainability. The team recommends that an analogy to the European Commission's Regional Advisory Council (RAC) model be adopted by CWSS for the purposes of facilitating the process in which shared principles for sustainable fisheries in the Wadden Sea can be elaborated jointly with stakeholders and broad support for these principles can be facilitated. The main task for the WS RAC could therefore be to provide the relevant Wadden Sea governmental institutions with advice on fisheries management in the Wadden Sea region.

A more in-depth discussion on the functioning of the WS RAC has been provided in Section 4 of this report. This section also includes recommendations on the structure and implementation of the WS RAC.

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1. THE WADDEN SEA

The Wadden Sea is a shallow estuarine area situated along the coasts of Denmark, Germany, and The Netherlands, separated from the North Sea by small islands and sandbanks (Figure 1). It has an average width of 10 km and extends along 450 km of coastline from Den Helder in the Netherlands to Skallingen in Denmark – approximately 70% of its area is situated in the German sector. The area is characterised by salt-marshes and mud flats and shoals, cut through by channels and gullies. With a tidal amplitude of about 1.5 – 3.0 m, the Wadden Sea is a tidally driven ecosystem, with large intertidal areas. The area can be divided into three zones: the supralittoral or spray zone (dunes and salt meadows which are only flooded intermittently at high tidal levels), the intertidal (tidal sand- and mudflats covered by water twice daily) and the subtidal (tidal creeks and channels permanently covered by water).

The Wadden Sea ecosystem is an internationally important wetland. It is recognized as a biologically highly productive ecosystem of great natural, scientific, economic and social importance. The salt marshes host about 2,300 species of flora and fauna, with a further 2,700 species occurring in the marine and brackish areas. In total it is estimated that the Wadden Sea provides habitats for up to 10,000 species of unicellular organisms, plants, fungi and animals (Marencic *et al*, 2009). The high productivity and biodiversity of the Wadden Sea provides an important food resource for fish and birds, and the Sea acts as a nursery area for many North Sea fish and crustaceans, as well as a resting area for migratory coastal birds. The Wadden Sea is listed as a Ramsar wetland of outstanding international importance as a staging, moulting and wintering area for at least 52 populations of 41 migratory waterbird species which use the East Atlantic flyway and originate from breeding populations as far away as northern Siberia or Northeast Canada.

The Wadden Sea region is also an area of significant socio-economic importance to its bordering countries. Approximately 3.7 million people live along the Wadden Sea coast, of which about 75,000 live inside the Wadden Sea Area (see Figure 1) (Marencic, 2009). The region's traditional economic activities are commercial fisheries and agriculture, manufacturing in the metal, engineering, food and chemical industries, as well as harbour and shipping activities, the services sector and tourism. Fisheries (mainly shrimp and shellfish fisheries) in particular are an integral part of the region, generating a range of secondary activities such as sales and processing, and contributing to the region's cultural expression and tourism. Although the economic relevance of the fisheries sector in the region as a whole is relatively low (at a 0.2 % share of total employment in the region), the fish-processing sector in particular is of higher local relevance in certain locations, such as Cuxhaven (4 %), Bremerhaven (6 %) and Esbjerg (3 %) (Arndt *et al*, 2004).

As a result of this range of economic activities, the Wadden Sea ecosystem has been subject to a range of anthropogenic influences including large-scale engineering works such as the closing of the Zuiderzee (now Lake IJssel) in the 1930s, the altering of river flow into the estuary with sluices, coastal defence, infrastructure, harbour development

and harbour dredging, and pollution by industrial and agricultural run-off. There are high levels of recreational use, as well as exploitation of resources such as shrimp and mussels. In recent years considerable effort has been made to reduce nutrient inputs into the rivers and the Wadden Sea, with consequences for the ecosystem's primary and secondary productivity. Another factor which adds pressure to the Wadden Sea ecosystem is the introduction of alien species such as the Pacific oyster (*Crassostrea gigas*).

The ecological value of the Wadden Sea is widely recognised and each of three countries has designated Ramsar and Natura 2000 sites in the region. Furthermore, in 2009 the transboundary Dutch-German Wadden Sea was inscribed on the UNESCO World Heritage List, acknowledging the outstanding universal value of the world´s largest tidal barrier island system. In 2011, this inscription was extended to include the Hamburg Wadden Sea National Park as part of the Dutch-German Wadden Sea World Heritage property in recognition of the successful nature conservation work in the German Wadden Sea and the cooperation with the neighbouring states.

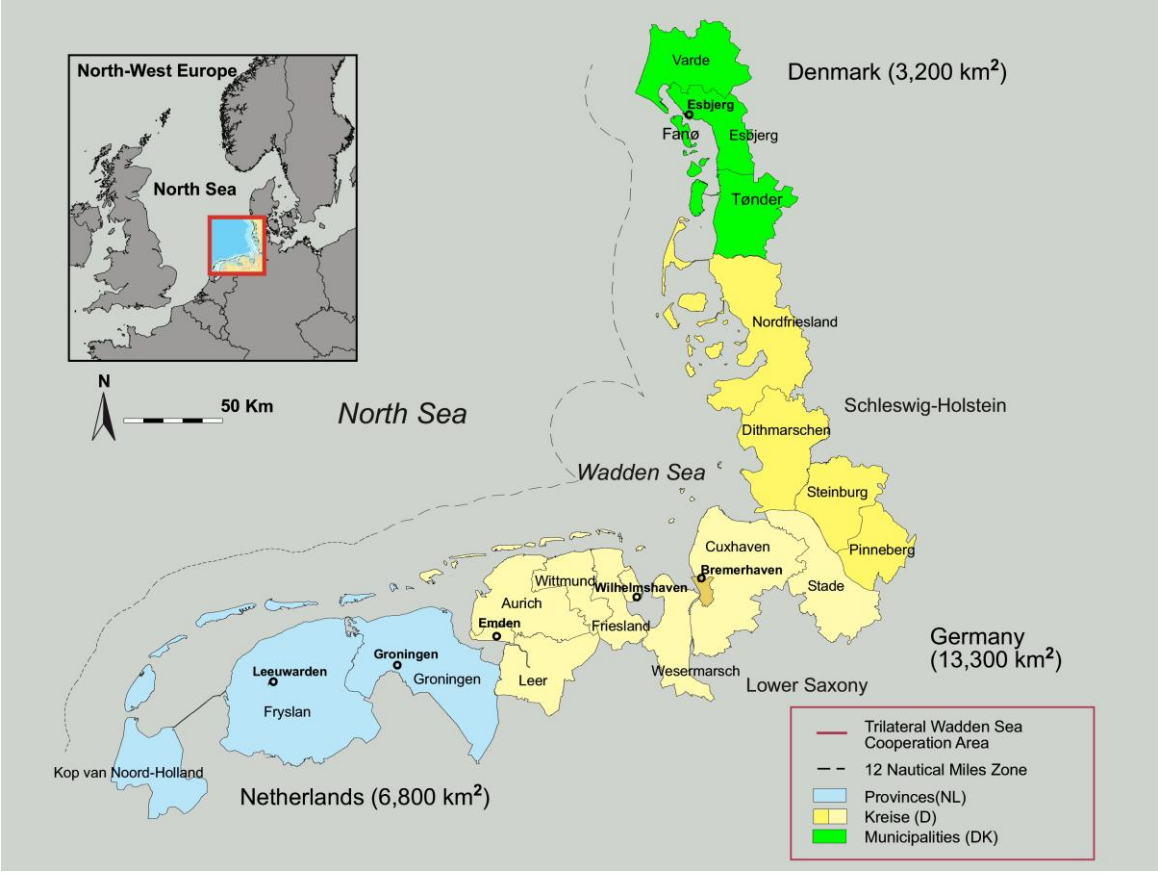


Figure 1. Map of the Wadden Sea, showing regional structure in The Netherlands (NL), Germany (D) and Denmark (DK) (). Note: the German part of the Wadden Sea falls into three German states (Länder): Niedersachsen or Lower Saxony (LS) in the south, Schleswig-Holstein (SH) in the north and Hamburg National Park (HH), a small area off the Elbe estuary. Since Germany is a federal republic, there are thus five in total (four main) autonomous management areas – NL, LS, HH (minor), SH and DK.

2. TASK 1

2.1. NATURE PROTECTION IN THE WADDEN SEA

Major parts of the Wadden Sea of the three Wadden Sea countries are designated as Natura 2000 sites (Box 1), subject to national nature protection legislation in accordance with the Habitats and Birds Directives.

The Wadden Sea area accessible to commercial fisheries is in its completeness protected under both the Habitats and Birds Directives. The commercial fisheries taking place in the Wadden Sea are regulated by national laws – see Section 2.2. Only those national regulations pertaining to the conservation objectives for the Natura 2000 sites are presented in this section of the report.

As a part of Task 1, this section presents a review of the regulatory framework for nature protection in the Wadden Sea and focuses on the implementation of Natura 2000 in the Danish, German and Dutch area of the Wadden Sea (Box 1). The regulatory framework relating to the commercial fisheries that take place in the Wadden Sea is only briefly mentioned in this section, as this information is addressed in detail in Section 2.2.

The information is presented for each one of the five management areas previously mentioned in Figure 1. These sub-regions refer to The Netherlands (NL), Lower Saxony (LS), Schleswig-Holstein (SH), Hamburg (HH) and Denmark (DK).

The information is provided in accordance with the obligations of the Member States for the protection of habitats and species from the Natura 2000 areas. Such requirements refer in particular to:

i) HABITATS, SPECIES AND CONSERVATION STATUS

- Specification of the **habitats** (Annex I from the Habitats Directive) and the **species of Community interest** (Annex II, and IV and V from the Habitats Directive) present in the national territory.
- Definition of the **Special Areas of Conservation** (SAC) and of **Special Protection areas (SPA)** in which those habitats/species can be restored/maintained to a favourable conservation status.
- Setting of a surveillance system to evaluate the **conservation status** of the protected habitats and species.

Note that the information on the conservation status was obtained from the Natura2000 webpage (http://natura2000.eea.europa.eu) administrated by the European Environment Agency. The database compiles the information submitted by the Member States to the European Commission in a Standard Data Form. Most of the data presented on the conservation status of habitats and species refer to the years 2009-2010. An up-to-date

status is currently under preparation and will be included in the EU 2012 report for the period 2007-2012. Appendix IV presents the criteria used to evaluate the conservation status of habitats and species.

For birds, the information on population trends was obtained from the reports carried out by the Joint Monitoring Group for Breeding Birds. Appendix VI presents more information on these studies.

ii) CONSERVATION OBJECTIVES AND MEASURES

- Setting of **objectives and measures** that will allow reaching the favourable conservation status of habitats and species.

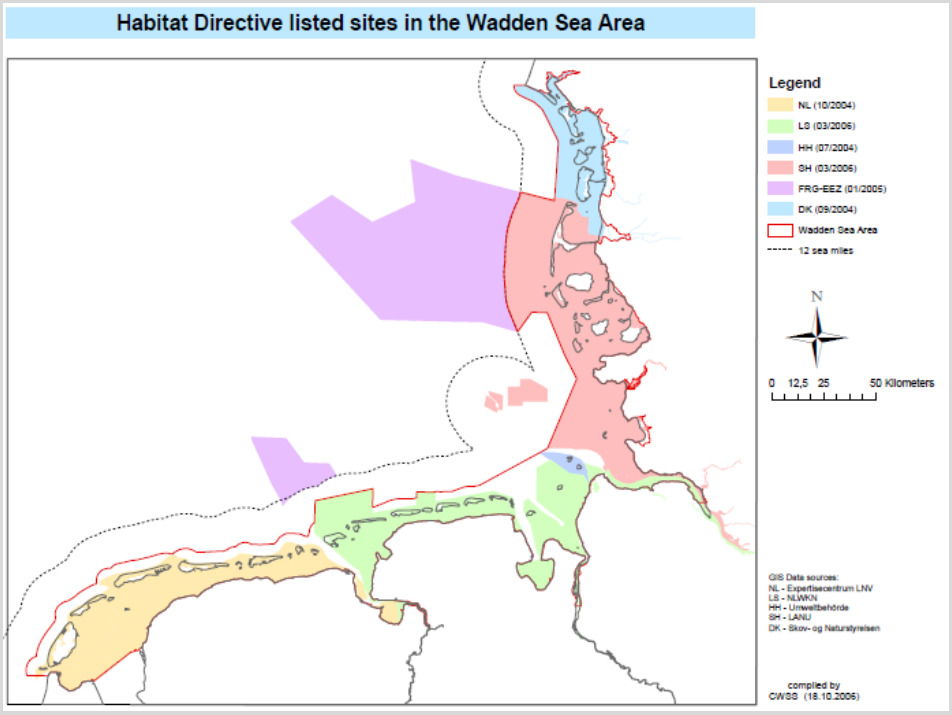
iii) EVALUATION OF PLANS AND PROJECTS

- Setting of a system which enables the **assessment** of plans or projects which may have a significant effect on the set Natura 2000 objectives.

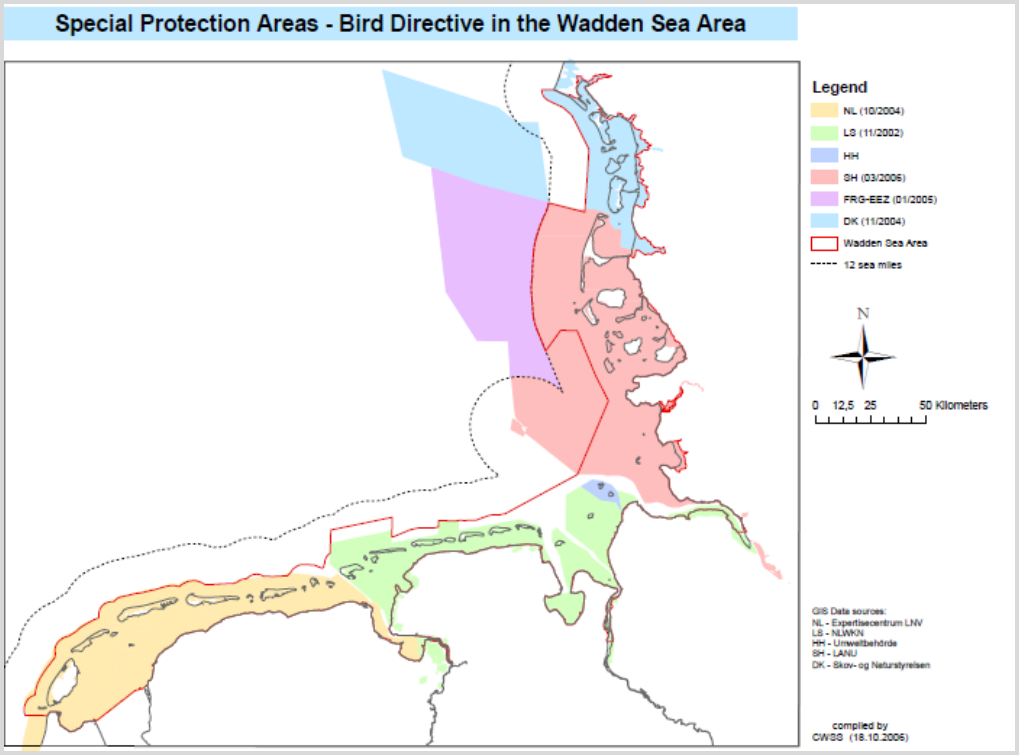
  Article 6-3 from the Habitats Directive requires that any plan or project likely to have a significant effect on the site's conservation objectives shall be subject to an appropriate assessment.

  The focus of this section is on those fisheries regarded as a *plan* or *project* which could have a negative impact on the conservation status of the Natura 2000 habitats and species.

Box 1: Natura 2000 areas in the Wadden Sea. Natura 2000 is a network of nature protection areas in Europe. It is comprised of special areas of conservation (SAC) and special protection areas (SPA). Both areas are designated by the Member States, the SAC under the Habitats Directive, and the SPA under the Birds Directive.



SAC from the Habitats Directive in the Wadden Sea area (CWSS)



SPA from the Birds Directive in the Wadden Sea area (CWSS)

2.1.1. THE NETHERLANDS

The Special Areas of Conservation listed under the Habitats Directive in the Dutch Wadden Sea are shown in the following table (from CWW, 2007).

Site	Code
Waddenzee	NL1000001
Noordzeekustzone	NL2003062
Duinen Texel, Waal en Burg, Dijkmans-huizen en De Bol	NL2003060
Duinen Vlieland	NL2003061
Duinen Terschelling	NL2003059
Duinen Schiermonnikoog	NL2003058

The areas relevant to the current study are *Waddenzee* and *Noordzeekustzone*. Both sites have been assigned as an SAC under the Habitats Directive and as an SPA under the Birds Directive:

- Waddenzee SAC: NL1000001
  SPA: NL9801001
- Noordzeekustzone SAC: NL2003062
  SPA: NL9802001

A. HABITATS, SPECIES AND CONSERVATION STATUS

The following tables summarize the information for each one of the areas of concern: Waddenzee and Noordzeekustzone.

Waddenzee		
Unless otherwise indicated, the information pertaining to the Waddenzee SAC was obtained from EEA Waddenzee (a), (2004) and SDF NL1000001 (2011). The information pertaining to the Waddenzee SPA was obtained from EEA Waddenzee (b) (2007) and SDF NL9801001 (2011)		
EC Habitats Directive SAC (NL1000001)		**EC Birds Directive SPA (NL9801001)**
Site details		
Area (Ha)	256,095	271,460
Biogeographic region	Atlantic	
Respondent	Natura 2000 Department, Ministry of Agriculture, Nature and Food Quality	
Administrative region	Overig Groningen	
General site character		
Marine areas, Sea inlets (55%) Tidal rivers, Estuaries, Mud flats, Sand flats, Lagoons (including saltwork basins) (38%) Salt marshes, Salt pastures, Salt steppes (4%) Coastal sand dunes, Sand beaches, Machair (3%)		Marine areas, Sea inlets (55%) Tidal rivers, Estuaries, Mud flats, Sand flats, Lagoons (including saltwork basins) (39%) Salt marshes, Salt pastures, Salt steppes (3%) Coastal sand dunes, Sand beaches, Machair (2%) Humid grassland, Mesophile grassland (1%)

Map	
	

Annex I habitats which feature in NL1000001	Conservation Status[2] (from SDF NL1000001, 2011)
1110 – Sandbanks which are slightly covered by sea water all the time (43% cover) 1140 – Mudflats and sandflats not covered by seawater at low tide (54%) Other (4,2%): 2190, 2160, 2130, 2120, 2110, 1330, 1320, 1310	(B) Good (A) Excellent
Annex II species which feature in NL1000001	**Conservation Status[3] (from SDF NL1000001, 2011)**
Mammals	
Grey seal (*Halichoerus grypus*) Common Seal (*Phoca vitulina*)	**(B) Good** **(B) Good**
Other non-Annex II mammals are mentioned for this site due to listing on the Berne, Bonn & Biodiversity conventions: Bottlenosed dolphin (*Tursiops truncatus*), Atlantic white-sided dolphin (*Lagenorhynchus acutus*), White-beaked dolphin (*Lagenorhynchus albirostris*), short-beaked common dolphin (*Delphinus delphis*)	
Fish	
Twaite Shad (*Allosa fallax*) River Lamprey (*Lampetra fluviatilis*) Sea Lamprey (*Petromyzon marinus*)	(A) Excellent (A) Excellent (A) Excellent
Annex I Birds which feature in NL9801001	**Conservation Status (from SDF NL9801001, 2011)**
Note: birds species with non-significant populations are not listed	
Barnacle goose (*Branta leucopsis*) Kentish Plover (*Charadrius alexandrinus*) Black Tern (*Chlidonias niger*) Bar-tailed Godwit (*Limosa lapponica*) European Golden Plover *(Pluvialis apricaria*) Pied Avocet (*Recurvirostra avosetta*)	(B) Good (C) Average or reduced (C) Average or reduced (B) Good (B) Good (C) Average or reduced

[2] Refers to the "*degrree of conservation of the structure and functions of the natural habitat type concerned and restoration possibilities*". (also see Appendix IV of this report)

[3] Refers to the "*degrree of conservation of the features of the habitat which are important for the species concerned, and possibilities for restoration*". (also see Appendix IV of this report)

Little Tern (*Sterna albifrons*)	(C) Average or reduced
Common Tern (*Sterna hirundo*)	(C) Average or reduced
Arctic Tern (*Sterna paradisaea*)	(C) Average or reduced
Sandwich Tern (*Sterna sandvicensis*)	(C) Average or reduced
Short-eared Owl (*Asio flammeus*)	(C) Average or reduced
Western Marsh-harrier (*Circus aeruginosus*)	(B) Good
Hen Harrier (*Circus cyaneus*)	(C) Average or reduced
Bewick's Swan (*Cygnus columbianus bewickii*)	(A) Excellent
Little Egret (*Egretta garzetta*)	-
Peregrine Falcon (*Falco peregrinus*)	(B) Good
White-tailed Eagle (*Haliaeetus albicilla*)	-
Eurasian Spoonbill (*Platalea leucorodia*)	(B) Good
Other, regularly occurring migratory birds which are not listed in Annex I of the EC Birds Directive are shown in Appendix I. These include the oyster catcher (*Haematopus ostralegus*) and common eider (*Somateria mollissima*), both of which have (C) Average or reduced conservation status.	

Noordzeekustzone

Unless otherwise indicated, the information pertaining to the Noordzeekustzone SAC was obtained from EEA Noordzeekustzone (a) (2004) and SDF NL2003062 (2004). The information pertaining to the Noordzeekustzone SPA was obtained from EEA Noordzeekustzone (b), (2007) and SDF NL9802001 (2011)

EC Habitats Directive SAC (NL2003062)	EC Birds Directive SPA (NL9802001)
Site details	
Area (Ha)	24,838	144,475
Biogeographic region	Atlantic	
Respondent	Natura 2000 Department, Ministry of Agriculture, Nature and Food Quality	
Administrative region	Noord-Friesland	
General site character	
Marine areas, Sea inlets (95%) Coastal sand dunes, Sand beaches, Machair (5%)	Marine areas, Sea inlets (97%) Coastal sand dunes, Sand beaches, Machair (3%)
Map	
	

Annex I habitats which feature in NL2003062	Conservation Status[4]
1110 – Sandbanks which are slightly covered by sea water all the time (80% cover) 1140 - Mudflats and sandflats not covered by seawater at low tide (2% cover) Others (0,5%) 1310, 1330, 2110, 2190	(C) Average or reduced (C) Average or reduced
Annex II species which feature in NL2003062	**Conservation Status**
Mammals	
Grey seal (*Halichoerus grypus*) Harbour Seal (*Phoca vitulina*) Harbor porpoise (*Phocoena phocoena*)	(B) Good (B) Good (B) Good
Fish	
Twaite Shad (*Allosa fallax*) River Lamprey (*Lampetra fluviatilis*) Sea Lamprey (*Petromyzon marinus*)	(C) Average or reduced (A) Excellent (A) Excellent
Annex I Birds which feature in NL9802001	**Conservation Status (from SDF NL9802001, 2011)**
Note: birds species with non-significant populations are not listed	
Kentish Plover (*Charadrius alexandrinus*) Black-throated loon (*Gavia arctica*) Red-throated loon / diver (*Gavia stellata*) Little Gull (*Larus minutus*) Bar-tailed Godwit (*Limosa lapponica*) Pied Avocet (*Recurvirostra avosetta*) Little Tern (*Sterna albifrons*)	(C) Average or reduced (B) Good (B) Good (B) Good (B) Good (B) Good (C) Average or reduced
Other, regularly occurring migratory birds which are not listed in Annex I of the EC Birds Directive are shown in Appendix I. These include the oyster catcher (*Haematopus ostralegus*) with "good" conservation status and the common eider (*Somateria mollissima*), with "average or reduced" conservation status.	

The following table summarises the trends of breeding and migratory birds in the Dutch Wadden Sea:

Trend	Breeding bird species (1991 – 2008) from JMBB (2010)	Migratory bird species (1987/88 - 2008/09) from JMBB (2010b)
Significant increase of >5% per year	Lesser Black-backed Gull Eurasian Spoonbill Great Cormorant Mediterranean Gull	Eurasian Spoonbill Great Cormorant Sanderling
Significant increase of <5% per year	Sandwich tern	Barnacle Goose Northern Pintail Great Ringed Plover Bar-tailed Godwit Common Redshank Northern Lapwing Grey Plover Eurasian Curlew Common Greenshank Common Gull Dunlin
No significant population change	Shelduck Little Tern Great Ringed Plover	Ruddy Turnstone Red Knot Northern Shoveler Dark-bellied Brent Goose

[4] Note that SDF NL2003062 was not operational at the time of writing - the data were therefore obtained from SDF NL9802001 (2011)

Trend	Breeding bird species (1991 – 2008) from JMBB (2010)	Migratory bird species (1987/88 - 2008/09) from JMBB (2010b)
		Common Teal Common Shelduck Black-headed Gull Pied Avocet Mallard European Golden Plover Great Black-backed Gull
Significant decrease of <5% per year	Common Gull Short-eared Owl Oystercatcher Herring Gull Common Eider Black-headed Gull Common Redshank Arctic Tern Avocet Black-tailed Godwit Northern Lapwing Eurasian Curlew Common Tern Kentish Plover	Eurasian Wigeon European Herring Gull Eurasian Oystercatcher Spotted Redshank Kentish Plover Ruff
significant decrease of >5% per year	Hen Harrier	
data do not allow trend analysis	Red-breasted Merganser Great Black-backed Gull Gull-billed Tern	
Uncertain trend (mostly due to strong fluctuations)		Whimbrel Curlew Sandpiper Common Eider

B. CONSERVATION OBJECTIVES AND MEASURES

In the Netherlands there are two types of objectives:

Key objectives (*kernopgaven*): relates to habitats and species for which, on the basis of assessment, improvement is considered necessary;

Conservation objectives (*instandhoudingsdoelen*): habitats and species for which the current conservation status is favourable and which must be maintained (CWSS, 2008).

The conservation objectives are only formulated for a site's habitats and species which are considered as being of importance. In the Dutch system, this is not automatically those listed in the site's Standard Data Form. At national level, for each habitat type or Annex II species, the 5 (10 for priority habitats/species) most important sites are determined, i.e. the SCI sites where each habitat or species is best developed and has the greatest size. These sites are selected as the Natura 2000 sites to be designated for the habitat or species in question. This first selection is supplemented by additional sites to ensure good national coverage, sufficient spread and links across boundaries. For birds, the site is selected only for those species for which it has national significance (one of 5 main sites/ minimum 1% of national breeding population/0.1% of biogeographic population regularly stages) (Zinke, 2009).

For each Natura 2000 Site, the objectives per habitat and species, including birds, are based on the national objective for that habitat or species and the contribution the Site can

make towards maintaining/achieving its favourable conservation status at national level. For certain habitats and species, which are under pressure and for which the Netherlands has a special responsibility within the EU context, complementary objectives to develop them (i.e. restoration) are set. Thus, in sites where their status is considered unfavourable (which is not the case for the Wadden Sea), the objective can be to increase the surface area or population (Zinke, 2009). However, overall, this signifies that no conservation objectives are formulated for those species and habitats which are not considered to be of importance to the SAC in question compared to other Dutch SACs. This approach is in keeping with the overall strategy of focusing efforts for maintenance and restoration of conservation status where the potential is highest (Zinke, 2009).

The Dutch system for prioritising objectives is logical and coherent, but it does mean that for the Wadden Sea, the objectives are not geared towards achieving favourable conservation status at trilateral level, but at Dutch level. Because for some Annex I habitats or annex II species the conservation status is considered favourable at national level or at least within the Dutch Wadden Sea, no objectives for expansion of such habitats or populations in the Wadden Sea are set. This is in contrast with the trilateral targets for the Wadden Sea which do systematically refer to increases (Zinke, 2009).

CONSERVATION OBJECTIVES FOR WADDENZEE

The Netherlands have merged the Wadden Sea SPAs and SCIs (and 6 other smaller N2000 Sites in the Wadden Sea) into a single Natura 2000 site with one official document, one single consultation procedure and one set of conservation objectives/management plans covering both Birds and Habitats Directive values. Such objectives are presented in the Dutch Ministerial Decision of Feb. 26 2009 (Zinke, 2009), following a public consultation process which began with the proposal of the draft designations for the 7 Wadden Sea N2000 SAC sites in mid-2007 (Zinke, 2009).

The Ministerial Decision (of Feb. 26 2009) establishes the conservation objectives formulated for the habitats and species for which the site is designated, and these designated habitats and species are the values which are used to evaluate any request or procedure for permit (Zinke, 2009).

The tables in Appendix II present the status and conservation objectives for the habitats and species protected under Natura 2000 in the Waddenzee and which are relevant for the current study. A summary is provided below:

- ***Habitats:*** The general objective for the habitats 1110 (sandbanks), 1130 (estuaries), and 1140 (mudflats) is to maintain the surface area and improve its quality. Among the site-specific objectives are to maintain the functional connection between the subtidal channels and the tidal banks, and to aim for the development of mussel banks.

- ***Fish:*** The general objective for twaite shad and river lamprey is to increase their respective populations. Specific objectives refer to maintaining the size and quality of the habitat.

- ***Mammals:*** Maintaining the size and quality of the habitat is the main objective listed for the grey and common seal.

- ***Birds:*** For some bird species, for example for the common eider and pied avocet, it is noted that the species are showing a declining trend, the cause of which is presumed to be located within the Wadden Sea. Therefore, to the basic objective is added 'improve quality of habitat' in which the habitat is either specified in generic terms (e.g. beaches for the Kentish plover) or specifically referred to as an annex I habitat (e.g. habitats 1110 and 1140 the common eider). In the single case of the oyster catcher, the objective is given as a range in population size (140-160,000 ind.) rather than as a precise population target. The cause for this appears to be related to uncertainties associated with the recovery of shellfish banks in the western Wadden Sea.

CONSERVATION OBJECTIVES FOR NOORDZEEKUSTZONE

The tables in Appendix II present the status and conservation objectives for the habitats and species protected under Natura 2000 in the Noordzeekustzone (URL 1) and which are relevant for the current study. A summary is provided below:

- ***Habitat:*** The conservation objectives for habitat type 1110, which occurs throughout the Noordzeekustzone (95%), are to maintain the distribution, surface area and quality of the habitat.

- ***Fish:*** The general objective listed for twaite shad, sea lamprey and river lamprey is to maintain the size and quality of their habitat, so that the population of the species can be maintained.

- ***Mammals:*** As above, the general objective associated with the grey and common seal and harbour porpoise is to maintain the size and quality of their habitat, so that the population of the species can be maintained.

- ***Birds:*** Maintaining the size and quality of the habitat is the general objective given for birds. For some bird species the objective specifies the amount of birds which the habitat should be able to maintain.

C. ASSESSMENT

The focus of this section is on fisheries, regarded as a *plan* or *programme* which could have a negative impact on the conservation status of the Natura 2000 habitats and species. In particular, this section explores how the assessment of *fishing activities in the protected area* is carried out in The Netherlands.

In the Netherlands, those who want to fish need to obtain a license from the government. If the fishery is to take place in the nature protected area of the Dutch Wadden Sea, then an extra licence must be obtained, which is covered by the Nature Conservation Act (*Natuurbeschermingswet*). In order to get this extra licence, an appropriate assessment has to be carried out; an assessment which is open for comments from stakeholders. The assessment implies that every fisheries activity has to be licensed according to nature

conservation objectives. Appropriate assessments are carried out for all licensed fisheries which take place in the Natura 2000 areas – this includes the blue mussel fisheries (twice a year), the cockle fishery (once a year) and the shrimp fisheries (every five years) (P. Walker, pers. comm.).

2.1.2. LOWER SAXONY

The Special Areas of Conservation listed under the Habitats Directive in the Lower Saxony part of the Wadden Sea are shown in the following table (from CWW, 2007).

Site	Code
Nationalpark Niedersächsisches Wattenmeer	DE2306301
Unterweser	DE2316331
Hund und Paapsand	DE2507301
Unterelbe	DE2018331
Unterems und Außenems	DE2507331
Küstenheiden und Krattwälder bei Cuxhaven	DE2117331

The area which applies to the current study is *Nationalpark Niedersächsisches Wattenmeer* (hereafter referred to as the Lower Saxony National Park). The site has been assigned both as an SAC under the Habitats Directive (DE2306301) and as an SPA (DE2210401) under the Birds Directive.

A. HABITATS, SPECIES AND CONSERVATION STATUS

The following table summarises the information for the Lower Saxony National Park.

Nationalpark Niedersächsisches (Lower Saxony National Park)		
Unless otherwise indicated, the information pertaining to the Nationalpark Niedersächsisches SAC was obtained from EEA Niedersächsisches (2008) and SDF DE2306301 (2008). The information pertaining to the Nationalpark Niedersächsisches SPA was obtained from EEA Niedersächsisches (2010) and SDF DE2210401 (2010).		
EC Habitats Directive SAC (DE2306301)		**EC Birds Directive SPA (DE2210401)**
Site details		
Area (Ha)	276,956.22	354,882.00
Biogeographic region	Atlantic	
Respondent	Landesbetrieb NLWKN Nieders. Landesbetrieb f. Wasserwirtschaft, Küsten- und Naturschutz	
Administrative region	Cuxhaven	
General site character		
Marine areas, Sea inlets (34%) Tidal rivers, Estuaries, Mud flats, Sand flats, Lagoons (including saltwork basins) (55%) Salt marshes, Salt pastures, Salt steppes (3%) Coastal sand dunes, Sand beaches, Machair (5%) Humid grassland, Mesophile grassland (3%)		Marine areas, Sea inlets (92%) Salt marshes, Salt pastures, Salt steppes (2%) Coastal sand dunes, Sand beaches, Machair (4%) Humid grassland, Mesophile grassland (2%)

Map	
	
Annex I habitats which feature in DE2306301	**Conservation Status (from SDF DE2306301, 2008)**
1110 – Sandbanks which are slightly covered by sea water all the time (14,6% cover)	(A) Excellent
1130 – Estuaries (0,9%)	(A) Excellent
1140 – Mudflats and sandflats not covered by seawater at low tide (47,5%)	(A) Excellent
1160 – Large shallow inlets and bays (29,3%)	(B) Good
1170 – Reefs (0,2%)	(C) Average or reduced
Other (5,7%): 1310, 1320, 1330, 2110, 2120, 2130, 2140, 2150, 2160, 2170, 2180, 2190, 3130	-
Annex II species which feature in DE2306301	**Conservation Status (from SDF DE2306301, 2008)**
Mammals	
Harbor porpoise (*Phocoena phocoena*)	(B) Good
Common Seal (*Phoca vitulina*)	(B) Good
Fish	
Sea Lamprey (*Petromyzon marinus*)	-
Annex I Birds	**Conservation Status (from SDF DE2210401, 2010)**
Note: birds species with non-significant populations are not listed	
Short-eared Owl (*Asio flammeus*)	(B) Good
Eurasian Bittern (*Botaurus stellaris*)	(B) Good
Barnacle goose (*Branta leucopsis*)	(B) Good
Kentish Plover (*Charadrius alexandrinus*)	(B) Good
Black tern (*Chlidonias niger*)	(B) Good
Western Marsh-harrier (*Circus aeruginosus*)	(B) Good
Hen Harrier (*Circus cyaneus*)	(B) Good
Corn crake (*Crex crex*)	(C) Average or reduced
Bewick's Swan (*Cygnus columbianus bewickii*)	(B) Good
Whooper Swan (*Cygnus cygnus*)	(B) Good
Peregrine Falcon (*Falco peregrinus*)	(B) Good
Black-throated Loon (*Gavia arctica*)	(A) Excellent
Red-throated Loon (*Gavia stellata*)	(B) Good
Gull-billed Tern (*Gelochelidon nilotica*)	(B) Good
Red-backed Shrike (*Lanius collurio*)	(B) Good
Mediterranean Gull (*Larus melanocephalus*)	(B) Good
Little Gull (*Larus minutus*)	(B) Good
Bar-tailed Godwit (*Limosa lapponica*)	(B) Good
Smew (*Mergus albellus*)	(B) Good
Ruff (*Philomachus pugnax*)	(B) Good
Eurasian Spoonbill (*Platalea leucorodia*)	(B) Good
European Golden Plover (*Pluvialis apricaria*)	(B) Good
Pied Avocet (*Recurvirostra avosetta*)	(B) Good
Little Tern (*Sterna albifrons*)	(B) Good
Common Tern (*Sterna hirundo*)	(B) Good
Arctic Tern (Sterna paradisaea)	(B) Good
Sandwich Tern (Sterna sandvicensis)	(B) Good

Other, regularly occurring migratory birds which are not listed in Annex I of the EC Birds Directive are shown in Appendix I. These include the oyster catcher (*Haematopus ostralegus*) and common eider (*Somateria mollissima*), both of which have "(B) good" conservation status.

The following table summarises the trends of breeding and migratory birds in Lower Saxony (and Hamburg):

Trend	Breeding bird species (1991 – 2008) from JMBB (2010)	Migratory bird species (1987/88 - 2008/09) from JMBB (2010b)
Significant increase of >5% per year	Lesser Black-backed Gull Eurasian Spoonbill Great Cormorant Mediterranean Gull Common Gull	Eurasian Spoonbill Great Cormorant
Significant increase of <5% per year	Sandwich Tern Common Eider Hen Harrier	Barnacle Goose Ruddy Turnstone Eurasian Wigeon
No significant population change	Shelduck Short-eared Owl Oystercatcher	Northern Pintail Bar-tailed Godwit Red Knot Northern Shoveler Dark-bellied Brent Goose Common Greenshank Common Gull Dunlin Spotted Redshank
Significant decrease of <5% per year	Little Tern Black-headed Gull Common Redshank Arctic Tern Avocet Black-tailed Godwit Northern Lapwing Common Tern	Sanderling Great Ringed Plover Common Redshank Grey Plover Eurasian Curlew Common Teal Common Shelduck Black-headed Gull Pied Avocet Mallard European Golden Plover Whimbrel European Herring Gull Eurasian Oystercatcher Great Black-backed Gull
significant decrease of >5% per year	Gull-billed Tern Herring Gull Great Ringed Plover	Kentish Plover Ruff Curlew Sandpiper
data do not allow trend analysis	Red-breasted Merganser Great Black-backed Gull Kentish Plover	Common Eider
Uncertain trend (mostly due to strong fluctuations)	Eurasian Curlew	Northern Lapwing

B. CONSERVATION OBJECTIVES AND MEASURES

The *Niedersächsische Strategie zum Arten- und Biotopschutz* (Niedersächsische, 2011) sets out the conservation objectives for the habitats and species for which the site is designated. For Lower Saxony, the bird species, other wildlife and plant species as well as habitat/biotope types with priority status for action were identified and classified into different priorities. For these species and habitat/biotope types, enforcement instructions were developed. Besides providing information on the ways of life or on the characteristics of the habitats/biotopes, these instructions essentially contain proposals for measures and appropriate instruments for the conservation and development of species and habitats.

CONSERVATION OBJECTIVES FOR THE LOWER SAXONY NATIONAL PARK

The tables in Appendix II present the status and conservation objectives for the habitats and species protected under Natura 2000 in the Lower Saxony National Park and which are relevant for the current study. A summary is provided below:

- ***Habitats***: The conservation objectives given for the habitats 1110 (sandbanks), 1130 (estuaries), 1140 (mudflats), 1160 (large shallow bays and inlets) and 1170 (reefs) aim for good water quality, low disturbance of marine mammal and bird populations and protection against harmful substances. A specific objective for habitats 1110, 1140 and 1170 is to have natural subtidal mussel beds at all stages of life and with intact communities; the preservation and development of a stable inventory of biogenic and geogenic reefs including various reef-building organisms (1170), and to have favourable conditions for the re-establishment of native oyster banks, *Sabellaria* reefs and subtidal eelgrass beds (1110, 1160. 1170[5]). The objectives also state that no forms of commercial or recreational fishing should lead to the impairment of the substrate, structure, functions, flora and fauna of the habitat (1140, 1160 and 1170). Commercial and recreational fishing should only take place in the peripheral areas of 1170. Finally for habitat 1170 it is also said that the effects from invasive species should be maintained at a moderate level.

- ***Fish:*** The main conservation objectives for designated fish species are to maintain and where required restore the migratory corridors of the species and their spawning areas.

- ***Mammals:*** The conservation objectives for the common seal and the harbour porpoise refer to stable populations and low disturbance of the habitats. One of the measures relates to the protection and development of mammal food resources. For the porpoise specifically the need to reduce by-catch is mentioned.

- ***Birds:*** The conservation objectives for birds list the preservation and restoration of habitat to a favourable conservation status, as well as the restoration of long-term self-sustaining populations. The requirement to develop a diverse and adequate food source is also mentioned.

[5] 1170 is only for the favourable conditions for the re-establishment of *sabellaria* reefs

C. EVALUATION OF THE FISHERIES

Appropriate assessments are not carried out for any of the fisheries taking place in Lower Saxony (there is a management plan for blue mussels in LS but this does not have the same objectives or include the same analysis as an appropriate assessment). A more detailed presentation of Lower Saxony fisheries is provided in Section 2.2.

2.1.3. HAMBURG

The Special Area of Conservation listed under the Habitats Directive in the Hamburg part of the Wadden Sea is shown in the following table (from CWW, 2007).

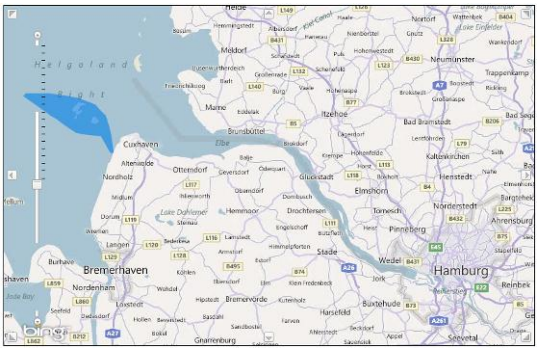
Site	Code
Nationalpark Hamburgisches Wattenmeer	DE2016301

This area is also related to the SPA area DE2016401 (*Hamburgisches Wattenmeer*) which is also included in this section of the report.

A. HABITATS, SPECIES AND CONSERVATION STATUS

The following table summarises the information for the Nationalpark Hamburgisches

Nationalpark Hamburgisches		
Unless otherwise indicated, the information pertaining to the Nationalpark Hamburgisches SAC was obtained from EEA Hamburgisches (2010) and SDF DE2016301 (2011). The information pertaining to the Nationalpark Hamburgisches SPA was obtained from EEA Hamburgisches (b) (2010) and SDF DE2016401 (2010).		
EC Habitats Directive SAC (DE2016301)		**EC Birds Directive SPA (DE2016401)**
Site details		
Area (Ha)	13750	11700
Biogeographic region	Atlantic	
Respondent	Stadtentwicklung u. Umwelt Naturschutzamt, Hamburg	
Administrative region	Hamburg	
General site character		
Marine areas, Sea inlets (11%) Tidal rivers, Estuaries, Mud flats, Sand flats, Lagoons (including saltwork basins) (85%) Salt marshes, Salt pastures, Salt steppes (2%) Coastal sand dunes, Sand beaches, Machair (1%) Humid grassland, Mesophile grassland (1%)		Marine areas, Sea inlets (10%) Tidal rivers, Estuaries, Mud flats, Sand flats, Lagoons (including saltwork basins) (86%) Salt marshes, Salt pastures, Salt steppes (2%) Coastal sand dunes, Sand beaches, Machair (2%) Humid grassland, Mesophile grassland (1%)

Map	
	

Annex I habitats which feature in DE2016301	Conservation Status (from SDF DE2016301, 2011)
1110 – Sandbanks which are slightly covered by sea water all the time (20% cover)	(B) Good
1140 – Mudflats and sandflats not covered by seawater at low tide (74%)	(A) Excellent
1160 - Large shallow inlets and bays (3%)	(A) Excellent
Other (3%): 1310, 1320, 1330, 2110, 2120, 2130, 2190	-
Annex II species which feature in DE2016301	**Conservation Status (from SDF DE2016301, 2011)**
Mammals	
Harbor porpoise (*Phocoena phocoena)*	(B) Good
Common Seal (*Phoca vitulina*)	(A) Excellent
Fish	
Twaite Shad (*Allosa fallax*)	(B) Good
River Lamprey (*Lampetra fluviatilis*)	(B) Good
Sea Lamprey (*Petromyzon marinus*)	(B) Good
Annex I Birds	**Conservation Status (from SDF DE2016401, 2010)**
Note: birds species with non-significant populations are not listed	
Short-eared Owl (*Asio flammeus*)	(A) Excellent
Barnacle goose (*Branta leucopsis*)	(B) Good
Peregrine Falcon (*Falco peregrinus*)	(A) Excellent
European Golden Plover *(Pluvialis apricaria*)	(A) Excellent
Pied Avocet (*Recurvirostra avosetta*)	(A) Excellent
Little Tern (*Sterna albifrons*)	(A) Excellent
Common Tern (*Sterna hirundo*)	(B) Good
Arctic Tern (*Sterna paradisaea*)	(B) Good
Sandwich Tern (*Sterna sandvicensis*)	(B) Good
Other, regularly occurring migratory birds which are not listed in Annex I of the EC Birds Directive are shown in Appendix I. These include the oyster catcher (*Haematopus ostralegus*) which has an "(A) excellent" conservation status.	

The trends of breeding and migratory birds in Hamburg, as reported by the Joint Monitoring Group for Breeding Birds (JMBB), have been reported amongst the trends for Lower Saxony.

B. CONSERVATION OBJECTIVES AND MEASURES

The information on conservation objectives was obtained from "*Act on the Wadden Sea of Hamburg National Park*"[6]. The document presents information that could be classified as general conservation objectives for the area.

Among these are the following:

- Conserve the area in its entirety and with its natural dynamics for its own sake
- Conserve the area as a habitat for species that depend on this unique tidal-flat habitat, as well as for the communities comprising such species
- Protect the area against damage
- Protect as habitats those areas on which species depend for their survival (fish spawn areas; seal resting areas; birds breeding, feeding, resting areas;

The document also presents what could be considered a general conservation objective for the protected species:

- Protect and promote the development of Wadden Sea plant and animal species that are highly endangered or are threatened with extinction, by means of suitable measures, and especially by means of intensified protection and intensified care, development and restoration of their biotopes and by protecting their other necessary conditions for life.

No particular conservation objectives are given regarding the specific habitat or species types.

C. EVALUATION OF THE FISHERIES

This section is not applicable as no large-scale commercial fishery takes place in the Hamburg National Park. According to National Park Law some commercial fishery on shrimps is allowed in special areas (as well as a small-scale fishery for private use according to Nr. 5b National Park Law HH).

[6] *Act on the "Wadden Sea of Hamburg" National Park. In the version promulgated on 9 April 1990 (Hamburg Law Gazette (Hamburgisches Gesetz- und Verordnungsblatt), No.11/1990 of 12 April 1990, pages 64 - 66) amended by resolution of the state parliament of 5 April 2001 (Hamburg Law Gazette, No.13/2001 of 18 April 2001, pages 52-53).* Document sent by Dr. Klaus Janke, personal communication March 6, 2012

2.1.4. SCHLESWIG-HOLSTEIN

The Special Areas of Conservation listed under the Habitats Directive in the Schleswig-Holstein part of the Wadden Sea are shown in the following table (from CWW, 2007).

Site	Code
NTP S-H Wattenmeer und angrenzende Küstengebiete	DE0916391
Dünen- und Heideland-schaften Nord-Sylt	DE0916392
Dünenland-schaft Süd-Sylt	DE1115391
Küstenland-schaft Ost-Sylt	DE1116391
Dünen- und Heideland-schaften Nord- und Mittel-Sylt	DE1016392
NSG Rantum-becken	DE1115301
Küsten- und Dünenlandschaften Amrums	DE1315391
Godelnie-derung / Föhr	DE1316301
Dünen St. Peter	DE1617301
Eiderstedt („Westerhever“, „Poppenbüll“, „Kotzenbüll“)	DE1618402
Untereider	DE1719391
Schleswig-Holsteini-sches Elbästuar und angrenzende Flächen	DE2323392
Gewässer des Bongsieler Kanal-Systems	DE1219391
Elbe bei Brunsbüttel/St. Margarethen	DE2119391

The area of concern to this study consists of the EU FFH area (SAC) *NTP S-H Wattenmeer und angrenzende Küstengebiete* (DE0916391) and the EU Bird directive area (SPA) *Ramsar-Gebiet S-H Wattenmeer und angrenzende Küstengebiete* (DE0916491). Each of these areas is described in detail in the table of subsection A. *Habitats, Species and Conservation Status*. The column to the left refers to the EU FFH area, and the column to the right refers to the EU Bird (Ramsar) area

A. HABITATS, SPECIES AND CONSERVATION STATUS

The following table summarises the information for the area of concern:

Ramsar- Gebiet S-H Wattenmeer und angrenzende Küstengebiete NTP S-H Wattenmeer und angrenzende Küstengebiete		
Unless otherwise indicated, the information pertaining S-H Wattenmeer und angrenzende Küstengebiete SAC was obtained from EEA Wattenmeer (2009) and SDF DE0916391 (2010). The information pertaining to the SPA area was obtained from EEA Ramsar Wattenmeer (2009) and SDF DE0916491 (2009)		
EC Habitats Directive SAC (DE0916391)		**EC Birds Directive SPA (DE0916491)**
Site details		
Area (Ha)	452,455.00	463,907.00
Biogeographic region	Atlantic	
Respondent	NPA S-H Wattenmeer & LANU (3) S-H Landesamt für den Nationalpark Schl.-Holst. Wattenmeer Landesamt für Natur und Umwelt des Landes Schleswig-Holstein	
Administrative region	Pinneberg	

General site character	
Marine areas, Sea inlets (64%) Tidal rivers, Estuaries, Mud flats, Sand flats, Lagoons (including saltwork basins) (30%) Salt marshes, Salt pastures, Salt steppes (2%) Coastal sand dunes, Sand beaches, Machair (1%) Inland water bodies (standing water, running water) (1%) Bogs, Marshes, Water fringed vegetation, Fens (1%) Humid grassland, Mesophile grassland (1%)	Marine areas, Sea inlets (60%) Tidal rivers, Estuaries, Mud flats, Sand flats, Lagoons (including saltwork basins) (34%) Salt marshes, Salt pastures, Salt steppes (2%) Coastal sand dunes, Sand beaches, Machair (2%) Inland water bodies (Standing water, Running water) (1%) Humid grassland, Mesophile grassland (1%)
Map	
	
Annex I habitats which feature in DE0916391	**Conservation Status (from SDF DE0916391, 2010)***
1110 – Sandbanks which are slightly covered by sea water all the time (2% cover) 1140 – Mudflats and sandflats not covered by seawater at low tide (27%) 1130 – Estuaries (3%) 1160 – Large shallow inlets and bays (28,3%) 1170 – Reefs (0,1%) Other (2,3%): 1210, 1220, 1310, 1320, 1330, 2110, 2120	(A) Excellent (A) Excellent (A) Excellent (A) Excellent (B) Good -
Annex II species which feature in DE0916391	**Conservation Status (from SDF DE0916391, 2010)***
Mammals	
Grey seal (*Halichoerus grypus*) Common Seal (*Phoca vitulina*) Harbor porpoise (*Phocoena phocoena)*	(B) Good (B) Good (B) Good
Fish	
Sea Lamprey *(Petromyzon marinus)* Twaite Shad (*Allosa fallax*) River Lamprey *(Lampetra fluviatilis)*	(C) Average or reduced (B) Good (B) Good
Annex I Birds which feature in DE0916491	**Conservation Status (from SDF DE0916491, 2009)***
Note: birds species with non-significant populations are not listed	
Short-eared Owl (*Asio flammeus*) Eurasian Bittern (*Botaurus stellaris*) Barnacle goose (*Branta leucopsis*) Kentish Plover (*Charadrius alexandrinus*) Black Tern (*Chlidonias niger*) Western Marsh-harrier (*Circus aeruginosus*) Hen Harrier (*Circus cyaneus*) Montagu's Harrier (*Circus pygargus*) Corn crake (*Crex crex*) Bewick's Swan (*Cygnus columbianus bewickii*) Whooper Swan (*Cygnus cygnus*) Merlin (*Falco columbarius*) Peregrine Falcon (*Falco peregrinus*) Black-throated loon (*Gavia arctica*) Red-throated Loon (*Gavia stellata*)	(A) Excellent (A) Excellent (A) Excellent (A) Excellent (A) Excellent (A) Excellent (A) Excellent (A) Excellent (A) Excellent (A) Excellent (A) Excellent (A) Excellent (A) Excellent (A) Excellent (A) Excellent

Gull-billed Tern (*Gelochelidon nilotica*) White-tailed Eagle (*Haliaeetus albicilla*) Black-winged Stilt (*Himantopus himantopus*) Mediterranean Gull (*Larus melanocephalus*) Little Gull (*Larus minutus*) Bar-tailed Godwit (*Limosa lapponica*) Bluethroat (*Luscinia svecica*) Ruff (*Philomachus pugnax*) Eurasian Spoonbill (*Platalea leucorodia*) European Golden Plover *(Pluvialis apricaria*) Spotted Crake (*Porzana porzana*) Pied Avocet (*Recurvirostra avosetta*) Little Tern (*Sterna albifrons*) Common Tern (*Sterna hirundo*) Arctic Tern (*Sterna paradisaea*) Sandwich Tern (*Sterna sandvicensis*)	(A) Excellent (A) Excellent (A) Excellent (A) Excellent (A) Excellent (A) Excellent (A) Excellent (A) Excellent (A) Excellent (A) Excellent (A) Excellent (A) Excellent (A) Excellent (A) Excellent (A) Excellent (A) Excellent (A) Excellent
Other, regularly occurring migratory birds which are not listed in Annex I of the EC Birds Directive are shown in Appendix I. These include the oyster catcher (*Haematopus ostralegus*) common eider (*Somateria mollissima*), both of which have an "(A) excellent" conservation status.	

* More recent reports are available (Gebiet 0916-391, 2011; Gebiet 0916-491, 2009), however these refer to out of date conservation statuses.

The following table summarises the trends of breeding and migratory birds in Schleswig-Holstein:

Trend	Breeding bird species (1991 – 2008) from JMBB (2010)	Migratory bird species (1987/88 - 2008/09) from JMBB (2010b)
Significant increase of >5% per year	Lesser Black-backed Gull Great Cormorant Great Black-backed Gull Gull-billed Tern	Eurasian Spoonbill Barnacle Goose Great Cormorant
Significant increase of <5% per year	Common Gull Shelduck Herring Gull Avocet Common Tern	Great Ringed Plover Ruddy Turnstone Northern Shoveler
No significant population change	Common Redshank	Northern Pintail Sanderling Eurasian Wigeon Common Redshank Northern Lapwing Grey Plover Whimbrel
Significant decrease of <5% per year	Little Tern Oystercatcher Common Eider Black-headed Gull Arctic Tern Northern Lapwing Great Ringed Plover	Bar-tailed Godwit Red Knot Eurasian Curlew Dark-bellied Brent Goose Common Greenshank Common Gull Common Teal Dunlin Common Shelduck Black-headed Gull Pied Avocet Mallard European Golden Plover European Herring Gull Eurasian Oystercatcher Spotted Redshank Great Black-backed Gull Kentish Plover Ruff

Trend	Breeding bird species (1991 – 2008) from JMBB (2010)	Migratory bird species (1987/88 - 2008/09) from JMBB (2010b)
significant decrease of >5% per year	Sandwich Tern Kentish Plover	
data do not allow trend analysis	Eurasian Spoonbill Mediterranean Gull Red-breasted Merganser Short-eared Owl Black-tailed Godwit Eurasian Curlew Hen Harrier	Common Eider
Uncertain trend (mostly due to strong fluctuations)		Curlew Sandpiper

B. CONSERVATION OBJECTIVES AND MEASURES

S-H Wattenmeer und angrenzende Küstengebiete

The conservation objectives for the protected habitats and species and for the protected birds in the S-H Wattenmeer und angrenzende Küstengebiete are given in two different documents. They are briefly explained below:

Regarding habitats and species, the conservation objectives for the SAC *NTP S-H Wattenmeer und angrenzende Küstengebiete* (DE0916391) were obtained from the document "*Gebietsspezifische Erhaltungsziele (gEHZ) für das FFH-Vorschlagsgebiet Gebiet DE 0916-391 NTP S-H Wattenmeer und angren-zende Küstengebiete*"[7].

This document refers to the Overarching objectives for the entire area (*Übergreifende Ziele für das Gesamtgebiet*), and to the Overarching objectives for the sub-regions (*Übergreifende Ziele für das Teilgebiet*). The sub-regions refer to a division made by the authorities, given the size of the area, and given the different anthropogenic history and the different geomorphological characteristics of the regions. Three sub-regions were created:

- Sub-region 1: National Park of Schleswig-Holstein Wadden Sea and adjacent coastal area
- Sub-region 2: Frisian holms Langeneß, and Gröde Nordstrandischmoor (Nordfriesische Halligen Langeneß, Gröde und Nordstrandischmoor)
- Sub-region 3: Polders on the west coast of Schleswig-Holstein (Köge an der Westküste Schleswig-Holsteins)

Among the overarching objectives for the entire area are:

- Preserve or restore to a possibly favourable conservation status the habitat types 1110, 1130, 1140, 1160, 1170; and the species Twaite shad, Sea lamprey, River lamprey, Grey seal, Common seal, and Harbour porpoise.

[7] Bekanntmachung des Ministeriums für Landwirtschaft, Umwelt und ländliche Räume vom 10. Juli 2007 – V 521- 5321-30-56 Http://www.schleswig-holstein.de/cae/servlet/contentblob/595192/publicationFile/Mai2007AmtsblattFFH_NP_pdf.pdf

- Preserve, primarily by guaranteeing the undisturbed evolution of natural processes, and in particular by conserving the habitats of the grey seal, harbour seal and the harbour porpoise as well as lampreys and various other fish species.

- Preservation of the relationships between the sub-areas of the whole, as well as the adjoining Sites of Community Importance on the islands and the mainland coast. This includes in particular the biotic and abiotic exchange and transport of biotic and abiotic material, for example the transport and transfer of sand and suspended matter, in order to preserve habitat types such as dunes and salt meadows, as well as the biogenic exchange of other organisms including plankton, invertebrates, fish and birds between the sub-areas.

Sub-region 1 and Sub-region 3 contain the habitats of interest for this study. Sub-region 1 contains habitats type 1110, 1130, 1140, 1160, and 1170. Sub-region 3 contains habitat type 1140 and 1160. The objectives for these sub-regions are presented in the tables in Appendix II. A summary is provided below:

- ***Habitats:*** Habitats 1110 (sandbanks), 1130 (estuaries), 1140 (mudflats), 1160 (large shallow bays and inlets), 1170 (Reefs) are considered of particular significance. Among the overarching objectives for these habitats are the conservation of their natural geomorphological dynamics and the hydrogeological and hydrochemical conditions, and the conservation of the highest possible water quality. Among the region-specific conservation objectives are the preservation of the ecological interactions with the terrestrial, freshwater and marine environments and the preservation of their functions as mudflats and tidal flats. For habitat 1170 the need to protect the area from mechanical damage is specifically mentioned.

- ***Fish:*** The general objective for designated fish species is the preservation of existing populations, and the preservation of the condition of their habitats.

- ***Mammals:*** Objectives for the grey and common seal and the harbour porpoise include the preservation of viable stocks and natural reproduction capacity, as well as the habitats in which these species live. One of the objectives relates to the requirement for preserving a diverse fauna (fish, shrimp, mussels and crabs) as a food resource.

- ***Birds:*** An independent document presents the conservation objectives for the SPA *Ramsar-Gebiet S-H Wattenmeer und angrenzende Küstengebiete*) (DE0916491)[8]. The document also presents the Overarching objectives for the entire area (*Übergreifende Ziele für das Gesamtgebiet*), and to the Overarching objectives for the sub-regions (*Übergreifende Ziele für das Teilgebiet*).

[8] Bekanntmachung des Ministeriums für Landwirtschaft, Umwelt und ländliche Räume vom 23. April 2007 – V 521- 5321-324.9-1 http://www.schleswig-holstein.de/cae/servlet/contentblob/594976/publicationFile/2007-04-23_Amtsblatt_VSG_NP_pdf.pdf

Among the Overarching objectives for the entire area are:

- Preserve the natural dynamics of the area (as transition area from land to sea; as hub for migratory birds; as breeding, moulting and witnering area for water birds; as food, moulting and resting site for sea birds)

- Achieve a favourable conservation status of bird populations in areas that are heavily influenced by traditional human uses

The area is also divided into 5 sub-regions:

- Sub-region 1: National Park of Schleswig-Holstein Wadden Sea and adjacent coastal area (Nationalpark Schleswig-Holsteinisches Wattenmeer und angrenzender Küstenstreifen)
- Sub-region 2: Nordfriesische Halligen (Langeneß, Oland, Hooge, Gröde, Nordstrandischmoor
- Sub-region 3: North Frisian Islands (Nordfriesische Inseln)
- Sub-region 4: Polders on the west coast of Schleswig-Holstein (Köge an der Westküste Schleswig-Holsteins)
- Sub-region 5 Estuaries / river mouths (Ästuare/Flussmündungen)

The detailed objectives can be seen in the tables of Appendix II but among the overarching objectives for the regions is the preservation of site-specific birds in their natural dynamics, and the preservation of typical habitat structures and functions.

Among the region-specific objectives is the preservation of suitable nesting, breeding, transit and overwintering areas, as well as large non-fragmented areas. Specific objectives refer to the requirement to prevent additional bird mortality from bycatch in fisheries; the requirement to have natural occurrence of shellfish stocks with site-appropriate accompanying fauna, and a natural fish fauna as a food resource for some of the bird species.

C. EVALUATION OF THE FISHERIES

In Schleswig-Holstein, appropriate assessments are generally not carried out for fisheries taking place in the area. An exception is the mussel fishery for which the last appropriate assessments were carried out at the end of 2011 prior to licensing. The most recent assessment also covered the import of seed mussels into SH and it is expected that this will also be carried out for the use of mussel seed collectors. A discussion on the suitability of said assessments is presented in Section 2.2.2.

2.1.5. DENMARK

The Special Areas of Conservation listed under the Habitats Directive in the Danish Wadden Sea are shown in the following table (from CWW, 2007).

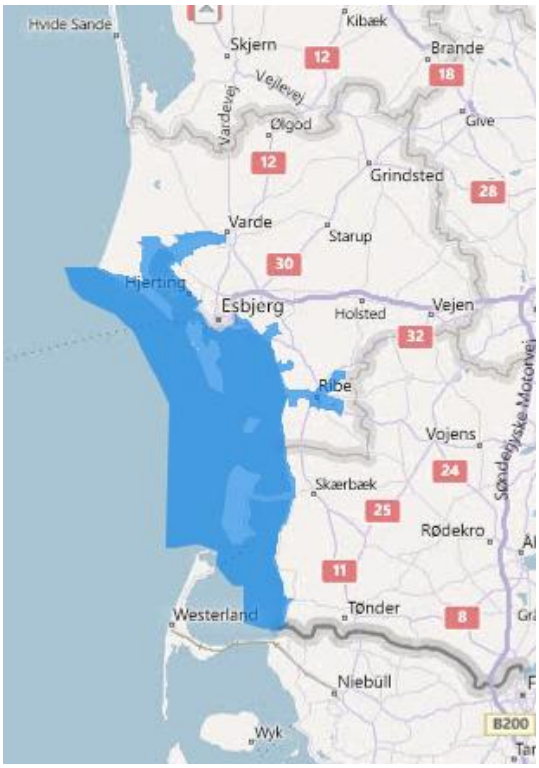
Site	Code
Vadehavet med Ribe Å, Tved Å og Varde Å vest for Varde	DK00AY176
Vidå med tilløb, Rudbøl Sø og Magister-kogen	DK009x182
Brede Å	DK009x346

The area of concern to the current study is *Vadehavet med Ribe Å, Tved Å og Varde Å vest for Varde* (hereafter refered as *Vadehavet*). Vadehavet has been assigned as both an SAC (DK00AY176) under the Habitats Directive and as an SPA (DK00AY057) under the Birds Directive. Both will be discussed here.

A. HABITATS, SPECIES AND CONSERVATION STATUS

The table on the next page summarises the information for Vadehavet.

Vadehavet		
Unless otherwise indicated, the information pertaining to the Vadehavet SAC was obtained from EEA Vadehavet (2009) and SDF DK00AY176 (2011). The information pertaining to the Vadehavet SPA was obtained from EEA Vadehavet (b) (2009) and SDF DK00AY057 (2009)		
EC Habitats Directive SAC (DK00AY176)		**EC Birds Directive SPA (DK00AY057)**
Site details		
Area (Ha)	134,732	115,671
Biogeographic region	Atlantic	
Respondent	Ministry of Environment	
Administrative region	Nature Agency	
General site character		
Marine areas, Sea inlets (55%) Tidal rivers, Estuaries, Mud flats, Sand flats, Lagoons (including saltwork basins) (28%) Salt marshes, Salt pastures, Salt steppes (4%) Coastal sand dunes, Sand beaches, Machair (5%) Heath, Scrub, Maquis and Garrigue, Phygrana (2%) Dry grassland, Steppes (1%) Improved grassland (3%) Other arable land (1%) Artificial forest monoculture (e.g. Plantations of poplar or Exotic trees) (1%)		Marine areas, Sea inlets (62%) Tidal rivers, Estuaries, Mud flats, Sand flats, Lagoons (including saltwork basins) (33%) Salt marshes, Salt pastures, Salt steppes (2%) Coastal sand dunes, Sand beaches, Machair (3%)

Map	
	

Annex I habitats which feature in DK00AY176	Conservation Status [9]	
	Obtained from SDF DK00AY176 (2011) [10]	Obtained from Nature Agency (2011)
1110 – Sandbanks which are slightly covered by sea water all the time (30% cover)	(A) Excellent	Unfavourable
1140 – Mudflats and sandflats not covered by seawater at low tide (34%)	(A) Excellent	Unfavourable
1130 – Estuaries (1%)	(A) Excellent	Unfavourable
1150 – Coastal lagoons (1%)	(A) Excellent	Unknown
1160 – Large shallow inlets and bays (1%)	(C) Average or reduced	Unfavourable
1170 – Reefs (4%)	(C) Average or reduced	Unfavourable
Other (29%): 2120, 2130, 2140, 2160, 2170, 2180, 2190, 2310, 2330, 3130, 3140, 7230, 9190, 91D0, 3150, 3160, 3260, 4010, 4030, 6210, 1310, 1320, 1330, 2110, 6230, 6410, 7150		

[9] Two types of conservation status for habitats and species are presented. The difference in the evaluation criteria is addressed in Box 3 of Appendix V. Also see Section 2.1.6

[10] The habitat conservation status refers to the "*degrree of conservation of the structure and functions of the natural habitat type concerned and restoration possibilities*". (Also see Appendix IV)

Annex II species which feature in DK00AY176	Conservation Status	
Mammals		
	Obtained from SDF DK00AY176 (2011) [11]	Obtained from Nature Agency (2011)
Grey seal (*Halichoerus grypus*)	(C) Average or reduced	Unknown
Eurasian Otter (*Lutra lutra*)	(A) Excellent	Favourable
Common Seal (*Phoca vitulina*)	(A) Excellent	Favourable
Harbor porpoise (*Phocoena phocoena*)	(B) Good	Unknown
Fish		
	Obtained from SDF DK00AY176 (2011)	Obtained from Nature Agency (2011)
Twaite Shad (*Allosa fallax*)	(A) Excellent	Unknown
River Lamprey (*Lampetra fluviatilis*)	(A) Excellent	Unknown
Sea Lamprey (*Petromyzon marinus*)	(A) Excellent	Unknown
Houting* (*Coregonus oxyrhynchus)*	(A) Excellent	Unfavourable
Brook Lamprey (*Lampetra planeri)*	(A) Excellent	Favourable
Salmon (*Salmon salar)*	(A) Excellent	Unfavourable
Annex I Birds which feature in DK00AY057	**Conservation Status (from SDF DK00AY057, 2009)**	
Note: birds species with non-significant populations are not listed		
Short-eared Owl (*Asio flammeus*)	-	
Barnacle goose (*Branta leucopsis*)	(A) Excellent	
Kentish Plover (*Charadrius alexandrinus*)	(A) Excellent	
Western Marsh-harrier (*Circus aeruginosus*)	-	
Montagu's Harrier (*Circus pygargus*)	-	
Gull-billed Tern (*Gelochelidon nilotica*)	(A) Excellent	
Little Gull (*Larus minutus*)	(A) Excellent	
Bar-tailed Godwit (*Limosa lapponica*)	(A) Excellent	
Ruff (*Philomachus pugnax*)	-	
European Golden Plover (*Pluvialis apricaria*)	(A) Excellent	
Pied Avocet (*Recurvirostra avosetta*)	(A) Excellent	
Little Tern (*Sterna albifrons*)	(A) Excellent	
Common Tern (*Sterna hirundo*)	(A) Excellent	
Arctic Tern (*Sterna paradisaea*)	(A) Excellent	
Sandwich Tern (*Sterna sandvicensis*)	(A) Excellent	
Wood Sandpiper (*Tringa glareola*)	-	
Other, regularly occurring migratory birds which are not listed in Annex I of the EC Birds Directive are shown in Appendix I. These include the oyster catcher (*Haematopus ostralegus*) and common eider (*Somateria mollissima*), both of which have "good" conservation status.		

The following table summarises the trends of breeding and migratory birds in the Danish Wadden Sea:

Trend	Breeding bird species (1991 – 2008) from JMBB (2010)	Migratory bird species (1987/88 - 2008/09) from JMBB (2010b)
Significant increase of >5% per year	Lesser Black-backed Gull Common Gull Sandwich Tern Herring Gull	Eurasian Spoonbill Barnacle Goose Great Cormorant Eurasian Curlew
Significant increase of <5% per year	Shelduck Little Tern Common Eider Black-headed Gull Kentish Plover	Northern Pintail Sanderling Red Knot Eurasian Wigeon Northern Shoveler Common Redshank Common Shelduck

[11] The species conservation status refers to the "*degrree of conservation of the features of the habitat which are important for the species concerned, and possibilities for restoration*". (Also see Appendix IV)

Trend	Breeding bird species (1991 – 2008) from JMBB (2010)	Migratory bird species (1987/88 - 2008/09) from JMBB (2010b)
		Eurasian Oystercatcher
No significant population change	Oystercatcher Common Redshank Arctic Tern	Ruddy Turnstone Northern Lapwing Grey Plover Common Greenshank Common Gull Common Teal Black-headed Gull European Herring Gull Great Black-backed Gull
Significant decrease of <5% per year	Avocet Black-tailed Godwit Northern Lapwing Great Ringed Plover	Bar-tailed Godwit Dark-bellied Brent Goose Dunlin Pied Avocet Mallard European Golden Plover Spotted Redshank
significant decrease of >5% per year	Common Tern	Whimbrel Kentish Plover Ruff
data do not allow trend analysis	Eurasian Spoonbill Great Cormorant Mediterranean Gull Red-breasted Merganser Short-eared Owl Gull-billed Tern Eurasian Curlew Hen Harrier	Common Eider
Uncertain trend (mostly due to strong fluctuations)	Great Black-backed Gull	Great Ringed Plover Curlew Sandpiper

B. CONSERVATION OBJECTIVES AND MEASURES

Unless otherwise indicated, the information presented in this section was obtained from Nature Agency (2011).

In Denmark, the Wadden Sea is treated as a single Natura 2000 site known as "N89 Vadehavet", with a single Natura 2000 plan covering the habitats and species present in the 4 Habitats Directive SAC areas (H78, H86, H90 and H239) and 9 Birds Directive SAP areas (F49, F51, F52, F53, F55, F57, F60, F65, and F67). The main areas of interest for the current study refer to H78 and F57. H86 and H90 refer to two rivers discharging into the Wadden Sea. The plan is revised every six years, and the current plan refers to the years 2010-2015, designating objectives for habitat protection (and the species of community interest therein), but also for bird protection, and water management (in accordance with the requirements of the Water Framework Directive). The municipalities and local authorities are responsible for designing the specific plan, selecting the instruments, and executing the measures which will lead to the given objectives.

Two types of objectives are provided: the general *"overordnet målsætning"*, usually given in terms of maintaining or restoring the favourable conservation status to habitats and species, and the specific targets *"konkrete målsætning"* which are given depending on the results of an evaluation on the condition of the habitats and the species.

The point of departure of the plan was to carry out an evaluation for the Danish Wadden Sea Area; however, the evaluation focused on the terrestrial habitats. The evaluation report states that a system for assessing the status of marine habitats, birds and other species is lacking. In this case a prognosis of the status was developed, based on the available knowledge and on the current threats to designated habitats and species (The threats can be seen in Box 2 of Appendix V).

The prognosis was given in terms of the definition of *favourable conservation status* stated in the Habitats Directive and three categories were given: *favourable*, *unfavourable* and *unknown.* The prognosis for the habitats and species of interest to this report can be seen in Box 3 of Appendix V.

For those habitats and species evaluated as *favourable*, the development in their area and its condition should be stable or increasing. For those evaluated as *unfavourable*, the development should be progressing in order to: (a) achieve favourable conservation status, as long as the natural conditions allow for it, (b) the total area of the habitat should be stable or in progress, if the natural conditions allow for it. For those with an *unknown* status, the objective is to achieve favourable conservation status which means that the habitat's species should form the basis for a breeding population.

Conservation objectives for Vadehavet

A detailed description of the conservation objectives for the habitats and species of Vadehavet can be seen in the tables in Appendix II. A summary is provided below:

- ***Habitats:*** Among the general objective for the habitats 1110 (sandbanks), 1130 (estuaries), 1140 (mudflats), 1160 (large shallow bays and inlets), and 1170 (reefs) is the achievement of favourable conservation status; andd in particular, the achievement of good water quality status, ensure ecological integrity of the area, and a rich fauna and flora which among others will help ensure food resources for the many species that inhabit the area.,

- ***Fish:*** Among the objectives for designated fish species is the achievement of favourable conservation status, i.e. the species should form the basis for a breeding population, and that migration routes to spawning grounds should be restored. High priority and enhanced protection is given to houting and its habibat.

- ***Mammals:*** Among the objectives given for the common and grey seal, and the harbour porpoise is that the area should be considered of favourable status, to ensure good water quality and good feeding conditions in the Wadden Sea.

- ***Birds:*** An overview of the Annex I bird species and regularly occurring migratory bird species is given in Appendix I. For the purpose of this study, it was deemed sufficient to take a more general approach and birds were therefore considered as a single group.

The conservation status for birds ranges from favourable to unfavourable with the most common threats in the marine environment including reduction and fragmentation of habitats, habitat destruction and reduced food availability due to finish and shellfish

fisheries and disturbance from marine traffic including fisheries. Conservation objectives are similar for most bird species, requiring that the state and total area of habitats must be stable or increasing, ensuring the availability of suitable and undisturbed grounds for roosting / breeding / foraging populations. Specific targets are given in terms of how many pairs of birds the habitat should be able to maintain.

C. EVALUATION OF THE FISHERIES

Since 2008, the Ministry of Food, Agriculture and Fisheries requires that any commercial fisheries taking place in the Natura 2000 areas of Denmark, need to have completed an impact assessment before a license can be granted. This has resulted in the prohibition of all bivalve fisheries within the Natura 2000 area of the Danish Wadden Sea. This is further discussed in Section 2.2.

2.1.6. COMPARISON OF THE IMPLEMENTATION OF THE HABITATS AND BIRDS DIRECTIVE

Based on the information presented in the previous sections, three topics were highlighted for further analysis of similarities and differences in the implementation of the Habitats and Birds Directive in the three Wadden Sea countries:

- Status of habitats and species
- Conservation objectives
- Designation of mussel banks

NOTE FOR CONSIDERATION

For each Natura 2000 site, national authorities submit a standard data form (SDF) that contains an extensive description of the site and its ecology. The European Topic Centre for Biological Diversity (ETC/BD) is responsible for validating these data and creating an EU-wide descriptive database. The information on conservation status for habitats and species presented in this report for Vadehavet is based on both the SDF data and Nature Agency (2011) data, as detailed in the corresponding table in Section 2.1.5-A. Both types of data are based on different evaluation criteria, outlined in Box 3 of Appendix V. For example, the information presented in Nature Agency (2011) employs criteria, some of which are based on objectives established in the Water Framework Directive while the SDF data are based on objectives established in the Habitats and Birds Directives. During this study, the validity of the Vadehavet SDF data was not recognized by the relevant Danish authorities, and the suggestion was made to retain the Nature Agency (2011) data as the sole source for Vadehavet conservation status. However, for all other Natura 2000 sites within the Wadden Sea Area, the information on conservation status was systematically based on the SDF data. For this reason, and for comparability purposes, the information obtained from the Vadehavet SDF was retained in the discussion on conservation status. Note that for the discussion on conservation objectives, which were

not systematically based on the SDF data, the information on Denmark obtained from Nature Agency (2011) was used.

STATUS OF HABITATS AND SPECIES

The information published in the EEA webpages (SDF data) was used as a basis for comparison between the different regions. In the particular case of DK, where two types of conservation statuses were available for habitats and species, only the EEA information was used, as explained above.

A comparison of the conservation status of habitats indicates that in general the habitats 1110 (sandbanks), 1130 (estuaries) and 1140 (mudflats) have an excellent status. This is with the exception for NL where these habitats were evaluated as good and average/reduced. Habitat 1160 (large shallow inlets) was evaluated as excellent in SH and HH, while in DK and in LS this was respectively average and good. Note that habitat 1160 is not reported in NL. Habitat 1170 (reefs) is in general considered to be of an average or reduced status. A table detailing the status of these habitats in the three countries is provided in Appendix III[12].

For mammals and fish species, the majority are in a good to excellent status, except for the grey seal, which is considered to be of average or reduced status in Denmark, and sea lamprey, considered of average or reduced status in Schleswig-Holstein – for a detailed comparison, see Appendix III. Note that Denmark accounts for a number of species which are not listed for the other Wadden Sea countries. These include: the Eurasian otter - with good status; and houting, salmon and brook lamprey – with excellent status[13].

With regards to birds the JMBB (2010) study revealed that for the trilateral Wadden Sea breeding bird populations (BBP) for species such as the lesser black-backed gull, Eurasian spoonbill, great cormorant and Mediterranean gull, experienced significant increases of more than 5% per year between 1991 and 2008. In contrast, BBP for species including the black-tailed godwit and northern lapwing showed significant declines of less than 5% annually in that same period.

At a trilateral level, JMMB (2010b) showed that migatory bird populations (MBP) for species such as the Eurasian spoonbill, barnacle goose and great cormorant experienced a significant increase of more than 5% per year between 1987/88 and 2008/09. Significant decreases of less than 5% were experienced by the MBP of the Kentish plover and ruff. Note that migratory mussel-eating birds such as the common eider and oystercatcher experienced significant declines of less than 5% in NL, SH and LS.

[12] The evaluation of DK's habitats 1110, 1130, 1140, 1160, and 1170 presented in Nature Agency (2011) refers to an unfavourable condition due to inadequate nutrient conditions.

[13] The evaluation of DK's eurasian otter, houting, salmon and brrok lamprey presented in Nature Agency (2011) refers to favourable, unfavourable, favourable and unfavourable status respectively. Favourable status refers to a species which has a stable or growing population in the area. Unfavourable status is due to the presence of barriers, lack of spawning / nursery areas and degraded water quality.

Further information on both studies is provided in Appendix VI.

CONSERVATION OBJECTIVES

The main conclusion from the comparative analysis carried out in the report "*National conservation objectives, Habitat -2/2, 2nd Trilateral workshop species and habitats*" (CWSS, 2008) was that the national conservation objectives given for the habitats by each of the different areas are to a high extent comparable. This conclusion was also reached in the current report.

The findings from the "*High level review of EC directives for collaboration and harmonisation, Identifying priorities for trilateral collaboration of the Wadden Sea*" (Zinke, 2009) are also in line with the findings of this report. One of the conclusions by Zinke (2009) was that the conservation objectives given in SH were more detailed than the ones given in NL. In the current report it was found that in general, the objectives presented by LS are more concrete and detailed than the set of objectives given by the other Wadden Sea regions.

In specific, the following can be said regarding the conservation objectives given by the different areas for the habitats and species protected under Natura 2000 and that are of interest for the current analysis. A detailed compendium of the conservation objectives for the different areas can be seen in appendix II:

Habitat type 1110 (sandbanks): general objectives include provision of appropriate habitat for the characteristic species, improving water quality, maintaining the natural dynamic processes, and protection against harmful substances. Specific objectives include the development of mussel banks (NL, LS), the restoration of fish stocks (NL), and the re-establishment of native oyster beds and S*abellaria* reefs (LS). Note that LS is also specific on the avoidance of habitat impacts from commercial fishing and limits maritime traffic speed to reduce the risk of collisions with mammals. DK also specifically identified trawl fishing as a threat to this habitat.

Habitat type 1130 (estuaries): objectives include the improvement of water quality, conservation of geomorphological dynamics, achievement of favourable conservation status and stable populations of characteristic species. LS is specific on the avoidance of barriers to migratory fish, and states that the habitat should serve as a breeding and feeding ground for birds and mammals.

Habitat type 1140 (mudflats): objectives are similar to the ones listed for H1110 (sandbanks). General objectives include those related to water quality, provision of good habitat for characteristic species and reduction of hazardous substances. Specific objectives include the restoration of intertidal mussel beds (NL), natural subtidal mussel beds at all stages of life and with intact communities (LS). LS also specifies that no fishing activities should impact on this habitat and that a future increase in invasive species is expected to take place.

Habitat type 1160 (large shallow bays): general objectives include the achievement of favourable conservation status, good water quality and undisturbed natural processes. Objectives listed by LS specifically include the development of natural subtidal mussel beds at all stages of life and with intact communities, the reestablishment of native oyster beds and subtidal *Sabellaria* reefs, the prevention of impacts by commercial or recreational fishing, and moderate displacement effects by invasive species. DK by contrast identified trawl fishing as a threat to the habitat.

Habitat type 1170 (reefs): both LS and DK acknowledge that there is limited knowledge on this habitat type: DK refers to limited knowledge on the specific boundary of the biogenic reef, while LS refers to a need for developing an inventory for reefs and reef-building organisms. Objectives listed by LS specifically include the development of natural subtidal mussel beds containing all life stages, the provision of favourable conditions for the re-establishment of *Sabellaria* reefs, and the development of natural communities of reefs. LS also concludes that the structure and function of reefs are not to be impaired by fishing, and that fishing should only take place in peripheral areas.

SH has as particular objective the preservation of natural areas of the sea bed or shallow water zones from mechanical (anthropogenic) damage or morphological disturbance, with hard substrates such as boulders, stones, natural mussel banks or Sabellaria reefs and sandbanks formed from a mix of these components. SH also lists the development of natural Sabellaria reefs as an objective, while DK identified the invasive pacific oyster as a problem for this habitat.

All regions present similar objectives for the conservation of marine mammals. Among these objectives are for example to maintain the size and quality of the habitat, to have long-term and stable populations, and to reduce waste and pollution of water bodies. Emphasis is placed on the protection of the food resources (LS, SH, DK). Some regions such as DK and SH specifically mention the reduction of maritime traffic to avoid collisions with mammals and identified fisheries as a threat to mammals (through bycatch and entanglement). LS also specifically lists the reduction of porpoise bycatch as an objective.

For protected fish species, the different regions also have similar objectives, including to increase or preserve the population, maintain the habitats and maintain or restore migratory corridors and spawning areas.

For birds, the objectives are given to improve the quality of habitats and specifications are made by LS in the creation of lakes, lagoons and flat landing areas and by DK in threats related to habitat reduction. Objectives also refer to targets for bird populations, with LS aiming for self-sustaining populations and an increase in the density of breeding pairs; and DK and NL actually specifying the amount of birds required and the amount of suitable breeding/foraging ground. Objectives are also listed regarding food requirements, with LS aiming to maintain sufficient food supply, development of adequate food sources; and SH aiming to have natural stock abundance of site-specific species such as mussels. With respect to fisheries, DK identified fisheries as a threat to food availability and through

disturbance to moulting and foraging birds. SH also aims to prevent bird mortality through bycatch in fisheries.

DESIGNATION OF MUSSEL BEDS

Previous studies carried out for the Common Wadden Sea Secretariat have addressed the issue of differences in the designation of Wadden Sea mussel beds:

- In DK mussel beds were first not classified as 1170 (reefs) (CWSS, 2008), but sublittoral mussel beds have now been classified under this habitat type[14].
- Along the same lines, mussel beds in NL are included in habitats 1110 and 1140 (CWSS, 2008), but are not especially designated as any of the habitat types 1110, 1140, or 1170 (Zinke, 2009).
- In the Dutch Wadden Sea SAC Decision, mussel beds are mentioned in the context of the conservation objectives for 1110 and 1140. For 1110, improving the opportunities for mussel banks to develop is mentioned, together with improving fish populations and species range, as a way to improve the quality of this Annex I habitat type. Restoring littoral mussel banks is mentioned as one of the means to improve the quality of 1140. However, this reference to mussel banks as one of the instruments to achieve favourable conservation status of habitat types 1110 and 1140 is not in the same league as an explicit designation of mussel banks as habitat 1170 (biogenetic reefs on soft or hard substrate) on the SDF of a site (Zinke, 2009).
- In LS sublittoral mussel beds have been designated as 1170 (reefs). In SH, so far (i.e. during the first reporting cycle) intertidal mussel beds have been reported as biogenic reefs (1170) within the standard data forms for the National Park of SH. After a revision of the definition by the EU a few years ago, reefs have to origin in the subtidal and may reach (or may not) into the intertidal. For the coming reporting period the standard data form will require revision as subtidal mapping in SH has not detected the presence of biogenic reefs. This implies that mussel beds will be integrated as typical species of 1140 (Mudflats and sandflats) in the intertidal.

The Zinke (2009) report also discusses the consequences of having differences in the designation of mussel beds among the Member States:

- Differences between designation/non-designation of habitat types and species across the Wadden Sea can, because of the strong protection awarded to designated features, have important consequences for stakeholders. During the targeted interviews, hints were given that because Dutch mussel beds are not designated as distinct 1170 reefs, German mussel fishermen are now displeased about the German definition and designation of these beds as biogenic 1170 reefs.

[14] H 1170 has been designated as biogenic reef (mainly sublitoral mussel beds). The actual reefs themselves have not yet been designated, since Denmark has no data on location of sublittoral mussel beds

The reasoning behind the difference in the designation of the mussel beds was one of the questions addressed during the interviews with contacts from each of the different areas.

In DK sublittoral mussel beds are generally designated as habitat type 1170, although some specific sublittoral mussel beds have not yet been designated because of lack of information. In NL, it was thought by interviewees to be unclear why mussel beds had not been designated as reefs. Mussel beds are included in two types of habitats: subtidal (H1110) and intertidal (H1140) with different conservation objectives for each (P. Walker, pers. comm.). For LS it was clarified that the existing mussel beds were designated in accordance with the theoretical interpretation of mussel beds being considered as reefs when they are in the subtidal, and when they grow from the subtidal to the intertidal (H1170). Intertidal mussel beds are therefore not considered as reefs and are included in H1140 (G. Millat, pers. comm.). And, as previously stated, although mussel beds were originally designated as reefs (H1170) in SH, this designation is being revised due to the absence of biogenic reefs in subtidal mapping surveys. Here also, intertidal reefs will be included in H1140. During the interviews held with regional representatives the conclusion was not reached that the different designations imply different levels of protection as all listed habitats require high levels of protection. This question could therefore be considered as academic and current conflicts between nature conservationists and the mussel sector continue regardless of this difference in designation.

2.2. FISHERIES IN THE WADDEN SEA

The following section presents an inventory of the current fisheries situation in the trilateral Wadden Sea. The inventory focused on the status of each key fishery from a trilateral perspective and within the respective Wadden Sea countries. The information presented is based on the available literature, with particular reference to the Wadden Sea Quality Status Reports. A series of interviews were also conducted to supplement the gathered information with local and regional knowledge. For each of the main identified fisheries, the following structure was adhered to:

A. Introduction to the fishery from a general perspective (background information)

B. National overview

C. Regulatory framework from a trilateral perspective and where appropriate according to each Wadden Sea country

D. Overview of fisheries currently engaged with the Marine Stewardship Council certification scheme for sustainable fisheries.

E. Conclusion

2.2.1. GENERAL NOTES ON WADDEN SEA FISHERIES

In the past the Wadden Sea has supported various commercial fisheries, including an important herring fishery, which in the 1930's produced up to 20,000 tons annually. This ended with the closure of the Zuiderzee in 1932 along with the increased pollution in the River Elbe (SGS, 2011). Today, fisheries in the Wadden Sea are primarily for shrimp and shellfish and, on a much smaller scale for eel, smelt and flatfish. Each of the key Wadden Sea fisheries is discussed in more detail in the sections below and a summary is provided in Table 1.

Table 1. Summary of main fisheries in the Wadden Sea for each Wadden Sea region (Nehls *et al*, 2009a, b; EC, 2011). NL (The Netherlands); LS (Lower Saxony / Niedersachsen); SH (Schleswig-Holstein); HH (Hamburg National Park) and DK (Denmark).

Target Species	NL	LS	SH	HH	DK
Blue mussel (*Mytilus edulis*)	- Seed mussel fishery (dredge and seed collectors), seed mussel import and culture	- Seed mussel fishery (dredge and seed collectors) and culture - wild mussel fishery (dredge) - Seed mussel import	- Seed mussel fishery (dredge and seed collectors) and culture - Seed mussel import	None	-Former wild mussel fishery (dredge) - now closed

Target Species	NL	LS	SH	HH	DK
Cockle (*Cerastoderma edule*)	- Manual cockle fishery by hand raking	None	None	None	- Small-scale mechanical cockle fishery outside the Natura 2000 area.
Other shellfish	-	- No landings since 1995	- Dormant since the mid-1990s (will be closed as of 2016) - Razor clam (*Ensis* spp.) outside conservation area - One 30ha Pacific oyster (*Crassostrea gigas*) and consumption collection - Seed oyster collection	None	- No *Spisula* landings since 2006 - One license for Pacific oyster culture but currently not in use
Brown shrimp (*Crangon crangon*)	- 92 shrimp trawl licenses. Dutch coastal waters (3-12 nm) also accessible to German shrimp trawlers (access to Danish fleet not specified)	- 117 shrimp trawl licenses. German coastal waters (3-12 nm) accessible to NL fleet, and from DK/German frontier to northern tip of Amrum also accessible to DK fleet.	- 116 shrimp trawl licenses. German coastal waters (3-12 nm) accessible to NL fleet, and from DK/German frontier to northern tip of Amrum also accessible to DK fleet.	some shrimp fishing allowed in special areas (as well as small-scale fishery for private use).	- 28 shrimp trawl licenses. Danish coastal waters (6-12 nm) accessible to German fleet from DK/German frontier to Hanstholm. NL fleet only allowed access outside 12nm.
Eel (*Anguilla anguilla*), flounder (*Platichthys flesus*, smelt (*Osmerus eperlanus*), Chinese mitten crab (*Eriocheir sinensis*)	- Fyke net fishery, (24 permits in use)	Fyke net fishery	Fyke net fishery	None	Fyke net fishery

Target Species	NL	LS	SH	HH	DK
Seabass (*Dicentrarchus labrax*) and mullet (*Liza aurata*)	- Bottom gill net fishery (5-6 permits in use) - Seine net fishery (4-5 permits in use)	-	- Bottom gill net fishery	None	-

NOTE ON MANAGEMENT FRAMEWORK FOR EU FISHERIES AND TRILATERAL TARGETS

For management purposes in The Netherlands, Germany and Denmark – as being Member States of the European Union - fisheries are subject to the principles and practices of the Common Fisheries Policy (CFP) of the EU, which has been in force since 1983. The general objective of the establishment of the CFP is to provide a legal framework for the "*… rational and responsible exploitation of the living marine resources on a sustainable basis, in appropriate economic and social conditions for the sector taking account of its implications for the marine ecosystem and of the needs of both producers and consumers*." (Venema, 2001). The CFP, however, applies for the most part only outside 12 nm off the coastal baseline (low-water line), with a few exceptions in the 6-12 nm zone (e.g. historical fishing rights). The Wadden Sea mussel and cockle fisheries listed above are coastal fisheries for which the management responsibility therefore lies with the Member States (passed on to the Länder in the case of Germany). The shrimp fisheries, which also take place beyond the 12 nm limit off the coastal baseline are subject to the principles and practices of the EU Common Fisheries Policy (CFP).

It should also be noted that other EU legislations apply to fisheries inside the 12 nm limit:

The Habitats and Birds Directives provide the legal basis for establishing a Europe-wide network of designated protected areas under Natura 2000 and require the adoption of conservation objectives for designated habitats and species with the aim of achieving favourable conservation status of these features. As such, where a plan or project has the risk of interfering with the achievement of a favourable conservation status, an appropriate assessment has to be carried out; however, not all fisheries are regarded as a plan or a project in all Wadden Sea countries, as discussed in section 2.1. In each fisheries sub-section, it is discussed whether or not an appropriate assessment is carried out.

The 2008 Marine Strategy Framework Directive (MSFD) puts a requirement on Member States to achieve 'good environmental status' for marine waters by 2020. It requires the development and implementation of strategies to (a) protect and preserve the marine environment, prevent its deterioration or, where practicable, restore marine ecosystems in areas where they have been adversely affected; and (b) prevent and reduce inputs in the marine environment, with a view to phasing out pollution, so as to ensure that there are no significant impacts on, or risks to, marine biodiversity, marine ecosystems, human health or legitimate uses of the sea. It requires the application of an ecosystem-based approach to

the management of human activities and the integration of environmental concerns into the different policies, agreements and legislative measures which have an impact on the marine environment (CWSS, 2010). The criteria for 'good environmental status' (ref. Commission Decision 2010/477/EU) includes a criterion that exploited fish and shellfish stocks should be maintained at 'MSY' (a productive stock biomass) – this is the same criterion that is currently being applied to fisheries managed under the CFP, although the target date is later (2020 as opposed to 2015). While the responsibility for choosing management targets and selecting and implementing management measures still remains with the Member States, the MSFD does provide an overarching framework for sustainable fisheries (and sustainable ecosystems) in marine coastal areas such as the Wadden Sea. Note, however, that in The Netherlands, the MSFD is not applied to the Wadden Sea.

The 2000 Water Framework Directive aims at the general protection of the aquatic ecology, specific protection of unique and valuable habitats, protection of drinking water resources, and protection of bathing water, with an emphasis on good overall ecological status, not just improved water quality standards. Under the WFD, member states must integrate these objectives for each river basin and are required to implement the necessary measures in order to achieve "good ecological status" and "good chemical status" by 2015 in all water bodies, with "good status" defined through broad ecological indicators including biological, hydromorphological, chemical and physico-chemical Quality Elements (CWSS, 2010). For fisheries, this means continued improvement in fish stocks through improved habitats and improved water quality and quantity, with fish being just one of the biological quality elements that are used to assess the ecological status of water bodies. Fish populations are measured and classified into one of the five ecological status classes (high, good, moderate, poor or bad) (EA, 2010). There is a requirement within the Directive for the linkages between surface and groundwater and water quantity and water quality to be taken into account in meeting objectives. There is also a requirement for the integration of the management of water-dependent Natura 2000 sites and river basin plans, and moreover, consideration must be given to the water needs of wetlands (CWSS, 2010).

A comparison of the EU directives listed above was carried out in CWSS (2010), and a summary is presented in Table 2 below. The Directives offer a range of integrative approaches, from the Habitats and Birds Directives, which are more focused on individual habitats and species, to the MSFD which offers the most integrative approach from the ecosystem perspective. The Trilateral Targets for the Wadden Sea encompass these different approaches of EU Directives and harmonise them between the three Wadden Sea nations. As such, CWSS (2010) defines the Trilateral Target concept as an integrated ecosystem concept which goes beyond the above EU directives. The Target concept fully covers and integrates the Habitats and Birds Directives, the Water Framework Directive as well as the World Heritage criteria. The Targets are consistent with the Conservation Objectives and Good Ecological Status approach from the Directives and additionally serve the World Heritage criteria. The Target concept is, furthermore, a trilateral concept relevant for the whole Wadden Sea Area. It is the common basis for the harmonisation of the different national approaches under the EU Directives (CWSS, 2010). In Table 3 is

shown a thematic overlap of the WS Trilateral Targets with these EU Directives. The overlap with World Heritage criteria is also shown; however, these are not discussed here (see CWSS, 2010).

Table 2. Comparison of EC Habitats and Birds Directives (HD, BD), Water Framework Directive (WFD) and Marine Strategy Framework Directive (MSFD). From CWSS (2010).

	BD + HD	WFD	MSFD
General objective	Favourable conservation status	Good ecological status / potential & good chemical status	Good environmental status
Indicators	Habitat (range, structure and function, characteristic/ typical species) Rare species (population, range, maintenance)	Biological (species composition and abundance) hydromorphological, chemical and physico-chemical Quality Elements	Biological, physical and chemical characteristics, pressures and impacts Environemntal targets and associated indicators
Reporting unit	Habitat type, species	Water body	Marine regions
Scale	Per country / bio-geographic area	River basin district	Marine (sub)regions (overlap with WFD)
Time	2007[1], 2015[1]	2015[2], 2021[2]	2020[2]
Management plan	N2000 management plan (Art. 6)	River basins management plan (Art 13, 11)	Programme of measures (Art. 13)

Table 3. Thematic overlap of Wadden Sea Plan Targets with issues from the EC Directives and the World Heritage criteria. From CWSS (2010).

TOPIC	Wadden Sea Plan Targets	Habitats / Birds Directive	WFD	MSFD	World Heritage Criteria
Landscape + Culture	+	-	-		
Water and Sediment	+	(indirectly)	+	+	VIII, IX
Salt Marshes	+	+	+		VIII, IX, X
Tidal Area (eu- / sub-litoral)	+	+	+	+	VIII, IX, X
Beaches and Dunes	+	+	-		VIII, IX, X
Estuaries	+	+	+		VIII, IX, X
Offshore Zone	+	+	-	+	VIII, IX, X
Rural Area	+	+	-		
Birds	+	+	-	+	X
Marine Mammals	+	+	-	+	X
Fish	+	+	+ transitional	+	X

2.2.2. BLUE MUSSEL (*MYTILUS EDULIS*) FISHERIES

A. BACKGROUND INFORMATION

Mussels are amongst the most important commercial fishery resources in the Wadden Sea. Fisheries for blue mussels (*Mytilus edulis*) can generally be carried out in several ways:

i) A direct fishery for adult mussels by dredge,

ii) A fishery for natural beds of small ('seed') mussels by dredge followed by a culture process on leased areas of seabed ('culture lots' or 'lays');

iii) Collection of newly settled mussels ('spat') on artificial collectors (usually ropes) followed by bottom culture; or

iv) Culture on ropes from settlement to harvest.

v) Import of seed mussels from areas outside the Wadden Sea (UK, Ireland)

In the Netherlands and Germany, collection of seed mussels (via dredge or collectors) followed by culture on lots is the norm, while in Denmark this is forbidden. In the Danish Wadden Sea, a fishery for wild adult mussels by dredge existed prior to 2009; however, this fishery has now been closed. On average about 70% of all commercially produced Wadden Sea mussels are of Dutch origin. A considerable part of the German landings are transported to The Netherlands where the majority of landings are traded (Nehls *et al*, 2009b).

i) Seed mussel fishery and culture

This type of fishery is only present in The Netherlands and Germany, as mussel culture is prohibited in the Danish part of the Wadden Sea. The fishery consists of the collection of seed mussels from natural beds. The seed mussels of 1-4 cm length are traditionally collected with a mussel dredge (Figure 2), although artificial seed collectors are increasingly used. The seed mussels are transferred to culture lots (lays) where the mussels are grown to marketable sizes (on-bottom culture). The total area of culture lots in the Wadden Sea is about 10900 ha (Nehls *et al*, 2009b). The seeding of culture lots is usually done in autumn and spring (with main spatfall occurring in in late summer (G. Nehls, pers. comm)). Part of the harvest of seed and half-grown mussels from the Dutch Wadden Sea are exported to the southwest of The Netherlands for cultivation in the Eastern Scheldt (Nehls *et al*, 2009b), which for both social and environmental reasons is the centre of mussel culture in the Netherlands.

The seed mussel fishery can be divided into a subtidal and intertidal fishery. In the Netherlands, the intertidal stock, fishery and culture were subject to intense exploitation in the early nineties, followed by a mass mortality of mussel-eating birds and in particular common eiders (*Somateria mollissima*) (Camphuysen *et al*, 2002). The event sparked strong controversy about mussel farming, which was considered to be a main cause of this collapse. The intertidal mussel fishery was almost completely closed in 1995 and since then the mussel stocks of the intertidal part of the eastern Dutch Wadden Sea have shown

recovery (Nehls *et al*, 2009b). Intertidal mussel beds have also become less attractive to fisheries in recent years due to the increased occurrence of the invasive Pacific oyster (*Crassostrea gigas*) (Nehls *et al*, 2009a). Seed mussels are therefore obtained from subtidal beds in the Netherlands. In Lower Saxony, Germany, however, the seed fishery is allowed in both the subtidal and certain parts of the intertidal, in accordance with a management plan. Licenses are issued by the State Fisheries Authority (Staatliches Fischereiamt). In Schleswig-Holstein, seed mussel fisheries are restricted to the subtidal outside the core zone of the National Park; under exceptions circumstances, however, a seed mussel fishery within the core zone is allowed, subject to specific restrictions.

Figure 2. Mussel dredges. Photo: Kat Collinson, MEP

ii) Wild mussel fishery

In the Danish part of the Wadden Sea, commercially sized mussels were historically fished from wild natural beds in subtidal areas (Nehls *et al*, 2009b; P. Sand Kristensen, pers. comm.). However, this fishery was closed in 2009 to maintain food requirements (36,000 tonnes) for birds – particularly eider ducks (P. Sand Kristensen, pers. comm.). In Lower Saxony, Germany, a wild mussel fishery is also carried out, restricted to the subtidal banks.

B. NATIONAL OVERVIEW

Table 4 presents a summary of the national situation of the mussel fishery in each of the three Wadden Sea countries.

Table 4. Summary of the situation of the mussel fishery in each Wadden Sea country: NL (The Netherlands); LS (Lower Saxony / Niedersachsen); SH (Schleswig-Holstein); HH (Hamburg National Park) and DK (Denmark). Based on data from Nehls *et al* (2009a and b) and SGS (2011a) unless otherwise indicated.

	NL	LS	SH	HH	DK
Type of mussel fishery	- Seed (by dredge and seed collectors) and culture	- Seed (by dredge and seed collectors) and culture - Wild, adult fishery by dredge, restricted to subtidal	- Seed (by dredge and seed collectors) and culture	None	-Wild, adult fishery by dredge prior to 2009. Mussel fisheries in Denmark ceased after an appropriate assessment concluded that there were significant impacts on protected bird species (common eider) (P. Sand Kristensen, pers. comm.)
Area fished	Subtidal (intertidal if 2000 ha of 1-yr old beds remain)	Subtidal and intertidal	Subtidal	N/a	Subtidal (P. Sand Kristensen, pers. comm.)
Culture lots	7,600 ha of which 3,300 ha are actually in use	1,300 ha	1,300 ha in 1985 when the National Park was established; then increased to 3,000 ha, but reduced to 2,000 ha since 1999. 300 ha extra for seed collectors since 2012	None	None
Relaying	Yes	Yes	Yes	N/a	N/a

	NL	LS	SH	HH	DK
Designation "mussel beds" under Habitats Directive	Integrated in habitat types 1110 (Sandbanks) and 1140 (Mudflats and sandflats)	Designated as habitat type 1170 (Reefs) in the subtidal and typical species of 1140 (Mudflats and sandflats) in the intertidal	Formerly designated as habitat type 1170 (Reefs) in the subtidal and intertidal – Due to absence of subtidal biogenic reefs, mussel beds integrated as typical species of 1140 (Mudflats and sandflats) in the intertidal	Designated as habitat type 1170 (Reefs)	Designated as habitat type 1170 (Reefs)
Mussel landings (also see Section 3.1.1)	Average 1995 – 2007: 35,166 tonnes of wet weight	Average 1994 – 2007: 6,318 tonnes of wet weight	Average 1994 – 2007: 12,454 tonnes of wet weight	None	Average 1994 – 2004: 2,500 tonnes of wet weight but limited landings after that
General trend in production (also see Section 3.1.1)	Decrease since 1990s	Decrease since 2000	Decrease since 2003	N/a	Decrease since 1980s - in 2009 the fishery was suspended due to stock decrease (CWSS, 2010)
General trend in mussel biomass (also see Section 3.1.1)	- Decrease in intertidal beds (predominantly in the Eastern Dutch WS) - Subtidal beds variable, ranging from ca. 10,000 to 80,000 tonnes ww between 1992-2008	- Decrease in intertidal beds until 2005, followed by increase in mussel bed area (1595 ha) and biomass (43,000	- Decrease in intertidal and subtidal beds (Heike Buettger, pers. comm.)	- No monitoring data found	- Decrease in subtidal beds - Status intertidal beds unknown as relatively little monitoring is taking place (Heike Buettger, pers. comm.)

	NL	LS	SH	HH	DK
		tonnes ww) until 2011 (Millat, pers. comm.)			
Import?	Yes, from the UK and Ireland	Potentially, although the extent of this is unknown (G. Millat, pers. comm.)	Formerly from the UK and Ireland but these were stopped by court rule in December 2011. Additionally there still exists import permission from other parts of the North Sea (which is dormant at the moment).	N/a	Yes, from Horns Reef area in North Sea for nature restoration project

C. REGULATORY FRAMEWORK

As previously stated, fisheries of The Netherlands, Germany and Denmark are subject to the Common Fisheries Policy (CFP) of the EU between the 12 and 200 nm limit from the coast. The Wadden Sea blue mussel fisheries take place within the 12-mile limit and management responsibility therefore lies with the Members States (passed on to the Länder in the case of Germany) under the regulations of national implementations of the EC Habitats and Birds Directives - as the area is declared as Natura 2000 sites - the Water Framework Directive and the Marine Strategy Framework Directive.

At a trilateral level, special consideration is given to the protection of intertidal mussel beds: although legally non-binding, Trilateral Targets for intertidal blue mussels were adopted in 1994 and trilateral policy and management measures for the blue mussel fishery were included in the 1997 Wadden Sea Plan and updated in the 2010 Wadden Sea Plan (WSP). Within the WSP, the following trilateral policies relate to blue mussel fisheries (CWSS, 2010):

> 4.23 and 9.6. The effects of mussel fishery are limited by the permanent closure of considerable areas and the reservation of sufficient amounts of mussels for birds. In addition, the management of fishery on mussels should not be in conflict with protecting and enhancing the growth of natural mussel beds and *Zostera* fields.
>
> 4.24 and 9.7. Mussel fishery will, in principle, be limited to designated parts of the subtidal area. Based on national management plans, fishery on the tidal flats and parts of the sublittoral may be granted. The fishery sector will, in close cooperation with competent authorities, improve existing practices in such a way that impacts of mussel fishery in general and seed mussel fishery in particular, will be minimised.
>
> 4.25 The current area of mussel culture lots will not be enlarged.

i) The Netherlands

An overview of the Dutch legislative and regulatory framework for Wadden Sea mussel fisheries is given in Table 5 below:

Table 5. Dutch national legislations and regulations for Wadden Sea mussel fisheries (From SGS, 2011):

Dutch National Legislation and Regulations	
Fisheries Act 1963	The main Dutch legislative act concerning fisheries
Order on Sea and Coastal Fisheries	The most important part of the secondary legislation based on the Fisheries Act
Uitvoeringsregeling visserij	Ministerial decree on the basis of which mussel fishing and culture is subject to fishing licences and tenancy of culture plots. The regulations forbid mussel fishery and mussel relaying during night, weekends and low visibility (article 47). Mussel seed collection using suspended installations is also subject to a specific licence (article 77).
1992 Policy Document on Sea	This policy document set the direction for the national

Dutch National Legislation and Regulations	
and Coastal Fisheries	fisheries policy until 2003. The policy aimed at an integration of fishing activities and conserving natural values where possible, and a separation of these two activities where necessary. The policy document includes the policy for shellfish fisheries and is centred on three core areas: closed areas (26 % of the intertidal mudflat area), food reservation for birds and co-management.
2005-2020 Policy Decision on Shellfish Fishery	Follow up on the 1992 Policy Document on Sea and Coastal Fisheries and sets out the current government policy on shellfish fishery and culture in the Wadden Sea. The policy laid down in this document is aimed at improving the sustainability of the shellfish sector. The mussel sector is expected to meet the sustainability targets by 2020.
National Planning Decree	Decree in which the governmental policy for the Wadden Sea for the period 2007-2017 is described. The main goal is sustainable protection and development of the Wadden Sea as a nature area and conservation of the unique open landscape with consideration for mutual relationships between nature protection, spatial planning, environment and water
Nature Conservation Act 1998	Act which ensures that nature areas designated under the Birds and Habitats Directives are protected under Dutch law. In the protected areas a licensing system is applied, with licenses issued either by the provincial governments or the Ministry of LNV (Ministry of Agriculture, Nature and Food Quality). The licensing system aims at ensuring that future projects which may affect the Natura 2000 areas will be evaluated in an appropriate assessment before permission is granted – While mussel fisheries are licensed twice a year (spring and autumn), this occurs once a year for the cockle fishery and every five years for the shrimp fisheries (P. Walker, pers. comm.). There are currently 93 mussel fishing licenses in the Dutch Wadden Sea.
Reglement Mosselvisserij and Reglement afdoening overtredingen	This regulation attributes powers to the board of the Producer Organisations to regulate the mussel seed fishery. The board can set the period and quantity for the seed fishery and divides this quantity into individual quota for the PO members. The regulation also implements the control of fished quantities by the members. Every catch has to be estimated (measured) by independent controllers.

In The Netherlands, an implementation plan was adopted in 2009, based on a 2008 framework agreement signed by the mussel fisheries sector, green NGOs and the Dutch government about the transition towards sustainable fisheries, as well as nature recovery in the Wadden Sea through the development of undisturbed intertidal and subtidal mussel beds. Agreement from the mussel farmers was subject to a guarantee that this goal would be achieved under the condition that seed supply would be maintained through other techniques. The resulting implementation plan aims to maintain mussel culture by a phased reduction of the subtidal mussel seed fishery (in increments of 20%) – through closure of subtidal beds taking into account scientific advice and stakeholder input (P. Walker, pers. comm.) – and its gradual replacement by artificial seed collectors (ASC)

(nets and ropes). Although 20% of the beds with new spatfall are closed for fishing each year this is not additive, i.e. if part of the new spatfall is in an area that has already been closed, then a smaller area will be closed. It is anticipated that by 2020, when the ASCs are expected to produce the average harvest quota of mussel seed, the whole subtidal seed fishery will be stopped and replaced by ASCs (Nehls *et al*, 2009b; SGS, 2011). In reality, however, this phasing out has proved more difficult than expected with some ASC installations being much less successful than others due to predation and local environmental conditions – discussions on whether this problem can be solved through imports of seed mussels from South Holland, which is currently forbidden, are ongoing (P. Walker, pers. comm.).

The harvest control rules and tools for the Dutch mussel fishery are the following (from SGS, 2011):

- Wild mussel stock assessment carried out before the start of the spring and autumn fishing seasons as part of appropriate assessments;
- Spring and autumn harvest quotas are based on the assessment and allocated by the government to Producer Organisation members;
- Fishery is restricted to high biomass areas;
- Harvest control by direct daily catch monitoring (Dutch Fish Product Board vessel) and VMS;
- A minimum of 85% of the seed fished in spring must remain on culture plots in the Wadden Sea for at least one year – i.e. no immediate transport of large volumes of seed outside the Wadden Sea area;
- Appropriate assessment carried out annually to show that the fishery will not impact bird populations or reduce the mussel stock biomass significantly overall
- Autumn fishery restricted to areas at high risk of storm and/or predation damage (starfish) over winter

ii) Lower Saxony, Germany

In Lower Saxony, the wild mussel and seed mussel fishery is regulated according to the Niedersachsen Fishery Ordinance of 1992 by the State Fisheries Administration which also applies the management plan (Bewirtschaftungsplan) of the National Park Law. The management plan takes into account the protection aims described in National Park Law and licenses (currently 5) are issued in consultation with the National Park Administration. According to the plan, 29 of the described 102 mussel bed sites have been excluded from seed mussel fisheries: 12 sites excluded according to the National Park Law (situated in the core zone of the park), 12 additional sites excluded according to the management plan and five additional sites which are voluntarily excluded from the fishery to enable long-term monitoring and a reliable calculation of the total blue mussel stock (Nehls *et al*, 2009b). The Lower Saxony mussel fishery is not regulated by TAC. However, annual monitoring of the blue mussel stock is carried out – when the stock falls below 10,000

tonnes, the fishery is halted. The same is true for the area covered by blue mussel beds – when this is less than 1,000 ha the fishery is also halted (G. Millat, pers. comm.).

The import of seed mussels into the National Park is not explicitly regulated by National Park Law (G. Millat, pers. comm.) and the extent of import into the Lower Saxony NP was not known at the time of writing.

iii) Schleswig-Holstein, Germany

In the National Park of Schleswig-Holstein, the mussel fishery is regulated by the State within the framework of the SH mussel fishing programme. This programme is in accordance with the SH Fisheries Law and allows a subtidal seed mussel fishery, 2000 ha of mussel culture plots and 300 ha of seed mussel collectors in zone II. In the core zone (zone I) subtidal seed mussel fishery is allowed as an exception and is subject to permits. The National Park Law only permits fishing according to the above mentioned programme. Licenses are issued for a 5-year period and there are currently 8 active in SH (H. U. Rösner, pers. comm.). The SH mussel fishing programme has been in force since 1997 and was amended within the framework of the revision of the National Park Law in 2000. A prolongation of the program has been negotiated between the Ministry and the fisheries sector for the period until end of 2026 and entered into force in 2012. Licenses were granted for another five years. The main elements contained in the programme are the specification of the conditions under which the mussel fishery may be carried out and the development of fishing and culture practices in the period under consideration (Nehls *et al*, 2011). As part of the recent prolongation, the program now allows the installation of mussel seed collectors and the area which can be used for cultures and seed collectors has been increased from 2000 ha to 2300 ha. The licenses have now for the first time been granted on the basis of an Appropriate Assessment. Note that in SH, there is no restriction on the quantity of seed mussels to be harvested and there are concerns that the capacity of the fleet is sufficient to reduce all existing stocks in the fishable areas down to below 0.1 to 0.05 kg/m^2 until the next spatfall (Nehls *et al*, 2009a). The programme, licenses and contents of the appropriate assessments, have been disputed by green NGOs such as WWF. In particular it has been criticised that the Appropriate Assessment was of low formal and scientific standard and did not follow the German standards for such assessments as applied in other projects. Further, no baseline investigations were conducted and the impacts of fisheries were assessed as being negligible, without consideration for the long-term decrease in mussel stocks, contradicting assessments in other areas and knowledge gaps. Monitoring of the intertidal blue mussel stock is carried out on an annual basis but no regular stock assessment of subtidal areas is conducted (Nehls *et al*, 2011).

Seed mussels were previously imported from the UK and Ireland into the SH Wadden Sea region since 2005 and this was allowed by the fishery administration. However, objections by the environmental NGOs Schutzstation Wattenmeer and WWF resulted in a court case in 2006 – 2011. In December 2011, the Schleswig-Holstein Higher Administrative Court (Oberverwaltungsgericht) ruled that this practice should be stopped due to the risk of introducing non-native species into the Wadden Sea Area and because National Park Law

had not been taken into consideration in granting the import licenses (H. U. Rösner, pers. comm.).

iv) Denmark

In Denmark, no mussels below 5 cm in shell length may be fished, transported or landed. Seed mussels are therefore not targeted or exported in or from the Danish Wadden Sea, with no mussel culture taking place. The fishery for wild, adult mussels which took place in previous years did have an allowance for by-catch of up to 10% weight of smaller mussels in wild mussel landings. In addition, the Danish Directorate for Fisheries gave permission in 2002 for a three-year nature restoration project for blue mussel beds in parts of the Danish Wadden Sea. The project required the relaying of up to 1,000 tons of blue mussel seed from the Horns Reef area more than 10 km west of the Wadden Sea conservation area to the seabed in the Wadden Sea Area (Nehls *et al*, 2009b).

A wild mussel fishery, which is now closed, took place mainly on the subtidal beds in Ho Bight and to a limited extent in the Lister Deep Area. The fishery was regulated by a 10,000 tonne annual quota, set by the Ministry of Food, Agriculture and Fisheries, with 37,000 tonnes reserved for birds. In 2004, the number of licenses issued by the Danish Directorate for Fisheries was reduced from 40 to 5 and very limited landings have taken place since. In 2009 the fishery was suspended due to stock decrease (CWSS, 2010) following an appropriate assessment.

v) Note on closed areas in the trilateral Wadden Sea

In Figure 3 are shown the areas permanently closed for the blue mussel fishery. Note that in the Netherlands, the intertidal is also closed for the mussel fishery until 2000 ha of 1-yr old beds remain (Nehls *et al*, 2009b). The situation is markedly different between the countries, with Germany – particularly Hamburg National Park and Schleswig-Holstein – accounting for the most closed areas.

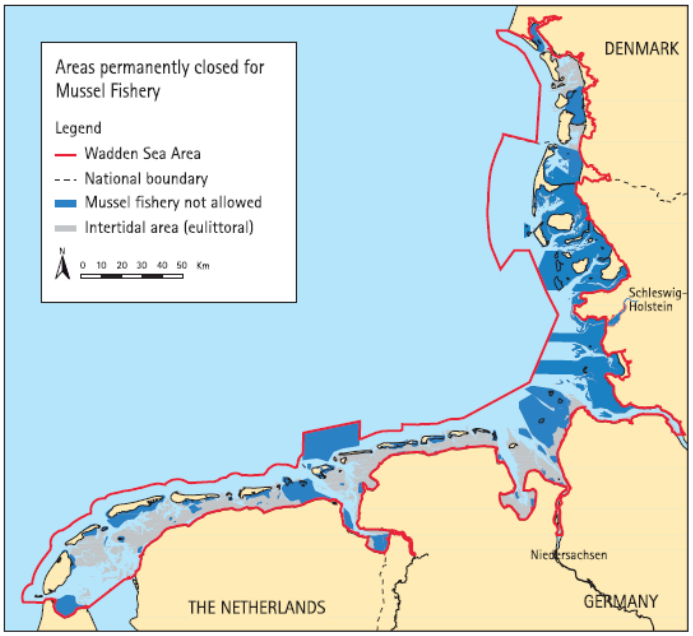


Figure 3. Map of the Wadden Sea showing areas permanently closed for the mussel fishery (Nehls *et al*, 2009b). Note that this figure is not up to date as the Danish mussel fishery is now closed entirely.

D. MARINE STEWARDSHIP COUNCIL (MSC) FISHERIES

The following Wadden Sea blue mussel fisheries are currently being/ have been assessed against the MSC Principle and Criteria for sustainable fishing.

- **Germany Schleswig-Holstein blue shell mussel fishery and culture.** This fishery takes place in the coastal area of Schleswig-Holstein and Flensburger Innenförde (Baltic Sea). The assessment covers the seed mussel fishery by dredge and seed collectors, as well as the cultured mussel fishery by dredge. The assessment of this fishery is ongoing.

- **Germany Lower Saxony mussel dredge and mussel culture.** This fishery is carried out by Niedersächsische Muschelfischer GbR vessels around Lower Saxony. The assessment covers the cultured mussel fishery by dredge and nets as well as the seed fishery by dredge, nets and seed collectors. This assessment also addresses the genetic implications of the translocation of mussel seed and half grown mussels to culture plots in different geographic areas. The assessment of this fishery is ongoing.

- **Dutch blue shell mussel fishery and culture.** This fishery is carried out in the Wadden Sea and Zeeuwse delta of the Dutch coastal region. The assessment covers the seed mussel fishery by dredge and seed collectors, as well as the cultured mussel fishery by dredge. The assessment also addressed the genetic implications of the translocation of mussel seed and half grown mussels to culture plots in different geographic areas. This fishery was certified in July 2011. The certification of this fishery was subject to six conditions, lised below (SGS, 2011):

- Condition on Harvest Strategy (Information & Monitoring): Development of an independent data collection system. Information about suspended seed mussel collectors

(standing stock, harvested amounts) is currently available at farm level. There are, however, no protocols for the procedure and validation of independent data collection which ensure that estimates of harvested amounts are both reliable and independent.

- Condition on Harvest Strategy (Assessment of stock): Although the stocks of seed mussels and the mussels on the culture plots are regularly assessed, some uncertainties remain as to the influence of the stock size of suspended mussel culture and associated practices on the total mussel stock. An independent and ongoing monitoring programme should therefore be in place to determine the size of the stock and harvest of suspended mussel seed in order to estimate the effects of the harvesting strategy on the wild stocks.

- Condition on Harvest Strategy (Genetic information): Although information on the genetic characteristics of the mussel population is available on the basis of a synoptic survey, a survey programme for genetic profiling of the mussel population should be in place that is able to detect possible changes over a period of time with a five-year interval.

- Condition on Habitat (Status): Although the fishery is unlikely to reduce habitat function and structure to a point where there could be serious or irreversible harm, results of impact studies need to be taken into account to evaluate the effects of the seed fishery on the habitat types.

- Condition on Ecosystem (Information & Monitoring): Although sufficient data continue to be collected to detect any increase in the risk the fishery poses to the ecosystem, qualitative information on the effects of increase in the seed net collectors on the carrying capacity and effects on the ecosystem need to be available and applied. Independent data collection of stock and harvest size needs to be in place.

- Condition on Fisehry-specific management system (Compliance & Enforcement): Currently there are no clear monitoring, control and surveillance (MCS) measures in place that convincingly guarantee that fishermen comply with all measures in the management system. An MCS system must therefore be in place that demonstrates compliance with all management measures.

All conditions listed above are to be addressed by the fishery through an Action Plan, within a specified timeframe. These actions plans are publicly available in the assessment report for this fishery (see SGS, 2011)

E. CONCLUSION

The information presented in Section C highlights the different approaches taken by the Wadden Sea nations in managing their mussel fisheries. While The Netherlands seem to focus on co-management within a rigid regulatory and legislative framework, particulary in relation to the harvest strategy, the measures adopted by Germany especially appear to leave more freedom to the industry, by not imposing TACs but rather regulating the fishery through the closure of sites – for those licensed vessels within fishable areas, it can be assumed that the fishery is relatively unregulated. The Dutch approach has much tighter control on a year-to-year basis over industry, yet requires a higher effort (regular

monitoring, appropriate assessments) with some risk for the industry if the TAC fluctuates from year to year. The latter, however, is also true for the German fisheries with the potential for spat fall either occurring mostly outside or within the closed areas.

Also of interest are the different approaches to wild versus seed mussel fisheries and culture. While The Netherlands is moving towards a fishery completely made up of seed collection, Denmark has prohibited the seed fishery and culture altogether, while allowing a wild mussel fishery instead. The latter, however, is now closed due to food requirements for birds and stock decrease (see Laursen *et al*, 2010b).

Overall, it seems that mussel fisheries management in Denmark and The Netherlands is in principle in line with the requirements of the Habitats and Birds Directives. In both countries, appropriate assessments are carried out at least annually evaluating the risks the fishery poses to the Natura 2000 objectives with particular emphasis on the food requirements for birds. As previously stated, this approach culminated in the termination of the wild mussel fishery in the Danish Wadden Sea. In Germany, however, the picture becomes less clear. In Lower Saxony, no appropriate assessments are carried out to determine how the fishery may affect the qualifying features of designated habitats, although the area has been declared as National Park and as Natura 2000 site under both the Habitats and Birds Directive (note that the absence of appropriate assessments is not unusual per se as European fisheries are often regarded as an ongoing activity rather than a plan or project). Some monitoring does take place in LS, however, and there is a set limit for mussel biomass, below which the fishery is halted; note however that this limit does not make special reference to any food requirements for birds. While the management of the LS mussel fishery can certainly not be regarded as lax – a significant proportion of the National Park is closed to the fishery - there does appear to be a lack of coherence between national park management and the nature protection requirements set by the Habitats and Birds Directives. In Schleswig-Holstein, appropriate assessments are carried out from now on every five years and monitoring is carried out on an annual basis. However, monitoring mainly covers the closed intertidal. Nevertheless, with the exception of closed areas, there is nothing in place to prevent fisheries from overexploiting the mussel stock in one season. In recent years there have been several occasions that spatfall only occurred in areas open to fisheries (Nehls *et al*, 2011) and there is no precaution in place to prevent exploitation at 100% under such conditions. No food reservation policy for birds is in place. It has also been acknowledged that important knowledge gaps exist, particularly on the causes for the general decline in mussel abundance. These factors make it difficult for accurate appropriate assessments to be conducted and for the stakeholders to have confidence in the results they produce. In the German Wadden Sea, it would therefore appear that ground work still needs to be realised to fill these knowledge gaps before progress can be realised in coordinating mussel fisheries management with nature protection.

2.2.3. COCKLE (*CERASTODERMA EDULE*) FISHERIES

A. BACKGROUND INFORMATION

Cockles (*Cerastoderma edule*) in the Wadden Sea were originally gathered by hand, using a rake attached to a net (Figure 4), followed by mechanised cockle fishing from the 1950s onwards. Since the end of the 1970s, the cockle fishery in the Wadden Sea was primarily conducted with hydraulic suction dredges, which greatly improved efficiency and resulted in a steady increase in cockle landings (Ens *et al*, 2004). In 2004, however, the Dutch mechanical fishery was the subject of a high-profile court case at the European Court between the fishing sector and environmental NGOs (Waddenvereniging and Vogelbescherming Nederland). The case was based upon objections lodged by the NGOs which claimed that mechanical cockle fishing caused long-term and possibly irreversible damage to ecologically vulnerable areas and that the cockle quota set was too high in relation to the feeding needs of seabirds, in particular oystercatchers. These objections led to questions concerning the interpretation and application of the Netherlands' Nature Conservation Act (Natuurbeschermingswet) in the light of European Community law, in particular, Article 6 of Council Directive 92/43/EEC of May 1992 on the conservation of natural habitats and of wild fauna and flora (the "Habitats Directive"). The case resulted in a ruling by the European Court which stated the view that mechanical cockle fishing should only be authorised if the competent national authorities had made certain that the fishery's activity, thus considered as a project, would not adversely affect the integrity of the site. In the absence of certainty, this eventually resulted in a complete ban of the Wadden Sea mechanical cockle fishery (URL 2). From 2005, the mechanical cockle fishery in the Dutch waters of the Wadden Sea has been replaced by a manual fishery by hand raking. In other parts of the Wadden Sea Area, cockle fishing by hand raking also takes place; however this is limited to private use only in accessible areas of the tidal flats (CWSS, 2010).

Figure 4. Manual cockle gear used in The Netherlands. Source: URL 3.

The cockle fishery in Schleswig-Holstein and Lower Saxony was stopped in 1989 and 1992 respectively. The fishery is not allowed in the Hamburg National Park (Nehls *et al*, 2009b).

In Denmark, 99% of the Wadden Sea is closed for cockle fisheries. There is only one license for mechanical cockle fishing in the intertidal of the Danish Wadden Sea and the

fishery is restricted to the intertidal of three small areas in the Grådyb, outside the Danish Natura 2000 area, of which one may be fished per year (Nehls *et al*, 2009b).

B. NATIONAL OVERVIEW OF THE COCKLE FISHERY

Table 6 follows with a summary of the national situation of the cockle fishery in each of the three Wadden Sea countries.

Table 6. Summary of the situation of the cockle fishery in each Wadden Sea country: NL (The Netherlands); LS (Lower Saxony / Niedersachsen); SH (Schleswig-Holstein); HH (Hamburg National Park) and DK (Denmark). Based on data from Nehls *et al* (2009b) and Van Overzee *et al* (2008) unless otherwise indicated.

	NL	LS	SH	HH	DK
Type of cockle fishery	- Manual fishery by hand raking since 2005	- Mechanical fishery allowed outside the conservation area but not conducted at present (CWSS, 2010)	None	None	-Mechanical fishery by suction dredge outside the Natura 2000 area
Area fished	Intertidal	N/a	N/a	N/a	Intertidal
Cockle landings (also see section 3.1.2)	Approx. 407 tonnes of meat weight in 2009 (< 5% of the cockle stock)	None	None	None	Average 1997 – 2007 of 898 tonnes of wet weight (including shells)
General trend in production (also see section 3.1.2)	Strong decrease from 1999. Slight increase since 2005 due to increase in manual cockle landings	N/a	N/a	N/a	Decrease since 2001

C. REGULATORY FRAMEWORK

Cockles are a non-quota species and EU Total Allowable Catches (TAC) do therefore not apply to the cockle fishery. As with the Wadden Sea mussel fisheries, the cockle fisheries take place within the 12-mile limit from the coast and the management responsibility therefore lies with the Members States (or German Länder) under the umbrellas of the EC Habitats and Birds Directives, the Water Framework Directive and the Marine Strategy Framework Directive.

At a trilateral level, trilateral policy and management measures included in the 2010 Wadden Sea Plan also cover cockle fisheries (CWSS, 2010):

> 4.22 and 9.5. Cockle fishery is not allowed in the Wadden Sea Area, with the exception of mechanical fisheries in some small areas along the Esbjerg shipping lane and in the Ho Bay, and in Niedersachsen outside of the conservation area (but will not be carried out at present), as well as non-mechanical cockle fishing in The Netherlands.

i) The Netherlands

In the Netherlands, the cockle fishery is managed through a permit scheme (32 permit were allocated in 2008) with permits for hand raking issued under the Nature Conservation Act (see Table 5) and is allowed to catch a maximum yearly catch of 5% of the cockle stock; the remaining 95% being allocated to birds. In recent years, the cockle permits that have been granted corresponded to approx. 2.9 % of the cockle stock (at 50 cockles/m^2), and this was mainly for the province of Fryslân (RCW, 2010).

In June 2011, an agreement was reached between the cockle industry, conservation NGOs and the Dutch government. The agreement will act as a policy rule in the Nature Protection legislation and Fisheries legislations and addresses which areas of the Dutch Wadden Sea will be open to a limited number of licenses for hand raking which is in line with the status of the cockle stock. The agreement also covers the permanent closure of areas near Schiermonnikoog, Griend and Ameland to allow for the development of undisturbed cockle beds. Further research should also determine what impacts the manual cockle fishery has on oystercatchers and cockle bed development (CBS, 2011).

A list of measures which apply to the Dutch cockle fishery is shown below:

- Annual catch limit of 2.5% of cockles present on high-density beds (>50 ind./m^2)

- The annual cockle fishing plan is based on a spring survey of the cockle stock by the Netherlands Institute for Fisheries Research. Changes may be made in the course of the fishery if stock assessment issues or nature conservation concerns arise (Van Overzee et al, 2008);

- Fishing not allowed if stock falls below the agreed minimum reserved for birds (95%);

- Permits to the Producer Organisation “Op Handkracht Verder” are issued by the government (32 allocated in 2008) in line with the annual fishing plan (RCW, 2010);

- Permanent closure of areas near Griend, Ameland, Terschelling, Schiermonnikoog and Rottum to allow for the development of undisturbed cockle beds. In addition to these closed areas, there are a number of areas where fishing activity is limited, corresponding to 3 vessels permitted to fish simultaneously during years of high cockle abundance and two during years of low abundance[15]. The selection of vessels allowed to fish these areas is based on a lottery-type system;

- Cockles < 21mm may constitute max. 8% of the total catch (Van Overzee et al, 2008);

- Bycatch of other shellfish cannot be higher than 5% of the catch's gross weight (Van Overzee et al, 2008).

ii) Germany

In Germany, no cockle fishing is allowed according to National Park Law.

iii) Denmark

In Denmark, there is one license for a mechanical cockle fishery issued by the Danish Directorate for Fisheries. Since 2008 an annual Environmental Impact Analysis has to be carried out before the fishery can take place (Nehls *et al*, 2009b).

D. MSC FISHERIES

The "OHV Dutch Waddenzee and Oosterschelde Hand Raked cockle fishery" is currently undergoing MSC assessment. The fishery takes place in the Wadden Sea and Eastern Scheldt by hand raking and is conducted by members of the Producer Organisation 'Op Handkracht Verder'. This fishery is currently in the scoring phase, site visits were held on the 24th October 2011.

E. CONCLUSION

The Wadden Sea cockle fisheries have made significant progress from the perspective of nature conservation in comparison with the pre-2005 scenario when a large-scale mechanical cockle fishery existed in the Dutch Wadden Sea. As a consequence of the complete switch to cockle fishing by hand raking in the Dutch Wadden Sea after 2005, the environmental impact of the fishery on the Wadden Sea ecosystem has been greatly reduced and appropriate assessments carried out in both Denmark and The Netherlands continue to re-assess these impacts on an annual basis. Denmark alone currently hosts the only mechanical cockle fishery in the Wadden Sea and this takes place outside the Natura 2000 area. In Germany, an even more pro-nature protection stance has been adopted and National Park Law in the three states (SH, LS and HH) does not allow any cockle fishing. Of all the key fisheries present in the Wadden Sea, the cockle fisheries appear to be most in line with working towards the achievement of the Natura 2000 objectives.

[15] The difference between a "good" year and a "poor" year is 21.000 tonnes of cockles

2.2.4. SHRIMP FISHERIES

A. BACKGROUND INFORMATION

Brown shrimp (*Crangon crangon*) is a highly reproductive crustacean with a short life span of about one to three years. Its distribution ranges from the North Atlantic (Norway, Iceland) to North African waters and the Mediterranean. However, only the shallow coastal waters of the Southern North Sea, and in particular those of the Wadden Sea, give abundances that form the basis of an intensive fishery (EC, 2011). In the Wadden Sea, the shrimp fishery occurs throughout the year. It is allowed in the Dutch and German Wadden Sea with the exception of defined zero-use zones and is limited in Denmark to the area between the islands and in the offshore area (CWSS, 2010). Shrimp beam trawlers carry out the fishery as shown in Figure 5 below.

Figure 5. Dutch shrimp trawler in the Wadden Sea. From van Overzee *et al* (2008)

In Table 7 is given an overview of shrimp licences in The Netherlands, Germany and Denmark in 2010. Figure 6 shows the distribution of fishing effort (hours) of the Danish, German and Dutch shrimp fisheries from 2005 to 2008. The figure shows that the Danish fleet is almost exclusively fishing off the Danish coast and in some parts of the northern coast line of Germany. The German fleet, however, covers not only German but also Danish and Dutch coasts. This is related to the seasonal distribution of the shrimp, the fact that from a legal perspective foreign vessels are allowed to fish in neighbouring countries up to a certain distance from the base line and the fact that some of the German registered vessels are Dutch-owned with Dutch crews on board (EC, 2011). The distribution pattern of the Dutch fleet is very similar to that of the German fleet although it extends further to the North and the South towards the Channel and the Belgian coast. The Dutch fleet does not fish within the 12 nm limit along the Danish coast (EC, 2011).

Table 7. Number of shrimp licences in the three Wadden Sea countries in 2010. From EC (2011)

Country / region	Nb. licences
The Netherlands	225
Wadden Sea	92
Other coastal areas	133
Germany	233
Lower Saxony	117
Schleswig-Holstein	116
Denmark	28
Total	**508**

Within the 12 nm boundary member states have taken specific "non-discriminating" measures allowing foreign vessels to fish (EU (Com) 2371/2002). The same regulation also limits access to the particular national waters. For Denmark, Germany and the Netherlands the following access rules are valid for shrimp according to Annex I of EU (Com) 2371/2002 (from EC, 2011):

Coastal waters	Access for Danish fleet	Access for German fleet	Access for Dutch fleet
DK	Unlimited	Danish/German frontier to Hanstholm (6 – 12 nm)	Beyond 12 nm
Germany	Danish/German frontier to the northern tip of Amrum (3 – 12 nm)	Unlimited	Within 3 – 12 nm
NL	Not specified	Within 3 – 12 nm	Unlimited

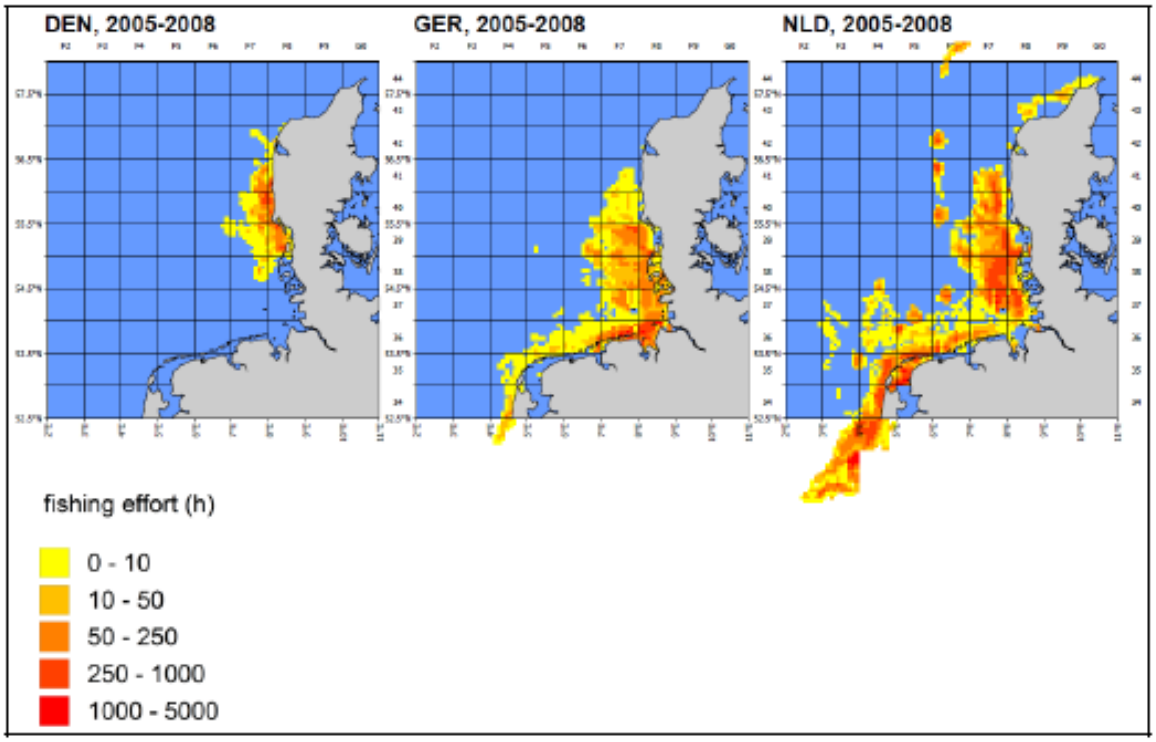


Figure 6. Fishing effort (hours) of the Danish, German and Dutch shrimp fisheries from 2005 to 2008. From EC (2011). Note that the resolution of this figure is not sufficient to allow for an accurate representation of fishing effort within the Wadden Sea Area.

i) The Netherlands

In The Netherlands, the brown shrimp fishery is an important sector in Dutch fisheries. In the period 2003 - 2008, the shrimp fishery's relative importance increased as the turnover of the brown shrimp fleet doubled, while the revenues of the overall coastal fishery remained about the same (approx. 250 million €) (EC, 2011).

The Dutch shrimp fishery is carried out by 225 licensed vessels. Of these, 92 vessels are operating in the Wadden Sea. The total average annual catch in The Netherlands (including that from vessels outside the Wadden Sea) was about 15,000 tonnes in recent years. According to fishermen, roughly estimated, about half of these landings are fished in the Wadden Sea (Nehls *et al*, 2009b). Major landings take place in the ports of the Wadden Sea (Zoutkamp, Lauwersoog, Harlingen, Den Oever) – see Figure 7.

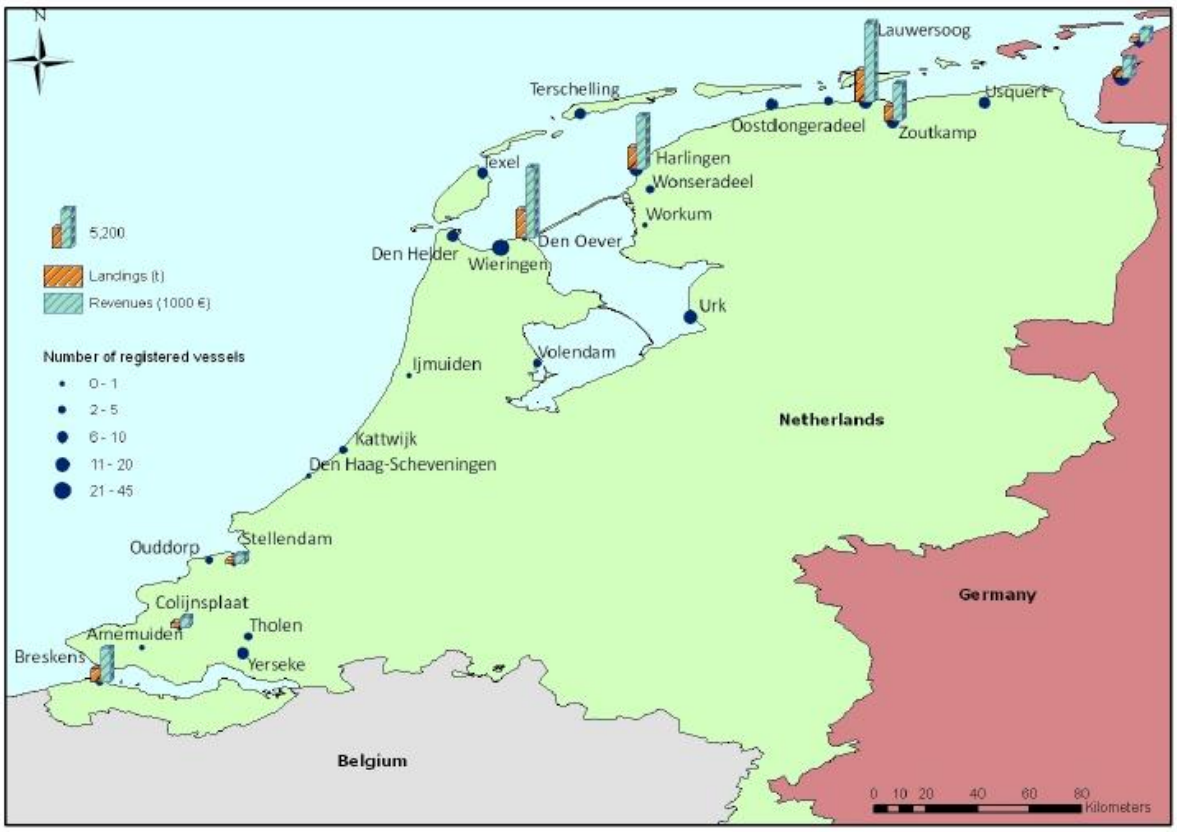


Figure 7. Dutch brown shrimp harbours: landings (red bar), revenues (blue bar) and number of registered vessels (navy dot). From EC (2011)

ii) Germany

In Germany, there are 233 licenced shrimp vessels, of which 117 in Lower Saxony (as of 2011) and 116 in Schleswig-Holstein (EC, 2011). The German shrimp in the Wadden Sea catch has been on average 12,000 tonnes per year between 1994 and 2007 (Nehls *et al*, 2009b). No large-scale commercial fishery takes place in the Hamburg National Park. According to National Park Law some commercial fishery on shrimps is allowed in special areas (as well as a small-scale fishery for private use according to Nr. 5b National Park Law HH). This study, however, has focused on the LS and SH shrimp fisheries.

In Germany shrimpers are mostly registered in Schleswig-Holstein and Lower-Saxony, where they have their home ports, Producer Organisations and official institutions (Figure 8). In the Figure 9 below is shown the relative importance of shrimp landings (tonnes) in relation to other fisheries. The higher "other" landings in Hoernum-Sylt are due to blue mussel landing (EC, 2011).

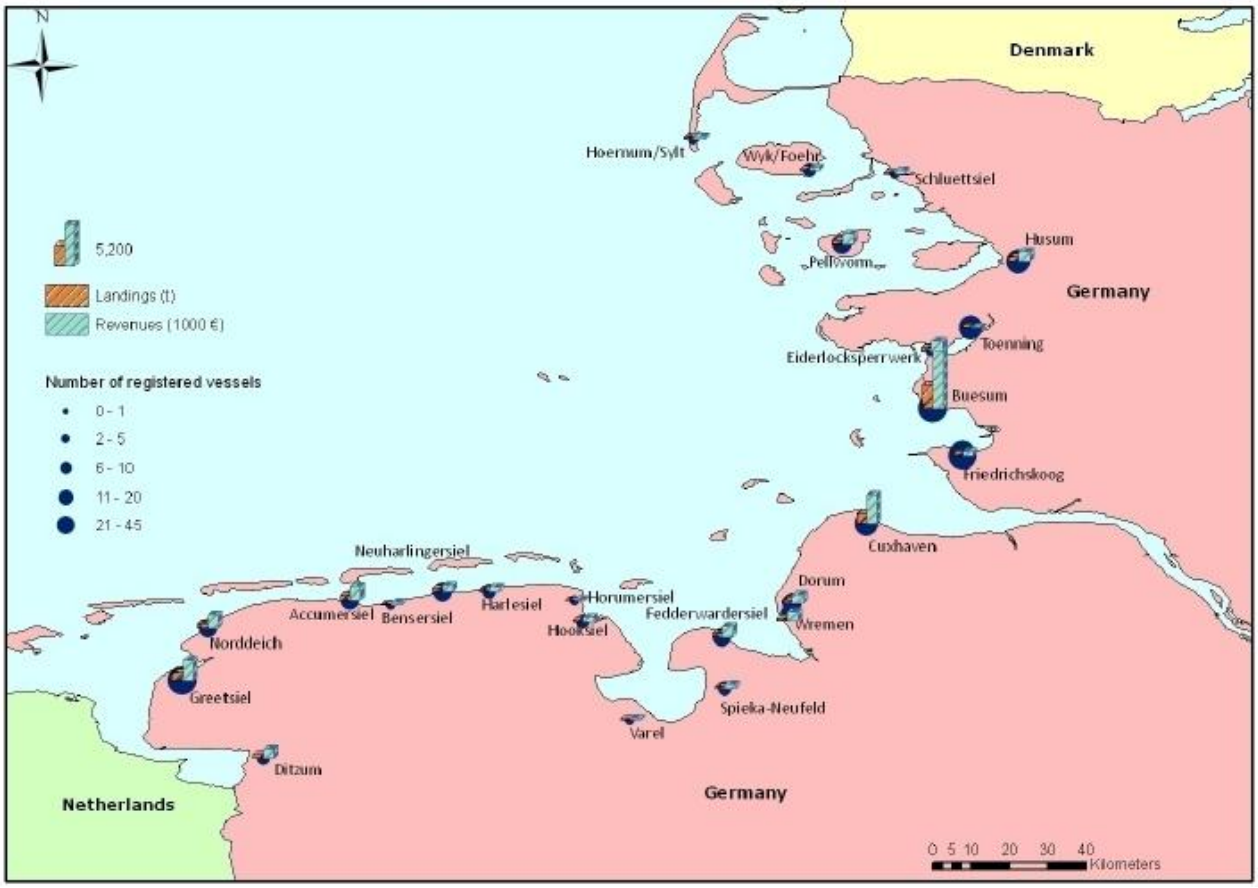


Figure 8. German brown shrimp harbours: landings (red bar), revenues (blue bar) and number of registered vessels (navy dot). From EC (2011)

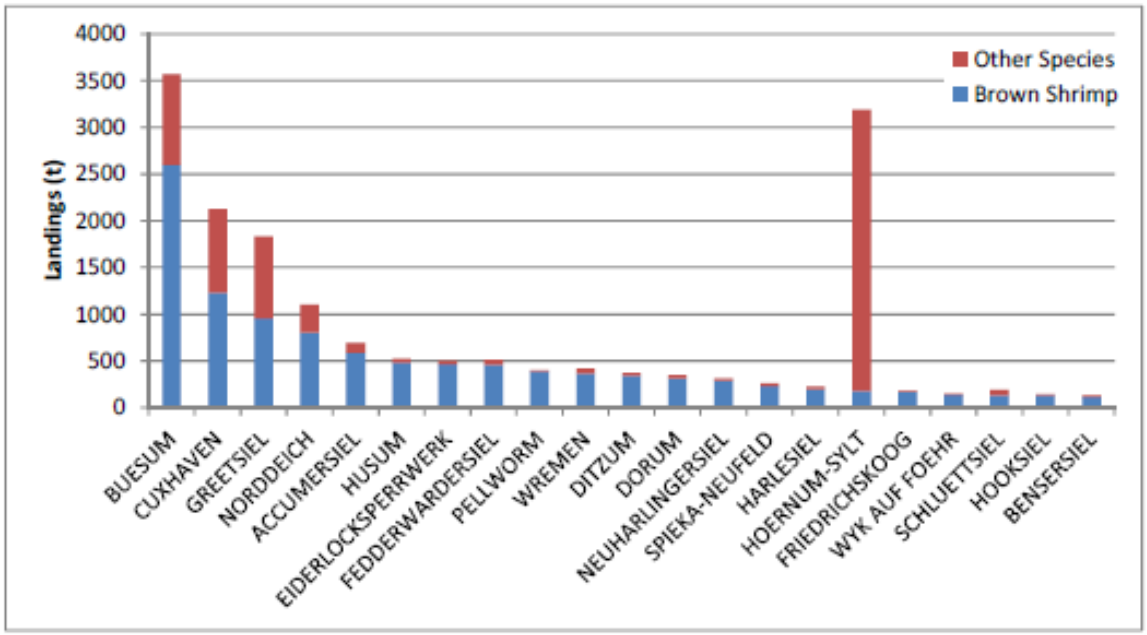


Figure 9. Brown shrimp landings (tonnes) vs "other" fisheries in Germany by harbour (with annual landings > 100 t). The higher "other" landings in Hoernum-Sylt are due to blue mussel landing. From EC (2011)

iii) Denmark

In 2010, 28 licensed vessels fished for shrimps in Danish waters (EC, 2011). The fishery takes place west of the 'Shrimp Line' drawn between the Wadden Sea islands from the peninsula of Skallingen to Rømø. In the last fifteen years, the Danish landings have been on average around 2,900 t (only Danish vessels) and about 3,400 t annually (including vessels from other EU countries, mainly German, Dutch and a few Belgian) (Nehls *et al*, 2009b). The main landing harbors are Havneby and Esbjerg. In Figure 10 below is shown the relative importance of Danish shrimp landings (tonnes) compared to other species. In Hvide Sande, which is just oustide the Wadden Sea Area, the majority of "other" species is made up of sandeels (EC, 2011).

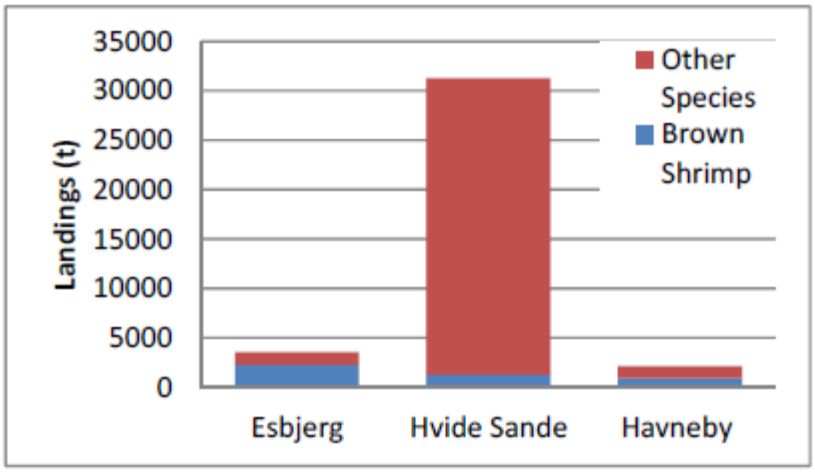


Figure 10. Brown shrimp landings (tonnes) vs "other" fisheries in Denmark by harbour. From EC (2011)

B. NATIONAL OVERVIEW

Table 8 provides a summary of the national situation of the shrimp fishery in each of the three Wadden Sea countries.

Table 8. Summary of the situation of the shrimp fishery in each Wadden Sea country: NL (The Netherlands); LS (Lower Saxony / Niedersachsen); SH (Schleswig-Holstein); HH (Hamburg National Park) and DK (Denmark). Based on data from Nehls *et al* (2009b) and EC (2011) unless otherwise indicated.

	NL	LS	SH	HH	DK
Type of shrimp fishery	92 licensed vessels	117 licensed vessels	116 licensed vessels	N/a	28 licensed vessels
Area fished	Dutch but also Danish (beyond 12 nm) and German (3-12 nm) coasts	German but also Danish (6 – 12 nm from Danish/German frontier to Hanstholm) and Dutch (3 – 12 nm) coasts			Exclusively off the Danish coast, west of the 'Shrimp Line' drawn between the Wadden Sea islands from the peninsula of Skallingen to Rømø, and in some parts of the northern coast line of Germany
Shrimp landings	15,000 tonnes (approx.. 50% correspond to the Wadden Sea) (Nehls *et al*, 2009b)	12,000 tonnes per year between 1994 and 2007			- 2,900 tonnes per year between 1994 and 2009 (only Danish vessels) - 3,400 tonnes per year (including vessels from Germany, The Netherlands and Belgium)
General trend in production (also see section 3.1.3)	Increase since early 1990s	Increase since early 1990s			Variable

C. REGULATORY FRAMEWORK

The Wadden Sea shrimp fisheries take place both within and outside the 12-nm limit from the coast and are therefore subject to both EU and member state regulations. Within the EU's Common Fisheries Policy (CFP) the North Sea brown shrimp fishery is not considered a pressure stock fishery, and so is not subject to management by TAC. At national level, the management responsibility lies with the Members States (or German Länder) under the umbrellas of the EC Habitats and Birds Directives, the Water Framework Directive and the Marine Strategy Framework Directive.

North Sea brown shrimp fisheries are affected by an important EU legal restriction, the Plaice Box, in force since 1986 (Regulations (EEC) 3094/86 and 55/87) and put in place to protect juvenile plaice (Figure 11). The regulation specifies that all beam trawlers between 8 and 24 m total length and with less than 221 kW / 300 hp engine power have to be listed in a "beam trawl list". Failing to register on the list excludes a vessel from fishing within the Plaice Box. The box is situated off the Dutch, German and Danish coasts, within the 12 nm limit. Larger vessels are excluded from the area due to their heavier gear and therefore higher susceptibility to disturb the benthic environment (EC, 2011).

Besides the above regulation, harvest control rules and tools of brown shrimp fisheries in Europe are limited to a two technical measures. One relates to allowable catch composition and specifies the target species (*Crangon*) must constitute a minimum of 60% of the catch when using a cod-end with mesh size 16-32mm (i.e. maximum bycatch of 40%) while the other relates to the structure of the nets, which must include a sorting grid or 'veil' net (Innes and Pascoe, 2007). Landings of shrimp are reported in European Community logbooks, and vessels over 15 m are equipped with VMS – in the Wadden Sea this corresponds to about 30% of vessels. Vessels smaller than 15m are not satellite tracked; these mainly fish in between the islands (Nehls *et al*, 2009b)

At trilateral level, trilateral policy and management measures for the shrimp fishery are included in the 2010 Wadden Sea Plan. Within the trilateral policy and management, the following policy relates to the shrimp fishery (CWSS, 2010):

> 4.27 In order to reduce bycatch and to reduce impact on the sea floor, trilateral policy principles for a sustainable shrimp fishery will be developed in close cooperation with the fisheries sector.

At national level, there are some differences in policies and practices within the Trilateral Cooperation Area. In Denmark, the shrimp fishery is not allowed within the line of barrier islands and the 6 nm area is exclusively reserved for Danish fishermen. In Germany 95% of the area of the Hamburg National Park is not open to the fishery although National Park Law makes some exceptions for shrimp fishing for human consumption in three tidal inlets within the core zone, which are also the only designated and marked navigable waters in the Conservation Area (Nehls *et al*, 2009b). In accordance with National Park Law, some small areas in the Schleswig-Holstein and Lower Saxony National Parks are also closed to the shrimp fishery – these are defined as zero use zones. In The Netherlands,

an agreement was reached in December 2011 between the fishing industry (Productschap Vis, Vissersbond, VisNed), NGOs (Stichting de Noordzee, Natuurmonumenten, WNF, Waddenvereniging) and the Dutch government on fisheries regulations within the Natura 2000 North Sea Coastal zone, adjacent to the Wadden Sea Area. This agreement is part of the "VIBEG" agreement which also covers the Natura 2000 area "Vlakte van de Raan". The aim of the agreement was to develop a fisheries regulation scheme which is in accordance with the Natura 2000 conservation objectives and strives for ecological sustainability whilst permitting a viable and economically sustainable fishing industry (URL 1). The agreement covers the zonation of the Natura 2000 area with specific control measures per zone – this agreement is valid until the end of the NSC management plan (2019). The agreement implies a complete but gradual termination of beam trawling from 1st Jan 2016 in the North Sea Coastal Zone and Vlakte van de Raan. For shrimp trawling, 10 % of the Natura 2000 area (Zone 1) will be closed to the fishery (and all other forms of fishing), in addition to another 15 % (Zone 2) which will be closed to all forms of fishing activity which disturb the seabed. The remaining 75 % of the area will stay open to the shrimp fishery (see Figure 12). The agreement also includes a provision for scientific research into the impacts of shrimp trawling with roller gear on benthic habitats. The agreement aims to replace the beam trawl fishery with tickler chains by best practice and innovative techniques such as electrofishing (which is currently not allowed under the CFP) – however, as contingency, the parties are working on developing alternative fishing methods. Access to the Natura 2000 areas will be for licensed vessels only[16] under Article 20 of the Nature Conservation Act ("Natuurbeschermingswet) (also see Table 5). A similar process is ongoing for the Dutch Wadden Sea shrimp fisheries, to determine how the fisheries can be managed to align them in accordance with the Natura 2000 objectives (P. Walker, pers. comm.).

Note that in Germany, so far no impact assessments are carried out for shrimp fisheries. In The Netherlands, an appropriate assessment is carried out every five years (although this does not include a scientific stock assessment) while this happens on an annual basis in Denmark.

[16] Note, the shellfish fishery will mainly be regulated via a management plan rather than Nature Protection law – until then however, a licensing scheme applies. There will be no increase in the number of licenses for shellfish fishing with vessels. License holders fish in accordance with a management plan. This does not yet apply to the Wadden Sea Area, however.

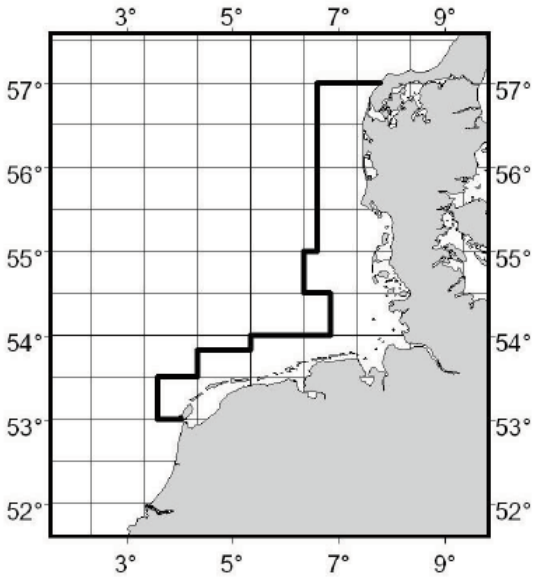


Figure 11. The Plaice Box along the Dutch, German and Danish coasts. From EC, 2011

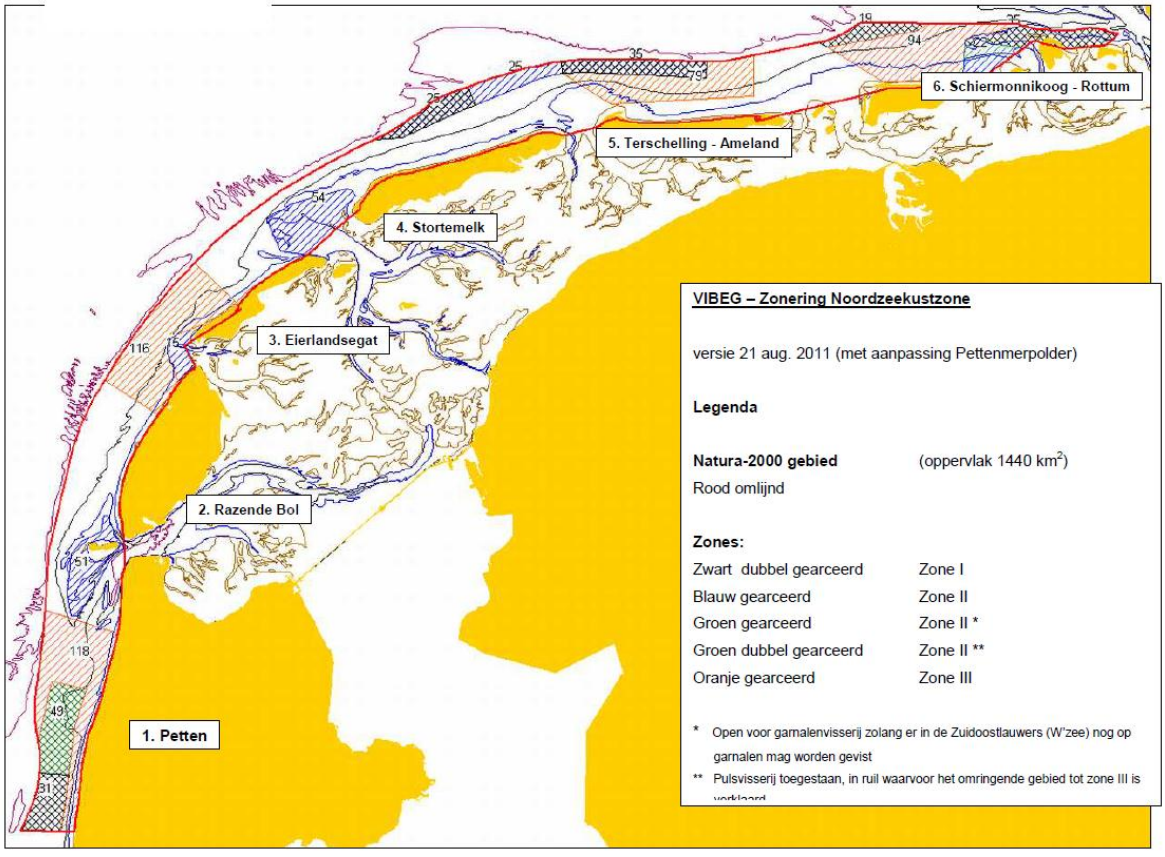


Figure 12. Natura 2000 area "Noordzeekustzone" adjacent to the Natura 2000 Wadden Sea Area. Black lined areas correspond to Zone 1 where no bottom trawling is allowed from 2012; blue and green areas correspond to Zone 2 where some shrimp fishing is allowed from 2014 (subject to impact assessment of shrimp roller gear); orange areas correspond to Zone 3 where only licensed innovative techniques are allowed from 2014 (Source: URL 1).

D. MSC FISHERIES

The following brown shrimp fisheries are currently undergoing MSC certification.

CVO Dutch North Sea brown shrimp fishery: this fishery is based around the Dutch coast and the Wadden Sea, and is dominated by a Dutch-owned trawl fleet, with the largest harvests deriving from Dutch and German fisheries. Smaller scale fisheries are prosecuted in the coastal areas of Belgium, Denmark and England. The assessment of this fishery is currently ongoing.

Germany North Sea brown shrimp fishery: this fishery is carried out by the Landesvereiningung für Nordseekrabben und Küstenfischer e.V. within the North Sea ICES sub areas IVa, b and c, of which the Wadden Sea is the core area. The assessment of this fishery is currently ongoing.

E. CONCLUSION

Through the VIBEG agreement, significant progress has been made by Dutch fisheries stakeholders in making Noordzeekustzone and Vlakte van de Raan shrimp (and other) fisheries management compatible with Natura 2000 objectives. Although this level of compatibility has not yet been reached in the Wadden Sea Area efforts are being made mainly through the appropriate assessments which are carried out by The Netherlands (every 5 years) and Denmark (annually). The effectiveness of these, however, can be contested due to an incomplete knowledge base: uncertainties of gear impacts on sensitive habitats, and the actual distribution of those sensitive habitats in the Wadden Sea – see Section 3; uncertainty with regards to the status of the target stock and the fishery's impact on that stock which is an issue that has been recognised in an ongoing MSC assessment of the Dutch NS brown shrimp fishery (P. Walker, pers. comm.). Danish and Dutch efforts to meeting N2000 objectives can therefore only be partly successful as long as these significant knowledge gaps remain.

In contrast, Germany currently does not regard their shrimp fisheries as plans or projects. Appropriate assessments are therefore not carried out. Although they have defined small zero-use zones within the national parks, most of the area remains accessible to fisheries. It would therefore seem that German shrimp fisheries management is lagging behind their Dutch and Danish counterparts in meeting nature protection requirements.

Fishing effort also constitutes an important factor in this assessment. The Danish Wadden Sea (up to 6 nm) is almost exclusively accessible to Danish shrimp trawlers which account for the lowest total fishing effort (in terms of total hours fished – see Figure 6). In contrast, fishing effort along the German and Dutch coasts is significantly higher with an almost complete overlap of the German and Dutch fleets and some of the highest fishing intensity occurring off the German coast. It should be noted that the fishing intensity displayed in Figure 6 is likely to be an underestimate as vessels under 15m length are not monitored with VMS and these are the vessels most likely to fish closer inshore.

2.2.5. OTHER SHELLFISH FISHERIES

Beside the blue mussel and cockle fisheries, a number of other shellfish fisheries have been carried out in the Wadden Sea. These have included *Spisula* fisheries in Denmark and Schleswig-Holstein. In Schleswig-Holstein, this fishery was allowed beyond the 3nm limit; however no *Spisula* fishing has taken place since 1996 due to low stocks and according to the Mussel Fishery Programme, this fishery will be closed in 2016. In Denmark there has been no fishery on *Spisula* since 2006 (Nehls *et al*, 2009b). Other shellfish fisheries include one Pacific oyster culture in Schleswig Holstein.

The Pacific oyster (*Crassostrea gigas*) occurs naturally in estuarine and coastal marine waters of Japan and south-east Asia where it is found in the intertidal and shallow sub tidal zone. In the Wadden Sea it is an invasive species where it has proliferated rapidly since its introduction in the late 1970s and now has a continuous distribution throughout the entire area (Nehring, 2011). In 1983 first specimens were observed near the island of Texel in the Dutch Wadden Sea, although they probably originated from an earlier introduction in the Oosterschelde in the 1970s. Since the 1990's this alien species has been frequently observed along the entire Dutch coast and in the Dutch Wadden Sea and in 1996 a first settlement of the Pacific oyster occurred in the western Wadden Sea area of Germany as well (Nehring, 2011). The reproductive success in *C. gigas* has been linked to higher water temperatures in summer and in 2006, the biomass of *C. gigas* in the Wadden Sea was estimated to be at least 61,000 tonnes wet weight (Nehls and Büttger, 2007 in Nehring *et al*, 2009). Since 1986, commercial farming activity began in the northern area of the German Wadden Sea near the island of Sylt on an area of 30 ha, primarily with seed taken from British and Irish hatcheries. Since 2011, manual collection of consumption oysters and oyster spat is also allowed to a limited extent. In the Danish Wadden Sea, fishing on Pacific oysters is not allowed, although some harvesting by hand gathering for tourism purposes does take place (P. Sand Kristensen, pers. comm.). In The Netherlands, an experimental fishery on Pacific oysters takes place, which involves manual collection by 15 people and aims to establish whether this species can be exploited as part of the Wadden Sea ecosystem (P. Walker, pers. comm.). Within the legally non-binding trilateral policy and management of the 2010 Wadden Sea Plan, the following relates to oyster culture: "4.26 The existing permit for oyster culture in Schleswig-Holstein will remain in force. New permits will not be granted."

In terms of MSC assessments, the team only identified the DFA Dutch North Sea *Ensis* fishery as being potentially of interest. The fishery targets razor shell (*Ensis directus*) with a shellfish suction dredge using both airlift and suction pump, by Signatories to the CPO Nederlandse Visserbond UA *Ensis* Fishery Management Plan. The fishery is carried out in the coastal waters in the south (west of Zeeland province) and in the North (above and between the islands bordering the Wadden Sea) of The Netherlands. Fishing in the Wadden Sea, however, is not allowed.

The information available at the time of this study was too patchy to conduct an in-depth review of shellfish fisheries other than the cockle and mussel fisheries. These fisheries are therefore not considered further in this study. Note, however, that the key issues relating to

these fisheries, such as the risk of invasive species, habitat impacts and ecosystem carrying capacity are similar to those of the mussel and cockle fisheries which are discussed in detail in the following sections.

Table 9. Summary of the situation of "other" shellfish fisheries in each Wadden Sea country: NL (The Netherlands); LS (Lower Saxony / Niedersachsen); SH (Schleswig-Holstein); HH (Hamburg National Park) and DK (Denmark). Based on data from Nehls *et al* (2009b).

	NL	LS	SH	HH	DK
Shellfish fisheries other than blue mussels or cockles	-	- No landings since 1995	- No *Spisula* landings since 1996 although allowed outside 3nm limit. - Razor clam by dredge (*Ensis* spp.) inside conservation area forbidden since 1999 - One 30ha Pacific oyster (*Crassostrea gigas*) - oyster (seed + adult) collection	No shellfish fishery permitted	- No *Spisula* landings since 2006 - One license for Pacific oyster culture but currently not in use. There is therefore no Pacific oyster culture
Landings	-	None since 1995	- No *Spisula* landings since 1996 - No razor clam landings - Oyster (*C. gigas*) landings from the culture at Sylt and from collection for consumption	N/a	Average *Spisula* annual landings 1999 – 2003: 2,846 tonnes (assumed meat weight), but none since 2006
General trend in production	-	- Decrease (*Spisula*)	- Decrease (*Spisula*) - Unknown (*Ensis*) - Stable (only culture) (Pacific oyster)	N/a	- Decrease (*Spisula*) - Static (Pacific oyster)
Management framework	-		- Permits are issued by the state - razor clam fishing not allowed in the Conservation Area - No *spisula* fishing allowed within 3nm limit		- Permits are issued by the state (5 are issued for Spisula although only 1 is in use; one for Pacific oyster culture)
Food reservation policy for birds	-	None	Food requirements for birds only addressed through appropriate assessment	N/a	Fishery subject to appropriate assessment

2.2.6. FINFISH FISHERIES

Several finfish fisheries take place in the Dutch part of the Wadden Sea. These include the following:

- Fyke net fishery for eel (*Anguilla anguilla*) although flounder (*Platichthys flesus*), smelt (*Osmerus eperlanus*) and the invasive Chinese mitten crab (*Eriocheir sinensis*) are also caught (Figure 13). This fishery has declined in effort in recent years, mainly due to the decline in eels. Nehls *et al* (2009b) state that 24 fyke net permits have been issued in the area. In Germany, this fishery takes place on a very small scale and is considered a marginal commercial fishery (H. U. Rösner, pers. comm.). In The Netherlands, the eel fishery is closed during the peak season between September and November in accordance with the Eel Management Plan (see below).

This fishery is subject to the eel management plans implemented by each EU member state is response to the 2007 EC Regulation which requires the escapement to the sea of 40% of silver eel biomass, relative to the best estimate of the theoretical escapement in pristine conditions (i.e. if the stock had been completely free of anthropogenic influences) (ICES, 2011). ICES advice for 2012 states that the status of eel remains critical with a historical minimum recorded in the abundance of all stages of eel (glass eel, yellow eel, and silver eel). Glass eel recruitment has fallen to 5% of the 1960–1979 average in the Atlantic region and to less than 1% in the North Sea area, showing no sign of recovery. Recruitment of young yellow eel has been declining continuously since the 1950s. ICES advice includes the recommendation that all commercial fishing activities affecting production and escapement of eels should be reduced to as close to zero as possible until there is clear evidence that both recruitment and the adult stock are increasing (ICES, 2011).

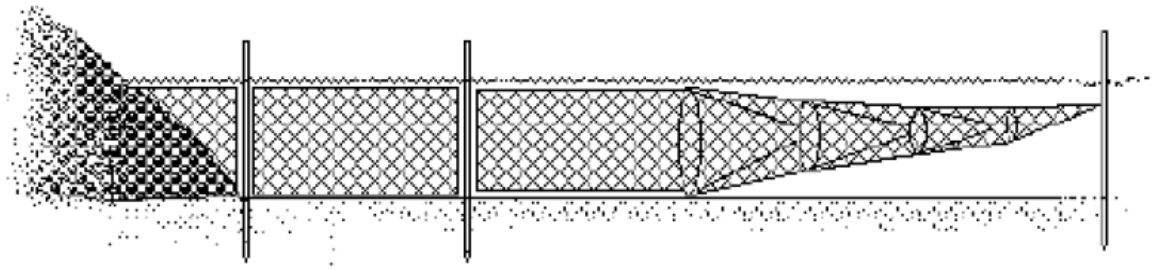


Figure 13. Fyke net drawing. From Van Overzee *et al* (2008)

- Bottom gill net fishery for seabass and mullet (Figure 14). The fishery takes place from May to September, along deep gullies (max. 5m depth) and on the intertidal during high tide with 1 to 3 m high nets and a 90 – 110 mm mesh. The fishery is regulated by a permit system. There are 13 permits issued for the gill net fishery in the Wadden Sea, of which 5 to 6 are actively used (Nehls *et al*, 2009b). Most permit holders can deploy up to 2,500 m of net; the use of nets of up to 5 km is not allowed in the Dutch Wadden Sea. In 2006 it was estimated that 237 km of drift nets were put out in the Wadden Sea (Van Overzee *et al*, 2008). A seine net fishery also targets seabass and mullet (Figure 15). The fishery

takes place from April until November on tidal flats although not in closed areas. The fishery is regulated by a permit system of which 4 to 5 are currently in use (Nehls *et al*, 2009b). Neither seabass nor mullet are subject to EU TACs. Recent increasing trends in water temperature have promoted a northerly shift in the distribution of these species with seabass now found further north into the North Sea. It is also thought that climate warming may have lengthened the duration of residence of adult seabass in the summer feeding areas (ICES, 2011), such as the Wadden Sea. The information on this fishery is lacking overall (H. U. Rösner, pers. comm.) and the importance of these species to commercial fisheries in the Wadden Sea could not be established.

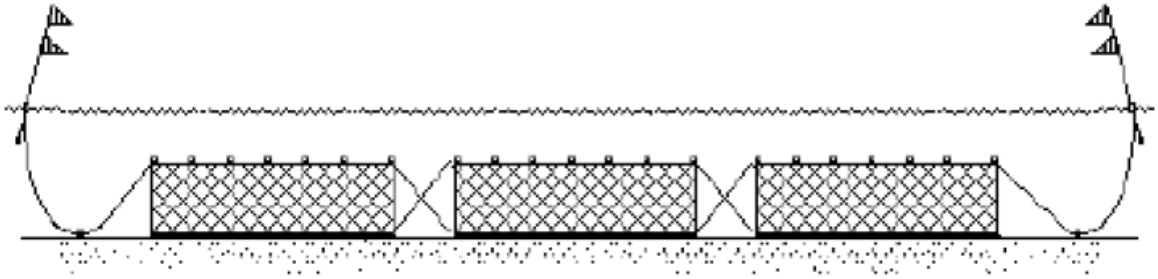


Figure 14. Drawing of bottom gill net. From Van Overzee *et al* (2008)

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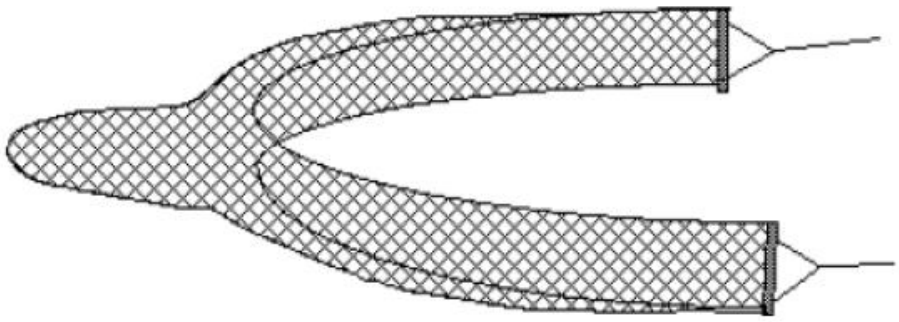

Figure 15. Seine net drawing. From Van Overzee *et al* (2008)

The information available at the time of this study indicated that none of the above fisheries were taking place on a significant scale in the Wadden Sea Area. Here also, the information was at best patchy and did not allow for an-depth review of each fishery. These fisheries are therefore not referred to in detail in any of the subsequent sections. Note, however, that this does not imply that management of these fisheries should be considered as marginal, and some of the issues likely to affect these fisheries (e.g. bycatch) are discussed in the following sections.

3. TASK 2

This task of the study centers on the development of an indicator-based framework for fisheries sustainability criteria, which is based on the core fisheries sustainability issues that affect or are likely to affect the Wadden Sea ecosystem. In order to identify these sustainability issues, the team has carried out an impact assessment for each of the main Wadden Sea fisheries in relation to the Wadden Sea ecosystem, including those habitats and species designated under the Habitats and Birds Directive, as well as habitats and species identified in the Trilateral Targets (defined in the Wadden Sea Plan 2010). The impact assessment aims to identify those fishing activities that are likely to interfere with the achievement of conservation objectives for the Wadden Sea, including Natura 2000 objectives and the Trilateral Targets. The results of the impact analysis, presented in Section 3.1 below, are then fed into the indicator-based framework for sustainability criteria (Section 3.2). These criteria are presented along a gradient of weak to strong sustainability, and compared to the existing MSC performance indicators. As such, an overarching framework will be developed in which the selected fisheries can be assessed for each national jurisdiction and recommendations for moving towards stronger sustainability made as necessary. The existing Trilateral Targets are also mapped on to this framework as far as possible. The results of this exercise are presented in Section 3.2.

3.1. IMPACT ASSESSMENT

In this section we first consider the impacts of the main fishing activities in the Wadden Sea in relation to the Wadden Sea ecosystem, including those features designated under the Habitats and Birds Directive and/or included in the Trilateral Targets of the Wadden Sea. The team notes that the fisheries information gathered during Task 1 is descriptive and does not provide the detail necessary for a quantitative assessment of impacts. Further to the information presented in the fisheries overview (see Section 2.2), the team will focus on the mussel, cockle and shrimp fisheries. This does not imply that impacts from other shellfish fisheries such as oyster culture and finfish fisheries such as the mullet and seabass fishery do not take place. The team, however, felt that these fisheries either took place on too small a scale to warrant an in-depth impacts study or presented too many knowledge gaps to complete an impacts study at this stage. Some key concerns have, however, been addressed in the sustainability framework.

An evaluation of the selected types of Wadden Sea fisheries was carried out according to four criteria: Status of target species and population, Bycatch and discards, Habitat impacts, and Protected species. The latter two criteria also cover those habitats and species which are considered as qualifying features under the Habitats and Birds Directive. Features which are included in the Trilateral Targets for the Wadden Sea are also included, although there is of course a strong overlap between the two.

3.1.1. MUSSEL FISHERIES

Mussel fisheries are associated with a variety of impacts and these are discussed in more detail below. Prior to this, however, this section provides a brief discussion on the types of mussel beds in the Wadden Sea.

A. TYPES OF MUSSEL BEDS

During this study, there has been considerable discussion about the impacts of fishing on mussel beds, with different perspectives coming from different areas (e.g. Wadden Sea vs. UK). At the root of this discussion has been a problem in distinguishing between impacts on different types of mussel bed, which may be very different; hence here we add an introductory paragraph of explanation.

Adult beds vs. seed beds: Mussel fishermen and fisheries management often distinguish between two broad types of mussel bed (for example, see Saurel *et al* (2004), MEP (2010)). 'Adult' mussel beds are beds which are long-established, with mussels of a mix of ages from recent spat to mussels which may be 4 or 5 years old, or older. These beds provide a suitable substratum for mussel spat settlement (dead mussel shell) and therefore tend to attract more frequent, predictable and abundant spatfall than elsewhere, and support high epifaunal biodiversity, as well as populations of predators such as birds. 'Seed' beds, on the other hand, may partly occur in areas where there is periodic spatfall (although frequently not every year) but where the mussels are usually lost to predation, storms or both in the first year after settlement. MEP (2010) provides an extensive description of two examples of 'seed' beds (which form the basis of the UK's largest mussel fishery) – one where mussels settle in the subtidal and are reliably consumed by starfish, and the other where mussels settle in the low intertidal and are removed by autumn or winter storms (although a small percentage sometimes persist). Generally speaking, in the UK, conservation agencies have accepted the argument put forward by mussel fishermen that these mussel beds are much less ecologically important than permanent beds (Saurel *et al*, 2004), and permit part or all to be fished.

In the Wadden Sea, a distinction between stable and unstable mussel beds has been discussed and attempted to be incorporated in the decision of spatial management of the fisheries. In the Netherlands, the distinction is still used for decisions on seed fisheries (see above). For the intertidal, there is extensive knowledge on sites which are populated by mussel beds over long periods and from some strong spatfall events there is also evidence that mussel beds may form on sites where there is little chance to persist over longer periods. A general distinction between stable and unstable beds is, however, often very difficult as stability is largely determined by storm events and ice winters (Nehls and Thiel, 1993). As a general rule it can be formulated that beds in sheltered area have higher survival probabilities than beds in exposed areas.

Intertidal vs. subtidal beds: As noted above, both adult and seed beds may occur in the intertidal and the subtidal, but it is useful to distinguish between the two. The fauna of subtidal and intertidal beds is somewhat different. Mussels in the intertidal grow slower,

with thicker shells and are less vulnerable to predation (Caldow *et al*, 2004). Intertidal mussel beds are mainly predated by green crabs, oystercatchers and gulls, while subtidal beds are predated by starfish, green crabs and eider duck (Saurel *et al*, 2004). Mussel dredgers can easily target subtidal beds, but cannot easily fish intertidal beds except low in the intertidal. In other words, they are not equivalent either ecologically or from a fisheries perspective. Knowledge on subtidal beds in the Wadden Sea is still rather limited. It is often claimed that subtidal beds are prone to strong predation, especially by starfish, and are thus less likely to persist over longer periods as known from intertidal beds (Nehls *et al*, 2011). This has in many cases lead to the decision of restricting fisheries to the subtidal parts of the Wadden Sea. There is, however, no scientific support for the assumption of general instability of subtidal mussel stocks even though structure and dynamics are likely to be different to intertidal beds. Also for subtidal areas long-lived assemblages are reported (Dankers and Zuidema 1995; Nehls *et al*, 2011). In The Netherlands it has recently been decided to reduce and finally phase out fisheries in the subtidal in order to re-establish subtidal mussel beds.

B. TARGET SPECIES AND POPULATION

The *Mytilus edulis* stock of the North Sea is considered as a single stock (SGS, 2011), with local variations in size and condition due to differences in local environmental conditions, affecting food availability, predation and spat fall. In most parts of the Wadden Sea, long-term observations of intertidal blue mussel beds have revealed a gradual or strong decline in the number and size of mature mussel beds over the last decade, with losses in mussel bed area apparently not being compensated by spatfall. The underlying causes have yet to be established, but there are indications that factors such as past over-exploitation by fisheries and changing climatic conditions may have contributed to the decline. In relation to the latter, it has been hypothesised that mild winters (resulting in a synchronized settling of mussels and the occurrence of their main predators in the Wadden Sea), warm summers (promoting the proliferation of the invasive Pacific oyster on mussel beds) and storms and ice cover may influence blue mussel recruitment and therefore the development of new or existing mussel beds (Nehls *et al*, 2009a). The status of permanent subtidal mussel beds is largely unknown (CWSS, 2010), although there are reports that over the last few years natural spat fall (as opposed to spat collected via ASCs) has declined, indicating difficulties in the actual settlement phase of the spat, the cause of which is unknown. Scientific investigations into this issue are currently ongoing (P. Walker, pers. comm.).

Wadden Sea mussel landings have experienced strong fluctuations, both annually and regionally (Figure 16). Overall, the total annual landings of blue mussels in the Wadden Sea (from both culture and wild fisheries) have shown a long-term decrease since the eighties to mid-nineties which is mainly attributed to decreasing landings in The Netherlands due to increasingly strict regulation of the fishery as well as decreasing spatfall and stocks. In the other areas, landings are rather variable but have also been low in comparison with the 1980s (Nehls *et al*, 2009b).

In soft sediment systems such as the Wadden Sea, mussels need hard substrata for attachment, so there is a concern that disruption of natural mussel beds can lead to a failure of future settlement because the spat requires adult mussels on which to settle (Gascoigne *et al*, 2005). Mussels can, however, settle on other types of hard substratum such as cockle shell and Pacific oyster shell, or even simply attached to each other so this may not be such a concern as it appears. As settlement of mussel spat in existing beds is rather predictable whereas establishment of new beds is an irregular process, any removal of mussel beds has implication on future spatfall and population development.

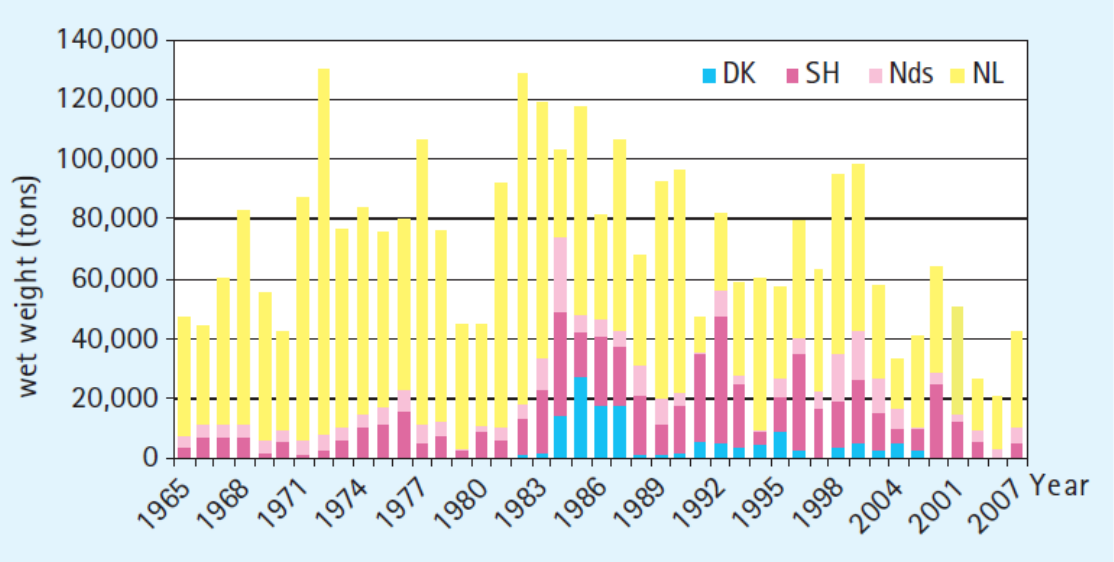

Figure 16. Total annual landings of Wadden Sea mussels in wet weight (including shells). Note that the years 2004 and 2001 on the x-axis are reversed. From Nehls *et al*, 2009b.

In most cases (with the exception of Denmark), mussel fisheries in the Wadden Sea act by fishing seed mussels from natural beds and placing them on mussel cultures for a limited period of time before they are finally harvested and marketed. Seed fisheries on natural beds and harvesting of the cultures will lead to a reduction of the mussel stocks through direct mortality from fishing and handling (probably low impact) and removal of mussels out of the system. The mussel population may further be negatively impacted by reduced survival of remaining mussels on natural beds. However, such impacts have not been quantitatively studied so far.

Mussels laid on the cultures remain in the system for a while (1-2 years) and grow to market size. Survival of mussels on the cultures is expected to be better than on natural beds (that is why mussels are brought to culture lots) and biomass on the cultures may increase from growth of mussels (Nehls and Ruth 1994). In general, the ratio of mussels brought to the cultures to mussels harvested is rather low (1: 1-2), so mussel cultures are unlikely to provide a substantial increase of overall mussel biomass, though at times a high proportion of mussel biomass is situated on the cultures (also see Protected Species below).

The consequences of mussel fisheries will differ whether they affect beds with high survival probability or beds with low survival probability; however, although fisheries policies try to focus fisheries on beds with low survival probability, there are few investigations into these effects. Mussel fisheries in some other areas (e.g. the Menai Strait, UK) have been based around areas of mussel spatfall which are expected to have low survival probability, with generally speaking no mussels surviving through the winter after settlement (although this is not always the case) (MEP, 2010). There is even an argument that fishing can stabilise these beds to some extent – this has been observed by one of the authors in the case where a very dense settlement causes the mussel spat to sever byssal attachments (Jo Gascoigne, pers. obs., South America skear, Morecambe Bay, UK, June 2005), but it is not a phenomenon that occurs systematically. It is not clear whether such 'reliably unstable' beds could be identified in a Wadden Sea context, however. Regarding the long-term development of natural mussel stocks and fisheries landings, no stabilizing effects of fisheries have been observed in the Wadden Sea, and there is no evidence that fisheries increase average mussel biomass of the Wadden Sea. As natural mussel beds may persist over long periods whereas cultures will be harvested at latest after two years, fisheries will normally in the long run cause a decrease in mussel stocks, though facilitating high stocks for short periods.

A major problem in assessing fisheries impacts on the mussel population of the Wadden Sea is the fact that spatfall is unpredictable in time and space, meaning that when beds are fished their regeneration rate is hard to assess. Spatfall is erratic outside existing beds and though it may be sufficient to sustain existing beds, reestablishment of beds which are lost to fishing does not currently occur every year (Nehls *et al*, 2011). This appears to have been the case in Denmark where in an attempt to reverse the declining trends in blue mussel abundance, 1,000 tonnes of seed mussels were spread out over former mussel beds in 2002 to re-establish them. This attempt appears to have had no permanent, positive effect, despite the fact that these mussel beds were not fished (Nehls *et al*, 2009b). While natural beds have the potential to persist over long periods of time, they may therefore need years to recover from destructive impacts such as those caused by fisheries.

Conclusion: potential long-term decrease in mussel stocks is likely to directly conflict with Trilateral Policy 4.23 and 9.6 "*The effects of mussel fishery are limited by (…) the reservation of sufficient amounts of mussels for birds. In addition, the management of fishery on mussels should not be in conflict with protecting and enhancing the growth of natural mussel beds*" and Trilateral Target for the Tidal Area "*A natural size, distribution and development of natural mussel beds*". Note that these effects will also have secondary effects on other Trilateral Targets such as those for birds.

This impact also implies conflict with the set conservation objectives for habitat types which integrate mussel beds:

- intertidal mussel fisheries: - 1140 (Mudflats and sandflats) in NL, SH, LS
- subtidal mussel fisheries: - 1110 (Sandbanks) in NL
  - 1170 (Reefs) in LS, DK[17]

C. BYCATCH AND DISCARDS

Mechanical harvesting of mussel seed and adult mussels

Mussel beds are the most species-rich benthic community of the Wadden Sea, with higher biomass and productivity of associated fauna than on surrounding mudflats (Asmus 1986; Buschbaum 2001; Saier 2002; Saier *et al*, 2010). The mussel bed community will be subject to impacts from dredging, relaying and harvesting in the cycle of processes of mussel fisheries and impacts will differ between intertidal and subtidal mussel beds. Survival of associated fauna during dredging has not been studied so far. It can be assumed that mortality will differ between species. A comparative study by Westphalen (2006) indicated that mussel cultures have a less rich associated fauna as compared to natural beds. This might be partly due to mortality from handling, limited time to re-establish the community and different structure of mussel cultures. In some cases, however, where the mussel beds used as sources of seed are transient, the newly established beds are less rich in associated fauna than a longer-established mussel bed, meaning that fishing has lower ecological impacts in these cases. It should be noted, that with regards to the collection of mussel seed and adult mussels by dredge, impacts from bycatch were considered as minor in two MSC assessments of this type of fishery, with caught quantities of mainly slipper limpets, oysters, starfish, crabs and occasionally finfish considered as insignificant compared to respective stock sizes (SGS, 2011; MEP, 2010).

Artificial Seed Collectors

Bycatch mainly includes epibionts and small crabs, none of which are retained (SGS, 2011). Some protected fish species such as twaite shad are likely to occur in the ASC footprint; however this effect was determined as unlikely in an appropriate assessment carried out for the Dutch ASC fishery (De Mesel *et al*, 2009).

Conclusion: uncertainty as to the quantified and species-specific impacts of bycatch in Wadden Sea mussel fishery by dredge. However, it is likely that this impact affects the species composition and integrity of fished habitats. This impact therefore implies conflict with the set conservation objectives for habitat types of Annex I of the HD, which integrate mussel beds (see section a); According to WSP § 4.23 "*The management of fishery on mussels should not be in conflict with protecting and enhancing the growth of*

[17] H 1170 has been designated as biogenic reef (mainly sublitoral mussel beds). The actual reefs themselves have not yet been designated, since Denmark has no data on location of sublittoral mussel beds

natural mussel beds and Zostera *fields*"; the Trilateral Targets on the Tidal Area - more specifically "*an increased area of geomorphologically and biologically undisturbed tidal flats and subtidal areas*"; the Trilateral Target on Fish "*Maintenance of the diversity of natural habitats to provide substratum for spawning and nursery functions for juvenile fish*" and the Trilateral Target on Estuaries: "*Maintaining and where possible restoring natural habitats and tidal dynamics typical of Estuaries*".

D. HABITATS

Mechanical harvesting of mussel seed and adult mussels

- Direct disturbance of the seabed through creation of furrows and sediment resuspension by dredge with direct impact on benthic organisms. Here also, impacts will differ between intertidal and subtidal mussel beds as associated species are different. In the Wadden Sea, however, the survival of associated fauna has so far not been studied quantitatively. Potential consequences of dredging for mussels include direct mortality of benthic fauna and flora and changes in benthic community structure and functioning. Mussel dredging may lead to a reduction in the complexity and ultimately the destruction of biogenic habitats such as *Sabellaria* reefs and other habitats such as *Zostera* beds. This would only be the case, however, if there is spatfall in these areas. The abundance and distribution of *Sabellaria* reefs in the Wadden Sea are currently not clear and this constitutes a significant knowledge gap for the assessment of fishing impacts. On the mussel beds themselves, a study by Dolmer *et al* (1999) has shown that dredging may instantly remove large numbers of large individuals and significantly reduce the number of other species associated with the area for up to 40 days after dredging. The lowering of intraspecific food competition caused by a reduced density of mussels did not increase the accumulation of biomass in the mussels which remained in the dredged area – it can therefore be concluded that mussel dredging may lead to reduced growth and – depending on fishing intensity - the destruction of the dredged mussel bed.

- Sediment resuspension may lead to localised reduction in dissolved oxygen and an increased nutrient load in the water column. This effect was shown to be relatively minor, however, in a study by Dyekjaer *et al* (1995) evaluating the effects of mussel dredging in a sheltered fjord in Denmark, where impacts on water quality were shown to be localised and temporary (limited to during the dredging operations) and relatively unimportant compared with total annual wind-induced resuspension and release of nutrients compared to load from land (Sewell and Hiscock, 2005). In the highly dynamic Wadden Sea, it can therefore be assumed that the overall effect of mussel dredging on water quality is for those same reasons relatively unimportant. Nevertheless, local and temporary impacts are likely and as such should be taken into account.

Mussel culture

- The presence of mussels and accumulated mud will alter habitats where culture plots are located (see Artificial Seed Collectors below).

- Import and translocation of mussel seed may lead to the inadvertent introduction of non-native species with potential adverse effects for natural communities. Examples of non-indigenous species already present in the Wadden Sea include the seaweed *Sargassum muticum*, the slipper limpet *Crepidula fornicata* and the Pacific oyster *Crassostrea gigas*. The latter was introduced in the 1970s and is now frequently found on rocky shores in south-west England and populations of the oyster have taken over areas of previously productive mussel beds in the Wadden Sea (Sewell and Hiscock, 2005). In their assessment of the risk that the transfer of mussels and introduction of nonindigenous species from the Irish and Celtic Sea poses to the Oosterschelde ecosystem, Wijsman and Smaal (2007) concluded that the risk was small but not totally absent. The chance of introducing exotic species by means of mussel transports was considered realistic for a number of species – particularly those associated with mussel beds in their place of origin. The actual chance of introduction depended on the possibility that the species was caught with the mussel fishery in the place of origin, the survival during the transport to the Netherlands, the habitat requirements of the species and the environmental conditions in the place of destination – in this case, the Wadden Sea. Once introduced, species that have the potential to become established in the Wadden Sea may negatively impact native species and habitats, including habitats of conservation concern (submerged sandbanks, large shallow bay, intertidal mudflats and sandflats, and reefs). Impacts include competition for space and resources with native species; alteration of substrata and water conditions; predation and depletion of native species populations; smothering of native species; consumption of pelagic larvae and indirect impacts on species through loss of prey and refuge (Sewell *et al*, 2008).

Artificial Seed Collectors

- Accumulation of mussel mud (faeces and pseudofaeces) underneath ASCs may lead to increased siltation and organic enrichment of the benthic environment or water column underneath or in the vicinity of ASCs, or in the case of exceptionally high production at the level of the ecosystem. This would have a negative impact on filter feeders such as shellfish but positive on deposit feeders such as worms. In severe cases, organic enrichment and increased siltation may also lead to hypoxia and anoxia of the benthic environment. These impacts may be an issue in shallow areas with reduced water flow; in the case of the Wadden Sea ASCs, however, which are generally placed in a more dynamic environment this is not likely to occur (De Mesel *et al*, 2009). Mussel culture may also lead to food shortages in the water column as mussels sieve large amounts of food and silt out of the water and store this as mussel biomass and faeces. This may have implications on the biomass of benthic organisms in the vicinity of the cultivation plots (Van Berkel and Revier, 1991). Research into the effects of ASC culture on the carrying capacity of the Wadden Sea is currently ongoing (P. Walker, pers. comm.).

- Formation of secondary mussel beds from mussel seed detached from ASCs. This is not necessarily a strong impact and would be highly localised (De Mesel *et al*, 2009). This impact is not considered further in this study.

- Localised disturbance of the seabed due to the actual installation, maintenance, operation and removal of the ASCs.

- Marine litter. During storms or during the actual handling of the ASCs some synthetic materials may come free and disperse in the environment with potential negative consequences for wildlife (entanglement and ingestion among others), landscape and general quality of the habitat. Although this is not a prominent issue with ASCs, it may have to be taken into account should a significant expansion of the installations become likely within the Wadden Sea.

Conclusion:

- Direct habitat impacts on fished subtidal and intertidal beds are likely to be caused by mussel dredging. Affected habitat types include those integrating mussel beds, but also potentially *Sabellaria* reefs and *Zostera* beds (although there is a lot of uncertainty associated with this due to lack of spatial distribution data).

- Artificial seed collectors activities may cause reduced water quality in the local environment – this is only likely to be of concern, however, should these take place on a significantly larger scale than is currently the case and at highly sheltered sites. This impact specifically may imply conflict with the WSP § 2.1 "*Trilateral policies for the reduction of inputs of nutrients (…) from all sources are congruent with those within the relevant EC Directives (WFD, MSFD) and the OSPAR framework. Special emphasis must be given to substances that cause unintended/unacceptable biological responses*" and the Trilateral Targets on Water and Sediment "*A Wadden Sea ecosystem which can be regarded as eutrophication non-problem area*" and "*Improvement of habitat quality of conservation of species*".

- Reduced biodiversity associated with cultured mussel beds as opposed to wild, natural beds. However, impacts should be limited if Trilateral Policy 4.25 is adhered to.

Generally, these impacts imply conflict with the set conservation objectives for Natura 2000 sites with habitat types which integrate mussel beds (see section a) as well as the Trilateral Policy 4.23 "*The management of fishery on mussels should not be in conflict with protecting and enhancing the growth of natural mussel beds and* Zostera *fields*"; the Trilateral Targets on the Tidal Area "*A natural size, distribution and development of natural mussel beds,* Sabellaria *reefs and* Zostera *fields*" and "*an increased area of geomorphologically and biologically undisturbed tidal flats and subtidal areas*"; the Trilateral Target on Fish "*Maintenance of the diversity of natural habitats to provide substratum for spawning and nursery functions for juvenile fish*"; and the Trilateral Target on Estuaries: "*Maintaining and where possible restoring natural habitats and tidal dynamics typical of Estuaries*".

- At ecosystem level, the risk of introduction of alien species through translocation of adult mussels or mussel seed import may be significant unless regulations, such as a ban on mussel seed imports, are in place. Significant changes have already taken place in the Wadden Sea ecosystem; however, any further impacts should be minimised. The Trilateral Policy on Alien Species states that "*The Trilateral Cooperation will support and intensify efforts to harmonise approaches to the prevention, management and monitoring of aquatic and terrestrial alien species introductions and will develop a common strategy for dealing with invasive alien species associated with ballast waters and aquaculture. This is also in line with a request from the UNESCO World Heritage Committee*." No specific Trilateral Targets have been formulated for alien species; however, this impact is likely to imply conflict generally with the Trilateral Target on Fish "*Maintenance of the diversity of natural habitats to provide substratum for spawning and nursery functions for juvenile fish*" and general Trilateral Targets for Tidal Areas. This impact may reduce the integrity of a SAC in general.

- Although this is currently not cited as a significant impact, marine litter from ASCs poses a potential risk to the Wadden Sea ecosystem; particularly should there be any significant expansion of ASC installations in the Wadden Sea Area. This impact may imply conflict with the following Trilateral Policy on Water and Sediment "2.4 *The three countries will, in the framework of OSPAR and the EU, support the development and implementation of programmes and measures to reduce the input of marine litter and oil from its many sources, as well as removing litter and oil from the coastal and marine environments, also aiming at reducing negative effects on animal populations and ecosystem functions*."

E. PROTECTED SPECIES

Mussel harvesting by dredge

- The removal of adult mussels from wild or cultured beds may lead to food shortages for mussel-eating birds such as the eider duck (predominantly feeding on subtidal beds) and oystercatcher (feeding on intertidal beds). Both species have experienced significant declines in the past of which the main cause was thought to be food shortages. For oystercatchers, this has been linked to the disappearance and subsequent slow recovery of the intertidal mussel beds, caused by the mussel fishery and to a lesser extent the cockle fishery (see below), in combination with natural factors such as recruitment failure and possibly winter storms (Camphuysen *et al*, 1996). Eider ducks have experienced several years with mass mortality which is thought to be related to low stocks of sublittoral and intertidal mussels (e.g. Camphuysen *et al*, 2002). It is also thought that the transport of mussels from culture lots in the Wadden Sea to culture lots in the Oosterschelde has further reduced food availability for common eiders (Ens *et al*, 2004); this is, however, further discussed below.

- Potential disturbance of breeding/foraging/resting birds and sea mammals due to increased traffic. Some measures are already in place to prevent this; for example in Germany it is illegal to disturb eider ducks from cultures.

Mussel culture

- The practice of mussel culture may have potential positive effects on bird populations. For the period 1992 – 2002, it was estimated that mussel biomass in the sublittoral areas of the Dutch Wadden Sea increased by on average 15% through better growth and lower mortality on culture plots (Bult *et al*, 2003b in Ens *et al*, 2007) – this includes both the export of mussels to the Oosterschelde and imports of half-grown mussels from Germany. In addition, in The Netherlands, mussels are transferred from ephemeral beds to more sheltered areas with a higher growth and less mortality and management of the mussel fishery requires that 85 % of the mussels fished in the Wadden Sea should remain within the system for at least one year. In Schleswig-Holstein, mussels have to remain on the cultures for at least 14 months. A recent MSC assessment of Dutch mussel fisheries in the Wadden Sea (see SGS, 2011) stipulated that overall food supply for birds would not be reduced by the mussel fishery, since the removals are compensated by the extra growth and reduced mortality of mussels on the culture plots. Nevertheless, this issue remains disputed, particularly since the dynamics of natural subtidal mussel beds are poorly understood in the Wadden Sea and the populations of mussel eating birds, in particular common eiders and oystercatchers, are still in decline (Laursen *et al*, 2010a). An open question remains, how frequently mussel fisheries – despite a small promotion of average mussel biomass on the cultures – may lead to periodic bottlenecks in the food demand of mussel eating birds, as all mussel from cultures are finally harvested and removed from the system. As such, this issue should certainly be taken into consideration for the development of sustainability criteria for the Wadden Sea.

Artificial Seed Collectors

- Impacts of marine mammals (e.g. harbour porpoise, harbour and grey seal, Eurasian otter if present) may occur through entanglement and subsequent injury or drowning and general disturbance during the various ASC operations (installation, harvest, removal etc.). In their appropriate assessment of Dutch Wadden Sea ASCs installations, De Mesel *et al* (2009) considered the risk of disturbance to be of particular concern to the harbour seal (*Phoca vitulina*) of which the pupping season coincides with ASC activity (late spring/summer). This was not considered to be the case for the grey seal of which the pups are born after the mussel season. It was noted, however, that impacts of ASCs on marine mammals will depend on the location of each ASC installation and it has been acknowledged that this requires further research.

- Potential disturbance of breeding, foraging or resting birds due to activities surrounding the ASCs. ASCs, however, are not operational between November and March, which is when some overwintering birds are most abundant in the Wadden Sea (e.g. eider ducks). Overlap and therefore interaction between the ASC operations and overwintering birds is therefore considered minimal. Furthermore, ASCs installations tend to be located at a certain distance from the intertidal flats used by breeding and foraging birds in order to reach a minimal depth. As such, interaction between the birds and the operational ASCs is not expected to have a significant effect. Nevertheless, although De Mesel *et al* (2009) in their appropriate assessment of ASCs in the Dutch Wadden Sea concluded that the

ASCs did not have a significant impact on birds, it should be noted that this type of conclusion can only be reached after an impact assessment is conducted for any specific ASC installation (or culture plot for that matter), taking into account any overlap between bird presence and ASC operations as well as the location of the installations in relation to known bird feeding/breeding/resting grounds. Furthermore, in the event where a significant expansion of ASC installations becomes likely in the Wadden Sea, potential cumulative impacts may arise and should be taken account of. One of the case studies considers conflicts between mussel fishers and birds, although in the context of a bottom mussel fishery. Conflicts between mussel eating birds and ASCs have developed in other regions and particularly predation by eider ducks is seen as a problem for the fisheries. For the Wadden Sea no such conflicts have been reported so far but cannot be excluded as eider are abundant birds during the whole year.

- Potential positive effect on birds through increased food availability (where birds may feed on detached mussel seed or from the ASCs directly) and as resting place (De Mesel *et al*, 2009).

Conclusion:

- Dredging for adult and seed mussels may lead to reduced food availability for eider ducks (mainly subtidal beds) and oyster catchers (intertidal beds). The situation is less clear for mussel culture; however, there is a risk that despite short-term increases in food availability, mussel culture may lead to a long-term decrease in the mussel stock (see section a). This impact therefore may imply conflict with the Trilateral Policy 4.23 "*The effects of mussel fishery are limited by (…) and the reservation of sufficient amounts of mussels for birds*" and the general Trilateral Targets and Policies on Birds, as well as the general conservation objectives for Annex II bird species under the Habitats Directive and Annex I birds under the Birds Directive.

- Disturbance to marine mammals and birds is likely, depending on the location of culture sites and timing of activity. Unless measures are in place to prevent this, this impact may be of concern should culture activities take place at a significant scale – this impact is, however, limited by the Trilateral Policies 4.25 "*The current area of mussel culture lots will not be enlarged*" and 9.22 "*Speed limits for ships have been imposed, taking into account safety, environmental, recreational and fishery factors*". Nevertheless, this impact may imply conflict with the overall Trilateral Targets and Policies for Birds and Mammals. Also affected may be the conservation objectives for Annex II bird and mammal (harbour seal) species under the Habitats Directive and Annex I birds under the Birds Directive.

3.1.2. COCKLE FISHERIES

A. TARGET SPECIES AND POPULATION

Target species is the common cockle (*Cerastoderma edule*), primarily fished in The Netherlands by hand rake. In the period 1994-2003 average annual cockle landings in the entire Wadden Sea were about 22,000 tonnes in wet weight, which decreased towards the end of the period (Figure 17). Most of these cockle landings were made in The Netherlands (Nehls *et al*, 2009b). Landings in recent years have dropped to record lows which is due to the abolition of the mechanical fishery in The Netherlands in 2005 (and subsequent switch to hand raking) and the absence of the cockle fishery in Germany since the late 1980s/ early 1990s. Note that cockle stocks in the Wadden Sea are highly dynamic, primarily due to great variability in spatfall between years and occasional mass mortalities in severe winters. About once every four or five years there is a good spatfall, creating new cockle beds (Ens *et al*, 2004).

Figure 18 shows the trend in the Dutch Wadden Sea cockle biomass (fished and unfished) in kg meat weight available to birds from 1990 to 2010 (this only includes observations of cockle densities over 50 ind/m^2 as smaller densities do not provide suitable foraging grounds for birds). Environmental conditions are believed to be the main cause for the 1996 minimum (CBS, 2011). The Dutch manual fishery targets up to 5% of the cockle biomass available to birds - in recent years, total landings have accounted for between 0.1 and 1.5 % of the stock, although – as can be expected following the closure of the mechanical fishery – these have shown an increase since 2005 (Figure 19) (Nehls *et al*, 2009b). Also note that the greatest effort of the manual cockle fishery is concentrated on beds with high cockle density (at least 600 cockles/m^2) which may have implications on the cockle stock, as was the case in the Scottish Solway Firth, where the cockle stock collapsed due to increased pressure from the manual fishery in combination with poor cockle recruitment (Davis *et al*, 2006). At present, this scenario is unlikely to repeat itself. Current cockle landings in the Netherlands are low and management of the manual cockle fishery is based on regular and local stock assessments carried out each spring – with the possibility of modification if conservation issues arise during the fishing season. In addition, cockle beds which are of importance to oystercatchers are increasingly avoided (WUR, 2011). With these measures in place it is highly unlikely that this fishery will escalate to a level where the cockle stock in the Dutch Wadden Sea becomes impaired.

In Denmark, where a cockle fishery by suction dredge is carried out, relatively low annual landings (< 1,000 tonnes) have been made in the last decade (Figure 17) (Nehls *et al*, 2009b). The mechanical cockle fishery is highly restricted by of the number of licenses issued (one) and the areas which are allowed to be fished. Furthermore, since 2008, an annual Environmental Impact Assessment is carried out before the cockle fishery is allowed to take place.

In Germany, a mechanical fishery is also allowed in Lower Saxony outside the conservation area; however, it is not conducted at present. In the Schleswig-Holstein Wadden Sea National Park this fishery is forbidden. No current cockle estimates exist for

the German Wadden Sea, potentially because the monitoring and research interest is not significant enough for this and because it is not required by the Trilateral Monitoring an Assessment Programme (TMAP) (H. U. Rösner; G. Millat, pers. comm.).

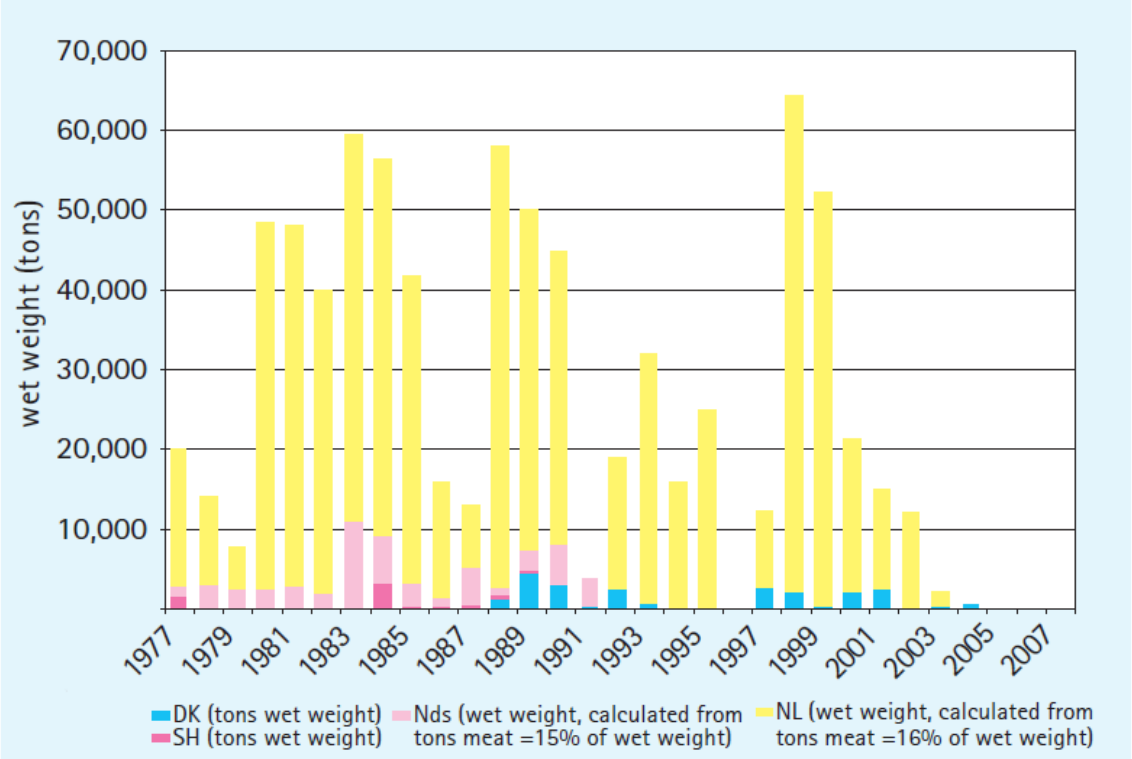

Figure 17. Total annual wet weight of cockles (tonnes) landed in the entire Wadden Sea. From Nehls *et al* (2009b).

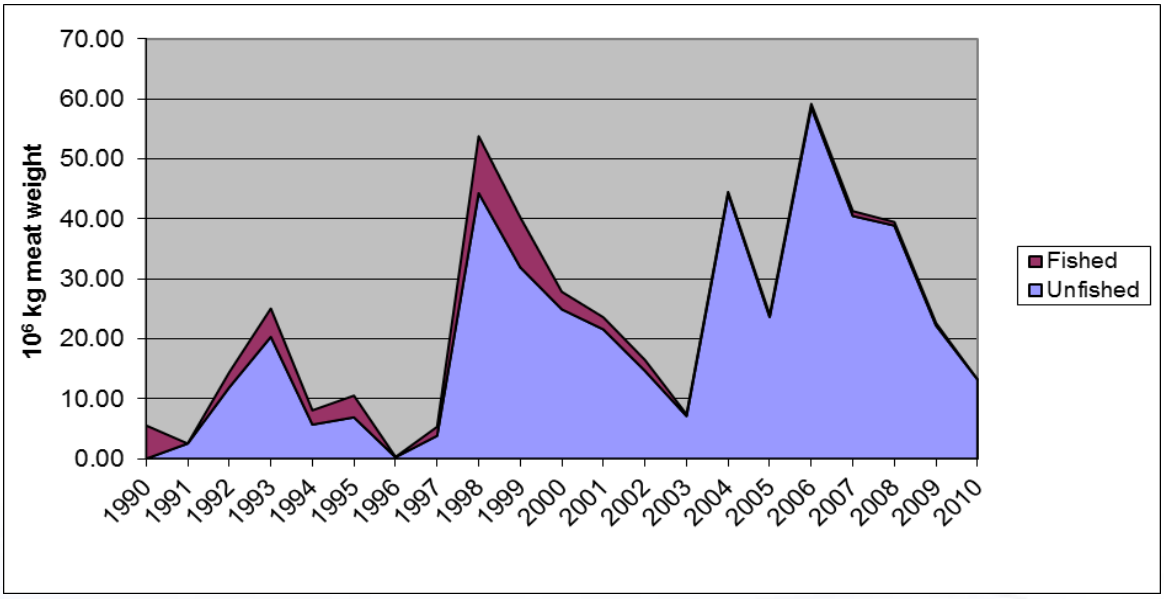

Figure 18. Total unfished and fished cockle biomass in the Dutch Wadden Sea (million kg meat weight). Biomass corresponds to cockle beds available for foraging birds (> 50 ind/m^2) (CBS, 2011)

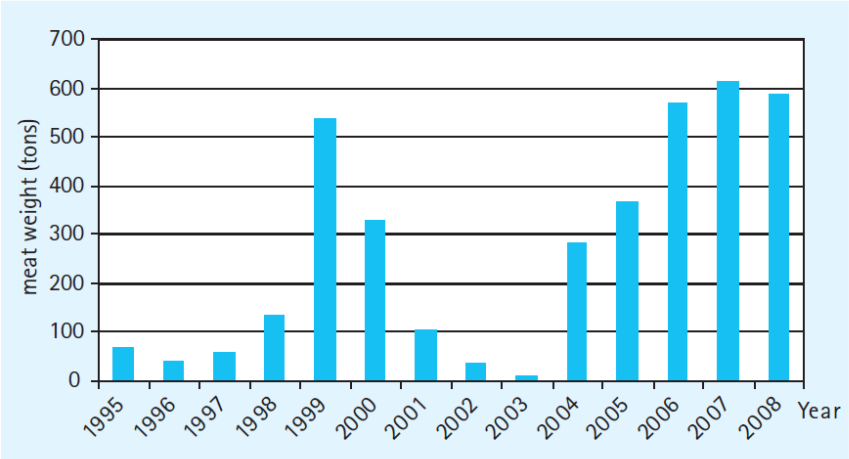

Figure 19. Cockle landings made by hand rakers in the Dutch Wadden Sea. From Nehls *et al*, 2009b.

Conclusion: reduction of Wadden Sea cockle stock is likely by both mechanical fishing and hand raking if no protection measures are in place. Although this impact is currently not a cause for concern, this impact should be taken into consideration for the sustainability framework. If impacts do occur, these are likely to conflict with the Trilateral Targets on the Tidal Area "*A natural dynamic situation in the tidal area*" and "*An increased area of geomorphologically and biologically undisturbed tidal flats and subtidal areas*"; as well as the Trilateral Target on Estuaries: "*Maintaining and where possible restoring natural habitats and tidal dynamics typical of Estuaries*". Note that these effects will also have secondary effects on other Trilateral Targets such as those for birds.

B. BYCATCH AND DISCARDS

Mechanical fishery by suction dredge

A direct effect of mechanised cockle fishing is that all benthic fauna which live just beneath the surface is washed out at sites where the cockle dredge disturbs the seabed. Although cockle dredges are equipped with a sorting grid which enables the larger organisms to escape, smaller benthic organisms are sucked up and are discarded. The mortality of benthic organisms is therefore mainly restricted to species that dwell in the upper layer, or are present with body parts that cannot regenerate. The negative impact of bycatch mortality is likely to last until immigrants and/or new generations have taken over completely and will be especially marked for long-lived sedentary species (Ens *et al*, 2004).

Manual fishery by hand raking

Although there will be localised disturbance of benthic organisms, this type of fishery has minimal bycatch and optimal discard survival occurs when cockles or other bivalves are

scattered thinly over the raked area (Hickin, 2008). The disturbance issue is addressed in the habitats section.

Conclusion: the mechanical cockle fishery by suction dredge is likely to negatively affect associated species. This impact may imply conflict with the Trilateral Targets on the Tidal Area "*A natural dynamic situation in the tidal area*" and "*An increased area of geomorphologically and biologically undisturbed tidal flats and subtidal areas*"; the Trilateral Target on Fish "*Maintenance of the diversity of natural habitats to provide substratum for spawning and nursery functions for juvenile fish*"; and the Trilateral Target on Estuaries: "*Maintaining and where possible restoring natural habitats and tidal dynamics typical of Estuaries*".

This impact also may imply conflict with the set conservation objectives for habitat types where mechanical cockle fishing – in theory – may take place:

- 1110 (Sandbanks) in NL, LS, SH, DK
- 1130 (Estuaries) in NL, LS, SH, DK
- 1140 (Mudflats and sandflats) in NL, LS, SH, DK
- 1160 (Large shallow inlets and bays) in LS, SH, DK
- 1150 (Coastal lagoons) in DK
- 1170 (Reefs) in LS, SH, DK

C. HABITATS

Mechanical fishery by suction dredge

- Direct impacts of the cockle fishery by suction dredge include large-scale physical disturbance of the substratum - the significance of which will depend on the type of habitat affected, and increased mortality of non-target benthic fauna, as previously discussed in the mussel fishery's impacts on habitats (Section 3.1.1). Cockle fishing by hydraulic suction dredge in areas with eelgrass (*Zostera*) beds reduces the integrity of the beds, leading to increased erosion (Rees, 1996). Cockle dredging also especially affects other shellfish species through direct disturbance, bycatch or by suspension and subsequent relocation of organisms to unsuitable habitats (Hiddink, 2003; Ens *et al*, 2004). In a study in the western Wadden Sea Kraan *et al* (2004) (in Ens *et al*, 2004) found evidence that shellfish decreased in the fished sites, whereas worms increased, compared to nearby unfished sites. (also see Bycatch section).

- Mechanical suction dredging may also lead to habitat alteration through changes in sediment composition followed by potential changes in the benthic community. This may lead to a lack of suitable settlement substrate for cockles and other bivalves such as blue mussels and tellins (*Macoma* spp.), with a potential negative impact on the recruitment of those species (Piersma *et al*, 2001; Hiddink, 2003).

- The resuspension of sediment may also have an indirect effect on species some distance from the dredging operation if they are smothered. This impact may include detrimental effects on eel grass beds (Sewell and Hiscock, 2005).

- Hiddink (2003) also cites a possible reduction in local productivity as macro algae, decomposing organic material and fine sediment are resuspended and transported away by the tide, possibly making the area less suitable for bivalves.

Manual fishery by hand raking

Although the Dutch manual cockle fishery currently operates at a relatively low level, hand raking may have direct, negative effects on the impacted area through disturbance of some interstitial species and under-sized cockles, leading to short-term changes in community composition, as well as trampling and physical disturbance of some habitat features such as eelgrass (Sewell and Hiscock, 2005). The impacts are likely to be highly localised but may be of concern should this fishery increase in intensity. Van Overzee *et al* (2008) estimate that approx. 50m^2 are affected per fisherman per tidal cycle, resulting in an impacted total area of *ca*. 120 ha per year. However, the same authors state that some of the impacts on other benthic organisms may potentially be reduced on beds with high cockle density through competition mechanisms.

Conclusion:

Mechanical cockle dredging causes large-scale physical disturbance of the substratum and associated fauna. This is likely to affect all habitats where cockle fishing occurs, including *Zostera* fields if fished. This impact may imply conflict with the set conservation objectives for HD Annex I habitat types where cockle fishing takes place (see section b), as well as the Trilateral Targets for the Tidal Area "*A natural dynamic situation in the tidal area*", "*An increased area of geomorphologically and biologically undisturbed tidal flats and subtidal areas*" and "*A natural size, distribution and development of (…)* Zostera *fields*"; the Trilateral Target for Fish "*Maintenance of the diversity of natural habitats to provide substratum for spawning and nursery functions for juvenile fish*"; and the Trilateral Target on Estuaries: "*Maintaining and where possible restoring natural habitats and tidal dynamics typical of Estuaries*".

- Localised, small-scale disturbance of the substratum and associated fauna by hand raking. This is likely to affect the intertidal where hand raking occurs, including *Zostera* if present. This impact may become of concern if this fishery takes place on a large scale. In this case, this impact may imply conflict with the same Trilateral Targets for the Tidal Area and Fish as above, as well as with the set conservation objectives for habitat types where hand raking takes place:

- 1110 (Sandbanks)
- 1130 (Estuaries)
- 1140 (Mudflats and sandflats)

D. PROTECTED SPECIES

Mechanical fishery by suction dredge

- Cockle fishing by suction dredge may lead to a food shortage for cockle-eating bird species such as oystercatchers and eider ducks, leading to reduced condition (as some species such as oystercatchers shift to other, less profitable prey) and increased mortality. For bird species which have demonstrated high site fidelity such as the oystercatcher this can be of particular importance. Nevertheless, in the 1990s Rappoldt *et al* (2003a) in Ens *et al* (2004) estimated the decline in the Wadden Sea oystercatcher population thought to be related to the cockle fisheries at 15,000 birds, which is 20% of the total decline of 85,000 birds – the remaining 80% being primarily attributed to the disappearance of intertidal mussel beds in that same period. This could in part be interpreted by findings which suggest that fishing practices which reduce the number of shellfish within a bed are less likely to impact feeding birds than those which reduce the overall area of a bed (such as the mussel fisheries). It is suggested that this is due to increased bird density and interference competition likely to occur as a result of reduced bed size (Sewell and Hiscock, 2005). Also note that the only mechanical cockle fishery currently taking place in the Wadden Sea corresponds to one Danish license. The continuation of the fishery is subject to an annual EIA and the fishery is confined to a very limited area. Furthermore, a food reservation policy for birds is in place in the Danish Wadden Sea.

- It has been hypothesised that an increase in the abundance of worms following cockle dredging may lead to increased presence of worm-eating bird species such as dunlins (*Calidris alpina*) (Ens *et al*, 2004).

- The actual fishing activity may lead to disturbance of feeding or roosting birds and marine mammals; however, considering that only one license is active within an area of high maritime traffic which falls outside the Danish Natura 2000 area (the Esbjerg shipping channel) this impact can currently be considered as negligible.

Manual fishery by hand raking

- Potential disturbance of feeding or roosting birds and marine mammals unless precautions are in place.

- Potential impact on birds which feed on cockles (e.g. eider ducks and oystercatchers) through removal of commercially sized cockles. The greatest effort is concentrated on cockle beds with high cockle density (at least 600 cockles/m2) which may have implications on the cockle stock available to birds (see precedent of Scottish Solway Firth). In the current Dutch management regime, the manual cockle fishery is only entitled to up to 5% of the cockle stock available to birds while actual landings were well below this value. Furthermore, stock assessments are carried out annually before the start of each fishing season. In this respect, the impact of the manual cockle fishery on food availability for birds can be considered as unlikely to have a significant impact.

Conclusion: although protection measures are currently in place to prevent a significant impact of the manual and mechanical cockle fishery on food availability for birds, this impact may become severe in the absence of any regulation. Unlikely as it is, this impact should therefore be considered in the sustainability framework. In the absence of current regulatory measures, this impact may conflict with the general Trilateral Targets and Policies on Birds, as well as the general conservation objectives for Annex I birds under the Birds Directive.

- Disturbance to marine mammals and birds is likely if no precautions are in place and in the event where the Danish mechanical cockle fishery increases in intensity – this impact is, however, limited by the Trilateral Policy 9.22 "*Speed limits for ships have been imposed, taking into account safety, environmental, recreational and fishery factors*". Nevertheless, this impact may imply conflict with the overall Trilateral Targets and Policies for Birds and Mammals. Also affected may be the conservation objectives for Annex II mammal species under the Habitats Directive and Annex I birds under the Birds Directive.

3.1.3. SHRIMP FISHERIES

A. TARGET SPECIES AND POPULATION

No reliable stock estimates exist for North Sea brown shrimp (*Crangon crangon*), however there are indications that annual North Sea landings in the last decade have increased and are close to the estimated MSY of 31,500 tonnes (van der Hammen & Poos, 2010). In addition, CPUE has also increased in the last decade which could be related to an increase in shrimp biomass. Note that from an economic perspective, recent reductions in shrimp prices point to overcapacity of shrimp fisheries in European coastal waters, with reduced profitability for the shrimp fleet and particularly for larger vessels (~ 221 kW). Although the total landings of brown shrimp were higher in 2009 than in previous years, this did not compensate for the low prices (Steenbergen *et al*, 2011)

In the Wadden Sea, annual landings for the three WS countries rose steadily from just under 20,000 tonnes in the 1980s to a maximum of just over 35,000 tonnes in 2007 and declined thereafter to approx. 27,000 tonnes in 2009 (Figure 20). It is thought that the increase in landings could be an effect of increased effort, as especially Dutch and Danish vessels increased their shrimping capacity in response to reduced fishing opportunities in other sectors of the industry (Jager *et al*, 2009). The more recent decrease, however, could be related to overcapacity and reduced profitability of the shrimp fleet in European coastal waters. Results of the Demersal Young Fish and Brown Shrimp Surveys (DYFS) also appear to be indicating a distributional shift in the shrimp stock towards deeper and more northern waters – the cause of this remains unknown (Jager *et al*, 2009). As no reliable stock estimates exist, the risks of this stock becoming overexploited cannot be determined with any degree of certainty. This in itself could be a cause for concern as shrimp play a key role in maintaining the functioning of coastal shallow ecosystems, both as predator and as prey (Campos and Van Der Veer, 2008). Despite this, however, there is

a consensus in the scientific community that the North Sea shrimp stock is not being overfished due to the species' life history characteristics (high fecundity and growth, high natural mortality) (Keus & Jager, 2008). From the perspective of the Wadden Sea ecosystem the North Sea shrimp stock is influenced by a multitude of factors which lie outside the influence radius of local and regional fisheries management – this includes widespread exploitation throughout the North Sea beyond the boundaries of the Wadden Sea area, as well various biological interactions and large-scale natural variability of the North Sea ecosystem. As such, the impact of the Wadden Sea shrimp fisheries on the North Sea shrimp stock are considered to be outside the scope of the present study.

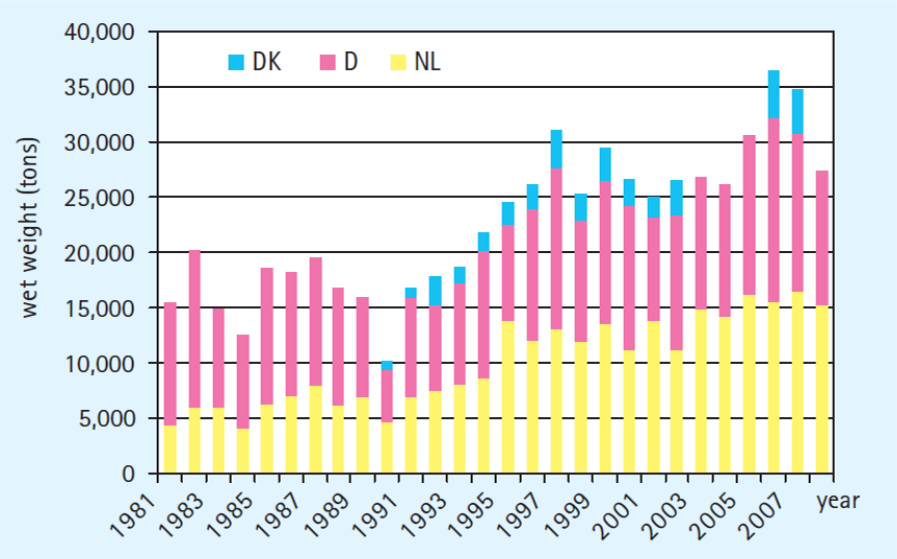

Figure 20. Wadden Sea landings of brown shrimp in wet weight (tonnes) between 1981 and 2007. From Nehls *et al*, 2009b.

B. BYCATCH AND DISCARDS

As is the case with many commercial capture fisheries, and particularly shrimp fisheries there has been a significant by-catch and subsequent discarding of juvenile fin-fish associated with this fishery (Innes and Pascoe, 2007). Bycatch in brown shrimp fisheries is caused by the fine mesh sizes of shrimping nets (the minimum legal limit for cod end mesh size is 20 mm), exacerbated by the fact that in the North Sea, some of the most productive shrimping areas overlap with nursery areas of commercially important fish species (Fischer, 2009). While some bycatch is retained and marketed, the majority is discarded. In general, bycatch in North Sea shrimp fisheries can be highly seasonal (EC, 2011) and make up 70 to 90 % of the total catch (in live weight), corresponding mainly to juvenile shrimp and organisms < 45 cm length (Fischer, 2009). As a bycatch reduction measure the use of veil nets or separator panels was made mandatory in 2003 for all vessels using an aggregate beam length of more than 8m (Innes and Pascoe, 2007).

Van Overzee *et al* (2008) estimated the bycatch of juvenile shrimp to be high (52 – 82%) with estimated survival rates at over 78%. It should be noted, however, that after cooking of the shrimps, a further 30 % of the remaining shrimp catch is discarded (Fischer, 2009).

It is clear that the bycatch of juvenile shrimp in this fishery can have implications on the North Sea shrimp stock.

A study carried out by the German Fisheries Research Centre lists more than 66 species of fish and 38 species of invertebrates (Neudecker *et al*, 1999) – this included low numbers of species designated as Annex II species under the EC Habitats Directive such as shad (*allosa* spp.) and lamprey (Petromyzontidae) (Fischer, 2009). Survival rates are known for a small number of non-commercial species; for species such as gobies, and juvenile pogge (*Agonus cataphractus*), sculpin (Scorpaeniformes) and eelpout (Zoarcidae) which are small and often end up being cooked together with the shrimp, survival rates are low. For larger sized individuals and species, the survival rates are considered to be about 90% (Berghahn *et al*, 1992). In terms of commercial species, bycatch may also include plaice, flounder, dab, herring and sprat; however the use of a veil net from 15 November to 15 April reduces bycatch of commercial fish species, although this is less so for under-sized flatfish (< 10cm) (Van Overzee *et al*, 2008). Fischer (2009) stated that in favourable conditions (short towing and sorting time, low temperatures and the use of a drumscreen) survival rates of dab and plaice were 7% and 20% of 50% of sole (Kelle, 1976); while round fish such as gadoids and clupeids experienced 100% mortality (Berghahn *et al*, 1992). The latter was in agreement with Van Overzee *et al*, 2008; however, these authors stated that flatfish such as dab and plaice had better survival rates at 14% for plaice and 19% for dab. The authors did note that any discarded flatfish would further suffer from consumption by birds which would furter reduce survival rates. Overall, it has been estimated that the international shrimp fisheries affect 10% of the Spawning Stock Biomass (SSB) for plaice (Neudecker, 2002). For sole, cod and whiting, this is estimated to be 1% (Van Overzee *et al*, 2008). Note, however, that as some measure of protection of juvenile plaice, access to the "Plaice Box" is restricted to vessels of a certain, small size (< 300hp) (See Figure 11, task 1). This does not, however, completely eliminate bycatch of juvenile plaice, especially in the shallow nursery grounds of the Wadden Sea (Fischer, 2009). Note that those shrimp fisheries which take place in deeper waters (e.g. the Belgian shrimp fisheries) account for a higher proportion of marketable shrimp in their total catch (Fischer, 2009). The issue of bycatch and how to deal with it is problematic, as there is no direct spatial relationship between individual catch samples and their respective fishing area, making spatial management difficult (Fischer, 2009). Despite a considerable amount of uncertainty, the issue of bycatch in North Sea shrimp fisheries has been recognised by the scientific community and discarding of commercially important species in the North Sea not only represents substantial foregone potential yield but for depleted stocks it can be considered a serious threat to biological recovery (Innes and Pascoe, 2007).

Conclusion: in the worst-case scenario, bycatch of juvenile shrimp may impact directly on the North Sea shrimp stock and indirectly affect population dynamics of Wadden Sea and North Sea fish stocks. Bycatch of commercial and non-commercial, migrating and non-migrating fish stocks is likely to have direct impacts on fish stocks and may affect species composition of Wadden Sea fish communities as well impair the passage of migrating fish between the Wadden Sea and river systems. In the context of existing pressures such as exploitation by commercial fisheries and climate change/variability,

these impacts should not be ignored and will therefore be considered in the sustainability framework. These impacts are already being addressed in the Trilateral Policies 11.1 "*Promote conditions for unhindered migration between the sea and upstream and/or inland waters and improvement of the physical conditions in river systems for diadromous fish*" and 11.3 "*In order to further reduce bycatch and to reduce impacts on the sea floor, the trilateral policy principles for a sustainable shrimp fishery will be developed in close cooperation with the fisheries sector*". In the so-called worst-case scenario, these impacts conflict with the:

- general Trilateral Targets on Fish;

- Trilateral Target on Estuaries "*Maintain and as far as possible restoring the function as migration route and breeding area for birds and fish*"

With regards to the bycatch of protected migratory species such as shad and lamprey, the impact of bycatch conflicts with the Trilateral Target on Fish "*Maintaining and restoring the possibilities for the passage of migrating fish between the Wadden Sea and inland waters*", the Trilateral Target on Estuaries cited above, as well as the conservation objectives set for

- Twaite Shad (*Allosa fallax*) in NL, SH, DK
- River Lamprey (*Lampetra fluviatilis*) in NL, SH, DK
- Sea Lamprey (*Petromyzon marinus*) in NL, LS, SH, DK
- Houting* (*Coregonus oxyrhynchus),* brook Lamprey (*Lampetra planeri)* and salmon (*Salmon salar)* in DK

C. HABITATS

Shrimp trawling leads to the disturbance of abiotic and biogenic habitat structures with the ecological consequences varying depending on both the substratum type and the degree of natural disturbance present in the environment (Simpson and Watling, 2006). There is growing scientific consensus that benthic habitats with high-relief biogenic structures, such as sponges, corals, and seagrass beds, as well as areas with few large-scale natural disturbances (including boulder, gravel, and even rippled sand bottoms), are more visibly impacted by trawling than shallow, low-relief areas of the seabed that experience frequent large-scale natural disturbances (see Collie, 1998; Jennings and Kaiser, 1998; Auster and Langton, 1999; Hall,1999; Collie *et al*, 2000; and National Research Council, 2002 in Simpson and Watling, 2006). Mud substrata that are characterized by overall low topographic structure, but a high degree of small-scale physical, chemical, and biological habitat complexity, may also be severely impacted (Simpson and Watling, 2006).

In an appropriate assessment for the Dutch shrimp fishery, Keus and Jager (2008) studied the impact of the shrimp fishery with otter and beam trawl on Wadden Sea habitats. The habitats of concern were those accessible to the fishery, which corresponds to the subtidal only. Impacts on benthic habitats were in this case thought to be minimal due to the presence of rollers which allows the gear to "bounce" over the seabed. This is in

agreement with a review carried out by the European Commission which suggests that impacts are reduced by the presence of these rollers. Although tracks of several meters wide are left behind by the trawl's "iron shoes", the authors report that these are only temporary in nature due to the presence of currents strong enough to wipe out these tracks. Only the outer rollers of the roller gear do not fully roll in parallel to the trawling direction. This results in some disturbance of the sediment and benthos on the outer parts of the trawl track; however, the report concludes that this impact is also thought to be temporary in nature (EC, 2011). These studies, however, investigated the visible impact on the substratum, assessed by the durability of mechanical traces in the sediment, while no information was provided on the impacts of this fishery on the sea bed community. With regards to the latter, research on impacts of shrimp fisheries (although a different species) on the mud, sandy mud and rocky communities of the Gulf of Maine has shown that the rockhopper otter trawl fishery, which is made up mainly of vessels <25 m long, leads to significant short-term changes in macrofaunal communities which became apparent on fishing grounds within 3 months of trawling (Simpson and Watling, 2006). A study was also carried out by Schroeder *et al* (2008) who modelled the influence of bottom trawling activities on the population densities of typical zoobenthic species occurring in the Natura 2000 habitats of "sand banks" and "reefs" within the German North Sea. The study showed that long-lived species are significantly more affected by bottom trawling than short-lived opportunistic species, with epifauna appearing more sensitive to this type of fishery than infauna. It was found that a single trawling event may on its own induce a shift of the ratio of K- and r-selected species towards r-selected species, i.e. towards more short-lived and opportunistic species and that this effect is enforced by further annual trawling events. Note, however, that this modelling study is based on benthic faunal mortality obtained from plaice beam trawls trials equipped with tickler chains. The authors considered it likely that shrimp trawls would produce much lower mortalities for benthic invertebrates; however, due to the lack of empirical studies these mortality rates have not yet been quantified. As a recommendation, the authors state that a local cessation of trawling activities would lead to an improved development of benthic communities. In this respect, a net gain could be expected from a relocation of trawling activities from less intensely fished areas to already intensely fished areas, with the positive effects in the now unfished area outweighing the negative effects in the intensely fished area, all the while keeping total fishing effort at a constant level.

While the argument exists that in the muddy and sandy habitats of the highly tidal and dynamic Wadden Sea, the impact of shrimping gear could be expected to be minimal – provided of course that the fishery does not take place in sheltered areas or areas with vulnerable habitats such as *Sabellaria* reefs[18] and *Zostera* fields, research into the discrete and cumulative effects of this fishery on benthic habitats in the Wadden Sea specifically is

[18] *Sabellaria* reefs have experienced a distinct decline in the Wadden Sea which has been attributed to the shrimp fisheries by some authors (e.g. Riesen & Reise, 1982). Vorberg (2000) suggested, however, that the decline is unlikely to have been caused by the shrimp fisheries. Through direct observation with underwater cameras it was shown that shrimpers may trawl over the robust reef structures without causing visible damage.

lacking. Until the entire picture becomes clear, the precautionary principle would therefore be recommended. As a result of the recent VIBEG agreement, reached in December 2011, research into this matter is taking place and a zonation scheme is being applied to the entire North Sea Coastal Zone Natura 2000 area (Noordzeekustzone) where only 75% will be accessible to licensed fisheries that disturb the seabed. These developments are also relevant for the present study as some of the closed areas directly border the Wadden Sea (see Figure 12 – task 1). Negotiations about closing areas in the Wadden Sea for shrimp fisheries are ongoing in The Netherlands.

Conclusion: Bottom-trawled shrimp fisheries impact bottom habitats in areas such as the Wadden Sea. These effects may be temporary or long-term depending on the period of impact, the gear used and the substrate being trawled over. Benthic communities may also be affected in the same manner. There is not yet a definitive conclusion on the scale or duration of impacts of shrimping on the Wadden Sea ecosystem as empirical evidence is currently lacking. In recognition of the likely impacts, it would be prudent to adopt the precautionary principle and consider this impact in the sustainability framework. In the event where negative, long-term effects on Wadden Sea benthic habitats can indeed be demonstrated, this impact would be in conflict with the:

- Trilateral Targets on Water and Sediment "*Improvement of habitat quality for conservation of species*";

- The Trilateral Targets on the Tidal Area "*A natural dynamic situation in the tidal area*", "*An increased area of geomorphologically and biologically undisturbed tidal flats and subtidal areas*" and "*A natural size, distribution and development of (…)* Sabellaria *reefs and* Zostera *fields*"

- The Trilateral Targets on Estuaries "*Maintaining and where possible restoring natural habitats and tidal dynamics typical of estuaries*"

- The conservation objectives set for the habitats listed under the EC Habitats Directive where shrimp fishing takes place:

- 1110 (Sandbanks) in NL, LS, SH, DK
- 1130 (Estuaries) in NL, LS, SH, DK
- 1140 (Mudflats and sandflats) in NL, LS, SH, DK
- 1160 (Large shallow inlets and bays) in LS, SH, DK
- 1150 (Coastal lagoons) in DK
- 1170 (Reefs) in LS, SH, DK

D. PROTECTED SPECIES

Discarding by shrimp trawlers may have a positive effect on some bird populations, in particular scavenging piscivorous seabirds such as gulls. In Lower Saxony, it was estimated that the discards from the 1993 LS shrimp fishery were sufficient to feed about 60,000 seabirds a year (Walter and Becker, 1997). In this respect, the shrimp fisheries

may lead to an unnatural increase in stock size of some species of gulls in the Wadden Sea and thus to a shift in the natural species composition of breeding coastal birds (Walter and Becker, 1997; Fischer, 2009).

As previously stated, bycatch may also be of concern to a number of migratory fish species listed under the Habitats Directive. These include twaite and allis shad, sea lamprey and river lamprey (Keus and Jager, 2008; Fischer, 2009). In their appropriate assessment for the Dutch shrimp fishery, Keus and Jager (2008) concluded that bycatch of these species is unlikely in the case of shad and small in the case of lamprey with individuals that do get caught being returned to sea alive. Nevertheless, the issue of bycatch in shrimp fisheries is associated with a number of uncertainties. It can therefore not be concluded with any degree of certainty that the Wadden Sea shrimp fisheries do not impact migratory fish species.

Keus & Jager (2008) consider that disturbance to grey seals is unlikely as shrimping vessels are a regular presence in the fished areas and as such have become part of "ambient" disturbance. In The Netherlands, shrimping vessels are allowed to fish near seal resting places even during the pupping season and are subject to a strict set of rules, set out under Article 20 of the Nature Conservation Act and designed to minimise any potential impacts. The authors state that as long as these rules are adhered to it is not thought that the shrimp fishery in The Netherlands has a significant impact on the seals present in the area. Whether this is also the case in Germany and Denmark, however, is unclear. As such, disturbance to mammals and birds cannot be ruled out, particularly not when cumulative impacts from the range of fishing activities in the Wadden Sea are considered.

Conclusion: Disturbance to marine mammals and birds is likely if no precautions are in place – this impact is, however, limited by the Trilateral Policy 9.22 "*Speed limits for ships have been imposed, taking into account safety, environmental, recreational and fishery factors*". Nevertheless, this impact may imply conflict with the overall Trilateral Targets and Policies for Birds and Mammals. Also affected may be the conservation objectives for Annex II bird and mammal species under the Habitats Directive and Annex I birds under the Birds Directive.

3.2. SUSTAINABILITY FRAMEWORK

3.2.1. WEAK AND STRONG SUSTAINABILITY

Prior to establishing sustainability criteria, a review was carried out of two prominent papers (Ayres *et al*, 1998; Doring and Muraca, 2010) addressing the concept of sustainability. The team's understanding of the difference between strong and weak sustainability is, in simplistic terms, that weak sustainability accepts substitutability between forms of capital, while strong sustainability holds that fundamental services provided by nature cannot be substituted by man-made capital.

Applying the strong sustainability concept to commercial fisheries is not straightforward and there is a lack of literature about the application of the concept in practise. The literature further indicates that applying the concept to the practical situations will be difficult:

"*Actually, both "weak" and "strong" criteria… involve an implicit assumption that we would like to draw attention to, and challenge. They both imply a centralized decision-making process and a decision maker who decides on behalf of "society" among alternative programs and plans. But the real world is not at all like that*" (Ayres et al, 1998)

Part of the objective of the Common Wadden Sea Secretariat is to engage with the fishing industry to improve the sustainability of fisheries in the Wadden Sea. In the team's experience, it is critical that practicality rather than theory is at the forefront of efforts to engage with the industry if an inclusive transition towards greater sustainability is to be achieved. An attempt was therefore made to broaden the review of literature to enable sustainability criteria to be developed that could be practically applied in a fisheries context.

At this point it is useful to reflect that strong sustainability challenges a fundamental component of mainstream economics and, indeed, of the capitalist system, which underpins the development of industry (including the fishing industry) in Europe. This is an important point because acceptance of 'strong sustainability' requires a shift away from conventional economic theory.

Weak sustainability, where substitution between forms of capital/resources is deemed acceptable, follows the capitalist principle where a central role is given to the accumulation of resources that can be used for further production. Providing the sum of natural capital and man-made capital is maintained, the situation is sustainable according to conventional economic thought (Daly, 2005). In terms of commercial fisheries, a fishery could therefore be considered weakly sustainable if the depletion of fish stocks leads to economic benefits that offset the depletion[19]. The problem for natural scientists is

[19] This approach assumes that it is possible to measure all objects against the same quantitative scale (e.g., money) (Martinez-Alier *et al*., 1998, cited in Garmendia *et al.*, 2010).

the understanding that many fundamental services provided by nature cannot be replaced at any level by man-made capital. An ecological approach would therefore require that the fundamental services underpinning the production of a system be maintained, i.e., it is necessary to maintain a minimum level of different types of natural capital. This runs against the capitalist principle that nothing has an intrinsic value beyond its exchange value on the market; good economic performance can compensate for ecological deterioration. This inevitably leads to conflict between the commercially minded and the conservation minded.

The field of ecological economics proposes that natural capital and man-made capital are more often complements than substitutes and that natural capital should be maintained on its own, because it has become the limiting factor (Daly, 2005). Daly (2005) provides the example that landings of fish are limited by the 'capital' of fish populations, not by the man-made capital of fishing boats. Weak sustainability holds that reduced catches can be addressed by building more fishing vessels, whereas strong sustainability recognises that if there are too few fish in the sea, catches must be limited to maintain catches into the future.

Moving from theory to practicality, it is apparent that fisheries cannot continue to exist without the ecosystem that fish live in. We would suggest, along the lines of the quote included from Ayres *et al* (1998) that it is a misnomer to think in terms of weak and strong sustainability. A weakly sustainable fishery – whereby depletion of fish stocks to a point where natural regeneration rates are diminished is acceptable so long as the resulting production is economically beneficial – is not sustainable. It is therefore necessary to develop definitions of sustainability that can be applied in a practical, ecologically minded context and which provide an indication of the current situation and the desired situation.

The criteria developed take into account the fact that fisheries are dependent on the biophysical system they exist within, therefore for a fishery to be 'weakly sustainable' requires that the capacity of the fish stock to maintain production into the future is not compromised. Our definition of weak sustainability does take into account substitutability, whereby natural systems can be replaced by man-made systems (see definition below), whereas strong sustainability acknowledges that different types of 'capital' should be independently maintained if a system aims to be sustainable.

On the basis of these considerations and following instructions from CWSS to develop definitions for weak, medium and strong sustainability, we applied the concept of sustainability within the boundaries of natural capital and derived the following definitions:

Weak sustainability: **full and unlimited substitution of ecosystem services between ecosystem components is acceptable, on condition that the overall productivity of the ecosystem is non-diminishing over time**. This definition assumes that certain types of man-made habitats may deliver the same level of ecosystem services as natural habitats (e.g. cultured mussel beds vs natural beds). This definition also assumes that because impacts on certain ecosystem components are reversible[20] weak sustainability can be met.

Medium sustainability: **all discrete ecosystem components are not safeguarded, but measures are in place, which prevent full and unlimited substitution of ecosystem services between ecosystem components**. The level of substitution allowed must be based on best available scientific advice and must preserve an appropriate condition of ecosystem services to maintain ecosystem integrity and function.

Strong sustainability: **no substitution of ecosystem services between ecosystem components is acceptable and all ecosystem services must be fully protected**. This means that fishing under this form of sustainability is only possible if it can be demonstrated that impacts cannot be reasonably expected to and are not likely to negatively affect the integrity and function of individual ecosystem components.

The above definitions assume that some environmental components are unique, i.e., cannot be substituted, and that functions related to them could be irreversibly lost if the component is compromised. The number of components considered unique varies depending on the definition applied, e.g., weak sustainability considers that natural mussel beds are not unique, whereas strong sustainability considers that they are. By the same reasoning, social and cultural components could also be considered unique, e.g., where the heritage of a coastal community is intrinsically linked to the sea. We suggest this is beyond the scope of the study, but that a full analysis of sustainability should take into account social and cultural factors when determining what is deemed acceptable or not. It nevertheless remains true that a minimum level of natural capital must be maintained to support the socio-cultural and economic benefits.

Where the available data are not sufficient to accurately assess impacts, it is assumed that the precautionary principle is applied.

It is emphasised that in this context, 'weak' and 'strong' are technical terms relating to how sustainability is defined, rather than value judgments.

This exercise is also not intended to pass definitive judgement on the sustainability or otherwise of Wadden Sea fisheries – it is a comparative and subjective exercise, clarifying the starting position of nature protection authorities in the dialogue with the fisheries sector and other involved stakeholders.

[20] Reversible is used here in the context when a fishing activity ceases, the affected ecosystem can recover to the state it was in prior to the disturbance.

3.2.2. THE SUSTAINABILITY FRAMEWORK

The sustainability framework (Table 10) provides a structure in which the level of sustainability of Wadden Sea fisheries, in accordance with the definitions provided above, can be assessed in terms of their impacts on the habitats and species identified as important within the nature conservation framework for the Wadden Sea (Natura 2000 as well as the areas addressed by the Trilateral Targets for the Wadden Sea).

Each relevant habitat or species is listed down the left of the table. The habitats and species considered are those identified in Task 1, as follows:

- 1110 Sandbanks slightly covered by sea at all times
- 1130 Estuaries – subtidal
- 1160 Large shallow inlets and bays - subtidal
- 1140 Mud and sandflats uncovered at low tide
- 1130 Estuaries – intertidal
- 1150 Coastal lagoons
- 1170 Reefs - Subtidal mussel beds
- Intertidal mussel beds
- *Sabellaria* reefs
- *Zostera noltii* intertidal
- *Z. noltii* and Z. *marina* subtidal
- Marine mammals
- Migratory fish
- Birds (e.g. oystercatcher, common eider)

In some cases, a distinction is made between the same habitat/species in the subtidal versus the intertidal – this is because fisheries activities tend to be different in the two areas.

The sustainability framework was used in two ways:

- To map the Trilateral Targets for the Wadden Sea and MSC standard for sustainable fisheries onto the sustainability gradient against the key Natura 2000 qualifying features identified in Task 1 (see Table 10).

- To map the three main Wadden Sea fisheries, taking into consideration their respective fishing methods, onto the same gradient (Table 11 to Table 13).

Table 10. Indicator-based sustainability framework for Wadden Sea fisheries

Habitat / species	Fishing activities implicated	Sustainability criteria			
		Weak	**Medium**	**Strong**	**MSC ***
1110 Sandbanks slightly covered by sea at all times 1130 Estuaries – subtidal 1160 Large shallow inlets and bays - subtidal NB the criteria for these general habitats assume that mussel beds, *Zostera* and *Sabellaria* are treated separately 1140 Mud and sandflats uncovered at low tide 1130 Estuaries – intertidal 1150 Coastal lagoons	Mussel dredging Mussel relaying Mussel ASCs Cockle hand raking Cockle mechanical dredging Shrimp trawling	No specific protection except for identified sub-habitats (mussels, *Zostera*, *Sabellaria* – see below), based on assessments that i) impacts cannot be reasonably expected to, and are not likely to, adversely affect habitat integrity and function, and ii) that habitat type has an intrinsic ability to recover from fishing impact and that any changes are reversible when fishing pressure is removed. Periodic monitoring takes place and systems are in place which enable management action if necessary. 'Weak' criterion likely to be sufficient for **MSC**, assuming that mussel beds, *Zostera* and *Sabellaria* are dealt with separately.	At least 50% of each habitat type is protected from fishing gear or fishing activities identified as affecting those habitats, or fisheries must show by annual monitoring and impact assessment that their impact cannot be reasonably expected to, and is not likely to, adversely affect habitat integrity and function. **Trilateral target** '*increased area of geomorphologically and biologically undisturbed tidal flats and subtidal areas*' equivalent to 'medium' or 'strong' depending on the extent to which fisheries are the main cause of disturbance.	Fishing is not permitted in any designated area unless fishery can prove by annual impact assessment and monitoring that their impact cannot be reasonably expected to, and is not likely to, adversely affect habitat integrity and function.	The fishery is highly unlikely to reduce habitat structure and function to a point where there would be serious or irreversible harm. There is a partial strategy in place if necessary to achieve the above, with some objective basis for confidence that it will work, and some evidence that it is being implemented successfully. The nature, distribution and vulnerability of all main habitat types in the fishery area are known at an appropriate level of detail. Sufficient data are available to identify habitat impacts, with reliable information on the spatial extent of interaction, and the timing and location of use of the fishing gear. Sufficient data are collected to detect any increase in risk to habitat.

Habitat / species	Fishing activities implicated	Sustainability criteria			
		Weak	**Medium**	**Strong**	**MSC ***
1170 Reefs - Subtidal mussel beds NB: Includes all subtidal mussel beds, not just those designated as reefs	Mussel dredging Cockle dredging Shrimp trawling	Long-term mean area of subtidal mussel beds maintained either by natural settlement or by subtidal lays. Assumption that mussel lay is ecologically equivalent to a natural mussel bed. 'Weak' acceptable for **MSC** if backed up by ecological data on the ecosystem services of natural mussel beds vs. mussel lays – otherwise 'medium'	Long-term mean area of subtidal mussel beds maintained as for weak, but natural beds also protected by TAC on fishery or area closures, such that an appropriate* percentage of natural beds are protected from exploitation. Other fisheries must show by annual monitoring and impact assessment that their impact cannot be reasonably expected to, and is not likely to, adversely affect habitat integrity and function. *Appropriate based on distribution of subtidal mussel beds and food requirements for birds. The appropriate % will differ between Wadden Sea regions and must be based on best available scientific advice.	Natural subtidal mussel beds protected from exploitation. Other fisheries must show by annual monitoring and impact assessment that their impact cannot be reasonably expected to, and is not likely to, adversely affect habitat integrity and function. **Trilateral target** '*a natural size, distribution and development of natural mussel beds*'. Requires strong sustainability from fisheries but still may not be met if fishing not the cause of habitat decline.	As above NB This takes mussel beds as a habitat rather than mussels as a protected species.

Habitat / species	Fishing activities implicated	Sustainability criteria			
		Weak	**Medium**	**Strong**	**MSC ***
Intertidal mussel beds	Mussel dredging	Long-term mean area of intertidal mussel beds maintained either by natural settlement or by intertidal lays. Assumption that mussel lay is ecologically equivalent to a natural mussel bed. 'Weak' acceptable for **MSC** if backed up by ecological data on on the ecosystem services of natural mussel beds vs. mussel lays – otherwise 'medium'	Long-term mean area of intertidal mussel beds maintained as for weak, but natural beds also protected by TAC on fishery or area closures, such that an appropriate* percentage of natural beds are protected from fishing. *Appropriate based on distribution of intertidal mussel beds and food requirements for birds. The appropriate % will differ between Wadden Sea regions and must be based best available scientific advice.	Natural intertidal mussel beds protected from fishing. **Trilateral target** '*a natural size, distribution and development of natural mussel beds*'. Requires strong sustainability from fisheries but still may not be met if fishing not the cause of habitat decline	As above NB This takes mussel beds as a habitat rather than mussels as a protected species.

Habitat / species	Fishing activities implicated	Sustainability criteria			
		Weak	**Medium**	**Strong**	**MSC ***
Sabellaria reefs	Mussel dredging Cockle dredging Cockle hand raking Shrimp trawling	The distribution of existing *Sabellaria* reefs is not known but the precautionary principle is applied and specific measures are in place which ensure the protection of these habitats should their presence be recorded 'Weak' acceptable to **MSC** unless fishing considered likely to be the cause of extirpation and failure to re-establish (see comment under MSC right)	The distribution of existing *Sabellaria* reefs is known or measures are being taken to improve the knowledge base. Known areas are protected from fishing gear or fishing activities identified as affecting *Sabellaria* reefs **Trilateral target** '*a natural size, distribution and development of Sabellaria reefs*' may not be achievable even with 'medium' or 'strong' criterion, depending on cause of failure to re-establish	The distribution of existing and former (< 20 years) *Sabellaria* reefs is known or measures are being taken to improve the knowledge base. Known areas are protected from fishing gear or fishing activities identified as affecting *Sabellaria* reefs Note: this is based on the assumption that monitoring programmes track the dynamics of features, enabling the protection of formerly known beds as appropriate.	It is probably unlikely that an MSC assessment would consider impacts on a species/habitat type that has been extirpated from the area unless there is evidence that the fishery under assessment was likely to be the cause of the extirpation, and/or the cause of a failure to re-establish. Evidence and pressure from stakeholders might play an important role in bringing these impacts into consideration.

Habitat / species	Fishing activities implicated	Sustainability criteria			
		Weak	**Medium**	**Strong**	**MSC ***
Zostera noltii intertidal	Mussel dredging Cockle hand raking	The distribution of existing *Zostera* fields is not known but the precautionary principle is applied and specific measures are in place which ensure the protection of these habitats should their presence be recorded	The distribution of existing *Zostera* fields is known or measures are being taken to improve the knowledge base. Known areas are protected from fishing gear or fishing activities identified as affecting *Zostera* fields	The distribution of existing and former (< 10 years) *Zostera* fields is known or measures are being taken to improve the knowledge base. Known areas are protected from fishing gear or fishing activities identified as affecting *Zostera* fields Note: this is based on the assumption that monitoring programmes track the dynamics of features, enabling the protection of formerly known beds as appropriate.	As for mussel beds above (taking *Zostera* to be a habitat rather than a protected species)
Zostera noltii and *Z. marina* subtidal	Mussel dredging Cockle dredging Shrimp trawling				

If fishery considered likely limiting factor on spread of *Zostera* beds, then 'medium' probably required, if not then 'weak' acceptable to **MSC**

Trilateral target '*a natural size, distribution and development of Zostera beds*'. May not be met even by strong criterion if problems other than fishing (e.g. disease or light penetration in subtidal).

Habitat / species	Fishing activities implicated	Sustainability criteria			
		Weak	Medium	Strong	MSC *
Marine mammals (e.g. grey seal, common seal, harbour porpoise, Eurasian otter)	All fisheries	Marine mammal bycatch* may occur in fishery but annual fishery's bycatch of cetacean population does not exceed 1.7%** of the best estimate of abundance. *ASCOBANS TARGET ** Includes entanglement in fixed installations **Trilateral Targets** relevant to fisheries (summarised): *Viable stocks, natural reproduction capacity and juvenile survival of harbour seal, grey seal and harbour porpoise*. Met by 'weak' unless fisheries are cause of poor juvenile survival, in which case medium	No evidence of cetacean bycatch in fishery, but indirect impacts through disturbance caused by fishery's general activity may occur. Direct impacts at MSY level unlikely to be acceptable for **MSC** for protected or endangered species –'medium' required	No evidence of cetacean bycatch in fishery. No indirect impacts likely through disturbance caused by fishery's general activity. Should there be potential for indirect impacts, then appropriate management measures are in place which limit any interaction with cetaceans to the degree where the fishery negatively affects less than 1.7%* of the best estimate of abundance *ASCOBANS TARGET	The effects of the fishery are known and are highly likely to be within limits of national and international requirements for protection of endangered, threatened and protected species. Direct effects are highly unlikely to create unacceptable impacts. Indirect effects have been considered and are thought to be unlikely to create unacceptable impacts. There is a partial strategy in place to ensure the fishery does not hinder recovery, with some objective basis for confidence that it will work, and some evidence that it is being implemented successfully. Sufficient information is available to allow fishery related mortality and the impact of fishing on the species to be quantitatively estimated. Information is sufficient to determine whether the fishery may be a threat to protection and recovery. (continued) Information is sufficient to measure trends and support a full strategy to manage impacts.

Habitat / species	Fishing activities implicated	Sustainability criteria			
		Weak	**Medium**	**Strong**	**MSC ***
Fish (e.g. twaite shad, river lamprey, sea lamprey, brook lamprey, houting, salmon)	Targeted fisheries (e.g. eel fyke netting) Shrimp trawling General disturbance	The fishery does not target any species which are protected, considered vulnerable (e.g. elasmobranchs) or overexploited. More than 5% of the fishery's total catch are non-target species and/or juveniles of the target species and these are retained or discarded by the fishery. - For species for which reference points (or suitable proxies) exist, fishery's impacts on population do not exceed maximum sustainable level - If reference points do not exist, the fishery's impact on the population should be considered 'negligible' relative to other sources of mortality from the same area (e.g. other fisheries such as inland eel fisheries, or mortality from turbines, barriers to migration pathways etc.). - For eel (as a target or non-target fishery), the fishery should not hinder meeting the objectives of the national Eel Management Plan.	The fishery does not target any species which are protected, considered vulnerable (e.g. elasmobranchs) or overexploited. Bycatch and discards are associated with the fishery but less than 5% of the fishery's total catch are non-target species and/or juveniles of the target species. Direct impacts at MSY level unlikely to be acceptable for **MSC** for protected or endangered species – 'medium' required	The fishery does not target any species which are protected, considered vulnerable (e.g. elasmobranchs) or overexploited. There is no evidence of bycatch or discards in the fishery. **Trilateral targets** relevant to migratory fish and fisheries: *Occurrence and abundance of fish species according to the natural dynamics in (a)biotic conditions. Favourable living conditions for endangered fish species.* Assuming 'favourable living conditions' includes no disturbance, then met by 'strong'.	As above

Habitat / species	Fishing activities implicated	Sustainability criteria			
		Weak	Medium	Strong	MSC *
Birds (e.g. oystercatcher, common eider)	Mussel dredging Mussel relaying Mussel ASCs Mussel husbandry Cockle hand raking Cockle dredging Shrimp trawling	Ecosystem carrying capacity and/or biomass* of intertidal mussel and cockle beds and subtidal mussel beds is assessed as sufficient** to meet ecological requirements of existing populations and to ensure that fisheries are not the limiting factor on these populations. *Assumes that mussel culture plots equivalent to natural beds for bird food. ** Based on best available scientific advice and bird food requirement estimates	As weak, but natural beds also protected by TAC on fishery or area closures, such that an appropriate* percentage of natural beds are protected from fishing. Indirect impacts on feeding or breeding birds may occur through disturbance caused by fishery's general activity. *Appropriate based on distribution of subtidal/intertidal beds and food requirements for birds. The appropriate % will differ between Wadden Sea regions and must be based on best available scientific advice.	All natural mussel beds and cockle beds protected from fishing, and measures are in place which protect important bird feeding or breeding sites from disturbance caused by the fishery's general activity. Research exists which demonstrates that the fishery does not in any way reduce the carrying capacity of the ecosystem.	As above

MSC: 'Weak' sufficient given evidence that bird populations can feed on mussel culture plots, otherwise 'medium'.

Trilateral Targets most relevant to fisheries: *Stable or increasing numbers and distribution taking into account that abundance of species is in line with prevailing physiographic, geographic and climatic conditions. Fluctuations in food stocks determined by natural processes. Habitat, food stocks and connectivity between habitats supporting a favourable conservation status*.

'Fluctuations in food stocks' only met by 'strong' criterion. Other targets met by 'weak' (to extent that fisheries are the barrier to 'stable or increasing numbers' and 'favourable conservation status').

Table 11. Sustainability framework vs Wadden Sea mussel fisheries

Habitat / species	Sustainability criteria		
	Weak	**Medium**	**Strong**
1110 Sandbanks slightly covered by sea at all times 1130 Estuaries – subtidal 1160 Large shallow inlets and bays - subtidal NB the criteria for these general habitats assume that mussel beds, *Zostera* and *Sabellaria* are treated separately 1140 Mud and sandflats uncovered at low tide 1130 Estuaries – intertidal 1150 Coastal lagoons	NL – Fishing is prohibited in all intertidal mussel beds in the Dutch Wadden Sea. Also gradual closure of subtidal mussel beds as seed fishery is replaced by ASCs. Fishery management based on regular monitoring of mussel stock and appropriate assessments (AA) are carried out. It is assumed that the AA accurately assess fishery impacts on designated habitats – **weak criterion met** DK – fishery currently closed due to appropriate assessment control (AA). Assumption that protection of designated habitats is covered under AA – **weak criterion met** DE (SH + LS) – mussel fishery managed through closed areas, mainly located in core zones of national parks and some outside. It is assumed that that as Natura 2000 areas, the LS and SH National Parks provide a modicum for protection of designated habitats vulnerable to dredging impacts – **weak criterion met**	NL – **medium criterion met** based on the assumption that periodic monitoring and AA identify any impacts on designated habitats DK – **medium criterion met** based on assumption that AA identify any impacts on designated habitats DE (SH) – mussel fishery managed through closed areas, mainly located in core zones of national parks and some outside. Only one AA has been carried out for SH based on projected impacts for 5-year period. Monitoring and impact assessment is therefore carried out, but not annually - **medium criterion not met** DE (LS) - **medium criterion not met** as no habitat impact assessments are in place	NL – **strong criterion met** based on the assumption that periodic monitoring and AA identify any impacts on designated habitats DK - **strong criterion met** based on assumption that AA identify any impacts on designated habitats DE (SH + LS) – frequency AA and monitoring not enough to ascertain habitat impacts are negligible - **strong criterion not met**

Habitat / species	Sustainability criteria		
	Weak	**Medium**	**Strong**
1170 Reefs - Subtidal mussel beds NB: Includes all subtidal mussel beds, not just those designated as reefs	NL – Long-term mean area of subtidal mussel beds maintained by gradual closure of subtidal beds to seed fishery and by presence of subtidal culture plots which ensure that ecosystem services are maintained – **weak criterion met** DK – Fishery is currently closed due to insufficient mussel biomass, as determined by AA - **weak criterion met by default** DE – Long-term mean area of subtidal mussel beds maintained by culture plots which ensure that ecosystem services are maintained - **weak criterion met**	NL – Long-term mean area of subtidal mussel beds maintained by gradual closure of subtidal beds to seed fishery and by presence of subtidal culture plots which ensure that ecosystem services are maintained. Fishery also regulated by TAC and food reservation policy for birds – **medium criterion met** DK – **medium criterion met by default** DE (SH) – Long-term mean area of subtidal mussel beds maintained by culture plots which ensure that ecosystem services are maintained however except for area closures no TAC in place. Closure of mussel beds in national parks does not guarantee that mussel stock is not overfished – **medium criterion not met** DE (LS) – Long-term mean area of subtidal mussel beds maintained by culture plots which ensure that ecosystem services are maintained. If mussel biomass falls below set limit reference point, fishery is halted - **medium criterion met**	NL – gradual phasing out of wild seed fishery implies move towards total protection of natural mussel beds; however this has not yet been achieved - **strong criterion not met** DK – fishery closed so **strong criterion met by default** DE – natural mussel beds not protected from fishing - **strong criterion not met**

Habitat / species	Sustainability criteria		
	Weak	**Medium**	**Strong**
Intertidal mussel beds	NL - Long-term mean area of intertidal mussel beds is maintained through closure of intertidal to mussel fishery - **weak criterion met** DK – Fishery is currently closed due to insufficient mussel biomass, as determined by AA - **weak criterion met by default** DE (SH) – Long-term mean area of intertidal mussel beds is maintained through closure of intertidal to mussel fishery - **weak criterion met** DE (LS) – Fishery also takes place in the intertidal, but long-term mean area of intertidal mussel beds is maintained in theory by intertidal culture plots - **weak criterion met**	NL – Long-term mean area of intertidal mussel beds is maintained through closure of intertidal to mussel fishery. TAC and food reservation policy for birds also ensures long-term mean area of intertidal beds is maintained – **medium criterion met** DK – Fishery is currently closed due to insufficient mussel biomass, as determined by AA - **medium criterion met by default** DE (SH) - Long-term mean area of intertidal mussel beds is maintained through closure of intertidal to mussel fishery - **medium criterion met** DE (LS) – Long-term mean area of intertidal mussel beds is maintained in theory by intertidal culture plots. No TAC in place, but if mussel biomass falls below set limit reference point, fishery is halted - **medium criterion met**	NL – intertidal is closed to the fishery - as long as intertidal fishery is not reinstated **strong criterion met** DK – **strong criterion met by default** DE (SH) – intertidal is closed to the fishery - as long as intertidal fishery is not reinstated **strong criterion met** DE (LS) - natural intertidal mussel beds not fully protected from fishing - **strong criterion not met**
Sabellaria reefs	NL, DE –Distribution of *Sabellaria* reefs is currently not known and no routine monitoring is taking place. No specific measures are in place which protect these habitats should their presence be recorded. Precautionary principle is not being applied – **weak criterion not met**	NL,DE – Distribution of *Sabellaria* reefs is currently not known and no routine monitoring is taking place - **medium criterion not met**	NL, DE – Distribution of *Sabellaria* reefs is currently not known and no routine monitoring is taking place - **strong criterion not met**

Habitat / species	Sustainability criteria		
	Weak	**Medium**	**Strong**
	DK – fishery currently closed – **weak criterion met by default**	DK – fishery currently closed – **medium criterion met by default**	DK – fishery currently closed – **strong criterion met by default**
Zostera noltii intertidal *Zostera noltii* and *Z. marina* subtidal	NL – Monitoring of seagrass beds is carried out annually or bi-annually. In addition to this mapping program, a system is set up in which people in the field are asked to pass on observations on presence of seagrass in other parts of the Wadden Sea (van der Graaf *et al*, 2009). Intertidal *Zostera* fields in the Dutch Wadden Sea are protected from fishing, but not the subtidal – **weak criterion met for intertidal *Zostera* – weak criterion not met for subtidal *Zostera*** DE – Regular monitoring of *Zostera* fields and stock development in SH and LS is being carried out (van der Graaf *et al*, 2009). It is therefore assumed that the distribution of *Zostera* fields is known. Intertidal *Zostera* is protected from the mussel fishery – **weak criterion met for intertidal *Zostera* – weak criterion not met for subtidal *Zostera*** as no specific measures are in place which protect these habitats should their presence be recorded (except in some "zero use zones").	NL - Monitoring of seagrass beds is carried out annually or bi-annually and distribution is therefore known. Intertidal *Zostera* fields in the Dutch Wadden Sea are protected from fishing, but not the subtidal – **medium criterion met for intertidal *Zostera* – medium criterion not met for subtidal *Zostera*** DE - Regular monitoring of *Zostera* fields in SH and LS is being carried out in the intertidal and subtidal. Intertidal *Zostera* fields are completely protected from mussel fishing activities - **medium criterion met for intertidal *Zostera***. However **medium criterion not met for subtidal *Zostera*** as no specific measures are in place which protect these habitats should their presence be recorded (except in some "zero use zones").	NL - Monitoring of seagrass beds is carried out annually or bi-annually and distribution is therefore known. Intertidal *Zostera* fields in the Dutch Wadden Sea are protected from fishing. It is highly likely that these areas comprise areas of former *Zostera* fields – **strong criterion met for intertidal *Zostera* – strong criterion not met for subtidal *Zostera*** DE – Regular monitoring of *Zostera* fields in SH and LS is being carried out in the intertidal and subtidal. Intertidal *Zostera* fields are completely protected from mussel fishing activities - **strong criterion met for intertidal *Zostera.*** No specific measures are in place to protect existing *Zostera* fields from fishing in the subtidal - **strong criterion not met for subtidal *Zostera***

Habitat / species	Sustainability criteria		
	Weak	**Medium**	**Strong**
	DK – In the Danish Wadden Sea, seagrass is monitored on a regular basis (van der Graaf *et al*, 2009), however the fishery is currently closed – **weak criterion met by default**	DK – fishery currently closed – **medium criterion met by default**	DK – fishery currently closed – **strong criterion met by default**
Marine mammals (e.g. grey seal, common seal, harbour porpoise, Eurasian otter)	NL – Bycatch through entanglement is prevented by requirement for enclosure surrounding ASC installations (De Mesel *et al*, 2009) - **weak criterion met** DE – Except for some measures taken at farm level, there are no specific measures are in place which systematically prevent entanglement of marine mammals in ASC installations. AA are not carried out to the extent where interactions with marine mammals are frequenctly monitored and quantified - **weak criterion not met** DK – fishery currently closed – **weak criterion met by default**	NL – Bycatch through entanglement is prevented by requirement for enclosure surrounding ASC installations. Indirect impacts on marine mammals possible through ASCs however impacts are location-dependent and are assessed through AA. - **medium criterion met** DE – No specific measures are in place which prevent entanglement of marine mammals in ASC installations - **medium criterion not met** DK – fishery currently closed – **medium criterion met by default**	NL – Bycatch through entanglement is prevented by requirement for enclosure surrounding ASC installations. Indirect impacts on marine mammals possible through ASCs however impacts are location-dependent and are assessed through AA. - **medium criterion met** DE – No specific measures are in place which prevent entanglement or disturbance of marine mammals in ASC installations - **strong criterion not met** DK – fishery currently closed – **strong criterion met by default**
Fish (e.g. twaite shad, river lamprey, sea lamprey, brook lamprey, houting, salmon)	NL, DE – no potential significant impacts determined - **weak criterion met** DK – fishery currently closed – **weak criterion met by default**	NL, DE – no potential significant impacts determined - **medium criterion met** DK – fishery currently closed – **medium criterion met by default**	NL, DE – no potential significant impacts determined - **strong criterion met** DK – fishery currently closed – **strong criterion met by default**

Habitat / species	Sustainability criteria		
	Weak	**Medium**	**Strong**
Birds (e.g. oystercatcher, common eider)	NL – Food reservation policy for birds is best on best available scientific evidence and ensures that fishery is not the limiting factor on mussel-dependent bird populations - **weak criterion met** DK – Fishery closed due to insufficient mussel biomass to meet food requirements for birds as determined by AA **- weak criterion met** DE – Area closures in national parks do not guarantee that mussel stock is not overfished to a point where bird populations may be affected. Although limit reference point exists for LS, how much of this corresponds to food requirements for birds is not specified. In SH, mussels must stay on cultures for a number of months and birds are not allowed to be scared from the cultures; however, these measures are not considered sufficient - **weak criterion not met**	NL – Food reservation policy for birds, TAC and closure of the intertidal ensures that fishery is not the limiting factor on mussel-dependent bird populations - **medium criterion met** DK – Fishery closed due to insufficient mussel biomass to meet food requirements for birds as determined by AA **- medium criterion met** DE – **medium criterion not met**	NL – gradual phasing out of wild seed fishery implies move towards total protection of natural mussel beds; however this has not yet been achieved. In addition, there is uncertainty as to what the effects of ASC installations are on ecosystem carrying capacity - **strong criterion not met** DK – Fishery closed due to insufficient mussel biomass to meet food requirements for birds as determined by AA **- strong criterion met** DE – **medium criterion not met**

Table 12. Sustainability framework vs Wadden Sea cockle fisheries

Habitat / species	Sustainability criteria		
	Weak	**Medium**	**Strong**
1110 Sandbanks slightly covered by sea at all times 1130 Estuaries – subtidal 1160 Large shallow inlets and bays - subtidal NB the criteria for these general habitats assume that mussel beds, *Zostera* and *Sabellaria* are treated separately 1140 Mud and sandflats uncovered at low tide 1130 Estuaries – intertidal 1150 Coastal lagoons	NL – Manual cockle fishery only takes place in intertidal. Habitat impacts are highly localised on beds with high cockle density although will be dependent on fishing pressure. Fishing intensity and corresponding impacts on designated habitats are assessed in appropriate assessments (AA) – on this basis, **weak criterion met** DK – Mechanical cockle fishery takes place outside Natura 2000 area. Environmental Impact Assessment (EIA) is carried out annually and assesses fishery impacts on habitats - **weak criterion met** DE (SH + LS) – no cockle fishing is currently allowed according to National Park Law – **weak criterion met by default**	NL – Intertidal mussel beds are protected from fishing. Assumption that fishing intensity and corresponding impacts on designated habitats are assessed in appropriate assessments (AA) - **medium criterion met** DK – **medium criterion met** based on assumption that EIA identifies any impacts on designated habitats DE – no cockle fishing is currently allowed according to National Park Law – **medium criterion met by default**	NL – **strong criterion met** based on assumption that AA can demonstrate that impacts on designated habitats cannot be reasonably expected to, and are not likely to, adversely affect habitat integrity and function DK - **strong criterion met** based on assumption that EIA identifies any impacts on designated habitats DE – no cockle fishing is currently allowed according to National Park Law – **strong criterion met by default**
1170 Reefs - Subtidal mussel beds NB: Includes all subtidal mussel beds, not just those designated as reefs	NL – Handraking does not take place on subtidal reefs. No potential impacts determined - **weak criterion met** DK – Environmental Impact Assessment (EIA) is carried out annually - Assumption that impacts on habitats is assessed by EIA - **weak criterion met**	NL – Handraking does not take place on subtidal reefs. No potential impacts determined - **medium criterion met** DK – **medium criterion met** based on assumption that EIA identifies any impacts on designated habitats	NL – Handraking does not take place on subtidal reefs. No potential impacts determined - **strong criterion met** DK – **strong criterion met** based on assumption that EIA can demonstrate that impacts on habitats cannot be reasonably expected to, and are not likely to, adversely affect habitat

Habitat / species	Sustainability criteria		
	Weak	**Medium**	**Strong**
			integrity and functioning DE (SH + LS) – no cockle fishing is currently allowed according to National Park Law – **strong criterion met by default**
	DE (SH + LS) – no cockle fishing is currently allowed according to National Park Law – **weak criterion met by default**	DE (SH + LS) – no cockle fishing is currently allowed according to National Park Law – **medium criterion met by default**	
Intertidal mussel beds	NL – Intertidal mussel beds are protected from fishing – **weak criterion met**	NL – Intertidal mussel beds are protected from fishing – **medium criterion met**	NL – Intertidal mussel beds are protected from fishing – **strong criterion met**
	DK – Environmental Impact Assessment (EIA) is carried out annually - Assumption that impacts on habitats is assessed by EIA - **weak criterion met**	DK – Environmental Impact Assessment (EIA) is carried out annually - Assumption that impacts on habitats is assessed by EIA - **weak criterion met**	DK – **strong criterion met** based on assumption that EIA can demonstrate that impacts on habitats cannot be reasonably expected to, and are not likely to, adversely affect habitat integrity and function
	DE (SH + LS) – no cockle fishing is currently allowed according to National Park Law – **weak criterion met by default**	DE (SH + LS) – no cockle fishing is currently allowed according to National Park Law – **medium criterion met by default**	DE (SH + LS) – no cockle fishing is currently allowed according to National Park Law – **strong criterion met by default**
Sabellaria reefs	NL, DK – Distribution of *Sabellaria* reefs is currently not known and no routine monitoring is taking place. No specific measures are in place which protect these habitats should their presence be recorded. Precautionary principle is not being applied – **weak criterion not met**	NL, DK – Distribution of *Sabellaria* reefs is currently not known and no routine monitoring is taking place - **medium criterion not met**	NL, DK – Distribution of *Sabellaria* reefs is currently not known no routine monitoring is taking place - **strong criterion not met**
	DE (SH + LS) – no cockle fishing is currently allowed according to National Park Law – **weak criterion met by default**	DE (SH + LS) – no cockle fishing is currently allowed according to National Park Law – **medium criterion met by default**	DE (SH + LS) – no cockle fishing is currently allowed according to National Park Law – **strong criterion met by default**

Habitat / species	Sustainability criteria		
	Weak	**Medium**	**Strong**
Zostera noltii intertidal *Zostera noltii* and *Z. marina* subtidal	NL – Monitoring of seagrass beds is carried out annually or bi-annually. In addition to this mapping program, a system is set up in which people in the field are asked to pass on observations on presence of seagrass in other parts of the Wadden Sea (van der Graaf *et al*, 2009). Intertidal *Zostera* fields in the Dutch Wadden Sea are protected from fishing – **weak criterion met** DK – In the Danish Wadden Sea, seagrass is monitored on a regular basis (van der Graaf *et al*, 2009) it is therefore assumed that the distribution of *Zostera* in the Danish Wadden Sea is known. However, there are no specific protection measures for *Zostera* fields, EIA is therefore not likely to be able to prevent impacts – **weak criterion not met** DE – no cockle fishing is currently allowed according to National Park Law – **weak criterion met by default**	NL - Monitoring of seagrass beds is carried out annually or bi-annually and distribution is therefore known. Intertidal *Zostera* fields in the Dutch Wadden Sea are protected from fishing – **medium criterion met for *Zostera*** DK – **medium criterion not met** DE – no cockle fishing is currently allowed according to National Park Law – **medium criterion met by default**	NL – Monitoring of seagrass beds is carried out annually or bi-annually and distribution is therefore known. Intertidal *Zostera* fields in the Dutch Wadden Sea are protected from fishing. It is highly likely that these areas comprise areas of former *Zostera* fields – **strong criterion met** DK – **strong criterion not met** DE – no cockle fishing is currently allowed according to National Park Law – **strong criterion met by default**
Marine mammals (e.g. grey seal, common seal, harbour porpoise, Eurasian otter)	NL, DK – Direct fisheries impacts on marine mammals through bycatch are unlikely and is expected to be below 1.7% of best estimate of abundance - **weak criterion met**	NL, DK – Direct fisheries impacts on marine mammals through bycatch are unlikely but indirect impacts on may be possible through disturbance. Based on the assumption that this impact is considered in the AA/EIA - **medium criterion met**	NL, DK – Direct fisheries impacts on marine mammals through bycatch are unlikely but indirect impacts may be possible through disturbance. Based on the assumption that this impact is considered in the AA/EIA - **strong criterion met**

Habitat / species	Sustainability criteria		
	Weak	**Medium**	**Strong**
	DE – no cockle fishing is currently allowed according to National Park Law – **weak criterion met by default**	DE – no cockle fishing is currently allowed according to National Park Law – **medium criterion met by default**	DE – no cockle fishing is currently allowed according to National Park Law – **strong criterion met by default**
Fish (e.g. twaite shad, river lamprey, sea lamprey, brook lamprey, houting, salmon)	NL, DK – there is no evidence of bycatch or discards of fish in the fishery - **weak criterion met** DE – no cockle fishing is currently allowed according to National Park Law – **weak criterion met by default**	NL, DK – there is no evidence of bycatch or discards of fish in the fishery - **medium criterion met** DE – no cockle fishing is currently allowed according to National Park Law – **medium criterion met by default**	NL, DK – there is no evidence of bycatch or discards of fish in the fishery - **strong criterion met** DE – no cockle fishing is currently allowed according to National Park Law – **strong criterion met by default**
Birds (oystercatcher eider duck)	NL – Food reservation policy for birds is based on best available scientific advise and ensures that fishery is not the limiting factor on cockle-dependent bird populations - **weak criterion met** DK – Assumption that food requirements for birds are continuously assessed by annual EIA - **weak criterion met** DE – no cockle fishing is currently allowed according to National Park Law – **weak criterion met by default**	NL – Food reservation policy for birds, TAC, area closures and spreading of hand rakers ensures that fishery is not the limiting factor on cockle-dependent bird populations - **medium criterion met** DK – Cockle beds in Natura 2000 area closed to cockle fishery and assumption that food requirements for birds are continuously assessed by annual EIA - **medium criterion met** DE – no cockle fishing is currently allowed according to National Park Law – **medium criterion met by default**	NL – Intertidal cockle beds are not protected from fishing - **strong criterion not met** DK – All intertidal cockle beds are not protected from fishing - **strong criterion not met** DE – no cockle fishing is currently allowed according to National Park Law – **strong criterion met by default**

Table 13. Sustainability framework vs Wadden Sea shrimp fisheries

Habitat / species	Sustainability criteria		
	Weak	**Medium**	**Strong**
1110 Sandbanks slightly covered by sea at all times 1130 Estuaries – subtidal 1160 Large shallow inlets and bays - subtidal NB the criteria for these general habitats assume that mussel beds, *Zostera* and *Sabellaria* are treated separately 1140 Mud and sandflats uncovered at low tide 1130 Estuaries – intertidal 1150 Coastal lagoons	NL – Appropriate assessments (AA) are carried out every five years and assess the fishery's impacts on designated habitats. On this basis, **weak criterion met** DK – Appropriate assessments (AA) are carried out annually and assess the fishery's impacts on designated habitats. On this basis, **weak criterion met** DE (SH + LS) – no AA are carried out which assess the fishery's impacts on designated habitats. Although zero-use zones exist, it is not specified whether designated habitats are protected from shrimp fishing – **weak criterion not met**	NL – Although fishery's impacts on designated habitats are assessed through AA, these do not take place annually and impacts on habitats can therefore not be appropriately evaluated - **medium criterion not met** DK – Fishing is not permitted within the "shrimp line". Appropriate assessments (AA) are carried out annually and assess the fishery's impacts on designated habitats. On this basis, **medium criterion met** DE – no AA are carried out which assess the fishery's impacts on designated habitats. Although zero-use zones exist, it is not specified whether designated habitats are protected from shrimp fishing - **medium criterion not met**	NL – Although fishery's impacts on designated habitats are assessed through AA, these do not take place annually - **strong criterion not met** DK – Fishing is not permitted within the "shrimp line". Appropriate assessments (AA) are also carried out annually and assess the fishery's impacts on designated habitats - **strong criterion met** DE – no AA are carried out which assess the fishery's impacts on designated habitats. Although zero-use zones exist, it is not specified whether designated habitats are protected from shrimp fishing - **strong criterion not met**
1170 Reefs - Subtidal mussel beds NB: Includes all subtidal mussel beds, not just those designated as reefs	NL – Appropriate assessments (AA) are carried out every five years and assess the fishery's impacts on designated habitats. On this basis, **weak criterion met** DK – Appropriate assessments (AA) are carried out annually and assess the fishery's	NL – Although fishery's impacts on designated habitats are assessed through AA, these do not take place annually - **medium criterion not met** DK – Appropriate assessments (AA) are carried out annually and assess the	NL – Although fishery's impacts on designated habitats are assessed through AA, these do not take place annually - **strong criterion not met** DK – Appropriate assessments (AA) are carried out annually and assess the

Habitat / species	Sustainability criteria		
	Weak	**Medium**	**Strong**
	impacts on designated habitats. On this basis, **weak criterion met** DE (SH + LS) – no AA are carried out which assess the fishery's impacts on designated habitats. Although zero-use zones exist, it is not specified whether designated habitats are protected from shrimp fishing – **weak criterion not met**	fishery's impacts on designated habitats. On this basis, **medium criterion met** DE – no AA are carried out which assess the fishery's impacts on designated habitats. Although zero-use zones exist, it is not specified whether designated habitats are protected from shrimp fishing - **medium criterion not met**	fishery's impacts on designated habitats. On this basis, **strong criterion met** DE – no AA are carried out which assess the fishery's impacts on designated habitats. Although zero-use zones exist, it is not specified whether designated habitats are protected from shrimp fishing - **strong criterion not met**
Intertidal mussel beds	Same as subtidal mussel beds	Same as subtidal mussel beds	Same as subtidal mussel beds
Sabellaria reefs	NL, DE, DK –Distribution of *Sabellaria* reefs is currently not known and no routine monitoring is taking place. No specific measures are in place which protect these habitats should their presence be recorded. Precautionary principle is not being applied – **weak criterion not met**	NL, DE, DK –Distribution of *Sabellaria* reefs is currently not known and no routine monitoring is taking place - **medium criterion not met**	NL, DE, DK –Distribution of *Sabellaria* reefs is currently not known and no routine monitoring is taking place - **strong criterion not met**
Zostera noltii intertidal *Zostera noltii* and *Z. marina* subtidal	NL – Monitoring of seagrass beds is carried out annually or bi-annually. In addition to this mapping program, a system is set up in which people in the field are asked to pass on observations on presence of seagrass in other parts of the Wadden Sea (van der Graaf *et al*, 2009). Intertidal *Zostera* fields in the Dutch Wadden Sea are protected from fishing, but not the subtidal – **weak criterion met for intertidal *Zostera* – weak criterion not met for subtidal *Zostera*** DK – In the Danish Wadden Sea, seagrass is monitored on a regular basis (van der Graaf	NL - Monitoring of seagrass beds is carried out annually or bi-annually and distribution is therefore known. Intertidal *Zostera* fields in the Dutch Wadden Sea are protected from fishing, but not the subtidal – **medium criterion met for intertidal *Zostera* – medium criterion not met for subtidal *Zostera*** DK – In the Danish Wadden Sea, seagrass is monitored on a regular basis. While a *de*	NL - Monitoring of seagrass beds is carried out annually or bi-annually and distribution is therefore known. Intertidal *Zostera* fields in the Dutch Wadden Sea are protected from fishing, but not the subtidal – **strong criterion met for intertidal *Zostera* – strong criterion not met for subtidal *Zostera*** DK - In the Danish Wadden Sea, seagrass

Habitat / species	Sustainability criteria		
	Weak	**Medium**	**Strong**
	et al, 2009) it is therefore assumed that the distribution of *Zostera* in the Danish Wadden Sea is known. While a *de facto* protection is assumed for intertidal *Zostera*, and the **weak criterion is therefore met for intertidal *Zostera***, no measures are in place to protect existing *Zostera* fields from fishing in the subtidal - **weak criterion not met for subtidal *Zostera*** DE – Regular monitoring of *Zostera* fields and stock development in SH and LS is being carried out (van der Graaf *et al*, 2009). It is therefore assumed that the distribution of *Zostera* fields is known. Intertidal *Zostera* is *de facto* protected from the shrimp fishery as these areas do not have enough tidal range to allow navigation – **weak criterion met for intertidal *Zostera* by default – weak criterion not met for subtidal *Zostera*** as no specific measures are in place which protect these habitats should their presence be recorded (except in some "zero use zones").	*facto* protection is assumed for intertidal *Zostera*, and the **medium criterion is therefore met for intertidal *Zostera***, no measures are in place to protect existing *Zostera* fields from fishing in the subtidal - **medium criterion not met for subtidal *Zostera*** DE - Regular monitoring of *Zostera* fields in SH and LS is being carried out in the intertidal and subtidal. Intertidal *Zostera* fields are *de facto* protected from shrimp fishing activities - **medium criterion met for intertidal *Zostera***. However **medium criterion not met for subtidal *Zostera*** as no specific measures are in place which protect these habitats should their presence be recorded (except in some "zero use zones").	is monitored on a regular basis. While a *de facto* protection is assumed for intertidal *Zostera*, no specific measures are in place to protect known *Zostera* fields from fishing in the subtidal - **strong criterion met for intertidal *Zostera* – strong criterion not met for subtidal *Zostera*** DE - Regular monitoring of *Zostera* fields in SH and LS is being carried out in the intertidal and subtidal. Intertidal *Zostera* fields are *de facto* protected from shrimp fishing activities - **strong criterion met for intertidal *Zostera***. However **strong criterion not met for subtidal *Zostera*** as no specific measures are in place which protect these habitats should their presence be recorded (except in some "zero use zones").
Marine mammals (e.g. grey seal, common seal, harbour porpoise, Eurasian otter)	NL, DK, – Fisheries impacts on marine mammals are assessed by AA. Direct impact through bycatch generally not considered an issue for the shrimp fishery and will therefore not exceed 1.7%** of the best estimate of abundance - **weak criterion met** DE – fisheries impacts on marine mammals	NL, DK – Assumption that there are no direct impacts on marine mammals. Indirect impacts on marine mammals possible by disturbance; however these are addressed in AA - **medium criterion met** DE – No AA is in place, therefore	NL, DK - Indirect impacts may be possible through disturbance. Based on the assumption that this impact is considered in the AA/EIA - **strong criterion met** DE – No AA is in place, therefore

Habitat / species	Sustainability criteria		
	Weak	**Medium**	**Strong**
	not assessed by AA. Although direct impact through bycatch unlikely to be an issue for the shrimp fishery, it cannot be concluded with any degree of certainty that impacts will not exceed 1.7%** of the best estimate of abundance **- weak criterion possibly not met**	uncertainty as to the degree of impact of direct and indirect disturbance of the shrimp fishery on marine mammal populations - **medium criterion not met**	uncertainty as to the degree of impact of direct and indirect disturbance of the shrimp fishery on marine mammal populations - **strong criterion not met**
Fish (e.g. twaite shad, river lamprey, sea lamprey, brook lamprey, houting, salmon)	More than 5% of the total catch is likely to consist of juvenile shrimp and/or non-targeted species. Impacts should be assessed for each regularly recorded bycatch or discarded species, in relation to the species' reference points or other sources of mortality. NL, DK - AA carried out annually in the case of DK and every five years in the case of NL only assess impacts in relation to designated migratory species – on the basis that any impacts would be adequately assessed by the AA, **strong criterion met for designated migratory species.** DE – AA not carried out and therefore no targeted assessment of shrimp fishery impacts on migratory designated species. Although impacts are unlikely to have population-level consequences, it cannot be concluded with any degree of certainty that impacts do not exceed maximum sustainable level. On this basis, **weak criterion possibly not met** NL, DK, DE - This study cannot establish	NL, DK, DE – More than 5% of the total catch is likely to consist of juvenile shrimp and/or non-targeted species – **medium criterion not met**	NL, DK, DE – More than 5% of the total catch is likely to consist of juvenile shrimp and/or non-targeted species – **strong criterion not met**

Habitat / species	Sustainability criteria		
	Weak	**Medium**	**Strong**
	levels of impact on the populations of each bycatch/discard species individually. Until such work is completed with particular reference to Wadden Sea shrimp fisheries it cannot be concluded with any degree of certainty that impacts do not exceed maximum sustainable level. On this basis, **weak criterion possibly not met**		
Birds (e.g. oystercatcher, common eider)	NL, DK – Ecosystem carrying capacity for birds addressed in AA. Shrimp fisheries are not considered to pose a threat to the food availability for birds but may a cause a shift in the natural species composition of breeding coastal birds by benefiting scavenging birds such as gulls - **weak criterion met** DE – Although shrimp fisheries are not considered to pose a threat to the food availability for birds no regular assessment evaluates the impacts this fishery may have on the wider ecosystem including birds – **weak criterion not met**	NL, DK, DE – No explicit protection in place by TAC or area closures to protect bird food availability or bird feeding grounds from impacts. There is the assumption that shrimp fisheries do not impact on the food availability for birds; however, ecosystem-wide impacts of these fisheries remain to be fully explored. For this reason **medium criterion not met**	NL, DK, DE – No explicit protection in place by TAC or area closures to protect bird food availability or bird feeding grounds from impacts. There is the assumption that shrimp fisheries do not impact on the food availability for birds; however, ecosystem-wide impacts of these fisheries remain to be fully explored. For this reason **medium criterion not met**

3.3. SUSTAINABILITY ANALYSIS

3.3.1. NATURE CONSERVATION TARGETS AND THE SUSTAINABILITY FRAMEWORK

Mapping the Trilateral Targets for the Wadden Sea and the MSC standard onto the sustainability framework enables us to make two general considerations:

- The MSC standard was generally on the 'weaker' end of the gradient than the Trilateral Targets;
- Some of the Trilateral Targets may not be met even if all Wadden Sea fisheries meet the strong criteria

Q: Why is MSC 'weaker' than the Trilateral Targets?

A: The MSC standard is specific to fisheries, while the Trilateral Targets are more general. MSC takes as a starting point that fishing is of itself a sustainable activity, as long as it is done in the right way. This approach implies almost immediately a 'weak' approach to sustainability (at least under the definitions proposed above), since fishing is by definition an activity that is extractive from the marine environment. MSC starts from a consideration of how a fishery can be conducted with the least possible impact. Trilateral Targets, conversely, start from the desired overall outcome of high nature protection. For example, 'a natural size, distribution and development of natural mussel beds' is very difficult to achieve in the context of a fishery, except for one that is very minimal (it also does not allow for any ecological benefits from relaid (artificial) mussel beds). It should be noted here however that the Trilateral Targets for the Wadden Sea were not developed with fisheries exploitation in mind. Both are valid approaches depending on the context, but the outcome will obviously be different.

Q: Why might the Trilateral Targets not be met even with 'strong' sustainable fisheries?

A: As noted above, the Trilateral Targets focus on outcome rather than impacts. Strengthening the sustainability of fisheries will therefore only help to move the ecosystem towards the targets if fishing is the main cause of the target not being met. So for example, it is hard to say whether *Sabellaria* reefs and subtidal *Zostera* beds would re-establish in the Wadden Sea if bottom fishing were banned, because the cause of their loss and failure to re-establish so far is not known – but it is probable that there are also other ecological requirements that would have to be met. Because of this mis-match, the Trilateral Targets, while a useful overarching set of objectives to guide high-level policy-making, do not appear the best tool to address the impacts of fisheries in the Wadden Sea specifically and in fact, this is not their objective.

3.3.2. FISHERIES AND THE SUSTAINABILITY FRAMEWORK

Several specific and general observations can be taken from the outcome of the second exercise – mapping fisheries on to the sustainability criteria. These are discussed below.

A. FISHERY-SPECIFIC OBSERVATIONS

Mussel fisheries

The following observations were made in relation to the Wadden Sea mussel fisheries. Note that in DK, all strong sustainability criteria were met by default as this fishery is closed:

General habitat impacts in DE (SH and LS). The disjointed approach to nature protection (through the Habitats Directive and the National Parks) and management of the German mussel fisheries is at the basis of this indicator not meeting strong or even medium sustainability. Appropriate assessments are an important instrument which ensures that fisheries management is kept in line with the requirements for nature protection as set out in the Habitats and Birds Directives and as adopted in the Trilateral Targets. The fact that these assessments are not carried out (in the case of LS) or are carried out only every five years (in the case of SH) means that the protection of these habitats from fishing can really only be ensured through the National Parks with their respective area closures. Under the assumption that as Natura 2000 areas the National Parks provide some modicum of protection, the weak sustainability criterion is met. For SH, the fact that appropriate assessments are not carried out with adequate frequency (the team proposes an annual frequency), implies that the medium sustainability criterion is not met.

Subtidal mussel beds in NL are not fully protected. As discussed, in section 2.2, work is in progress to meet this criterion, as the wild seed fishery is gradually phased out to be replaced by artificial seed collectors. Assuming that this phasing out will continue, culminating in the full replacement of the Dutch mussel seed fishery by ASCs in 2020 (see Section 2.2), the achievement of strong sustainability for this indicator is a possibility.

Subtidal mussel beds in DE are not fully protected as some subtidal mussel beds are fished. In LS, this impact is reduced due to the presence of a limit reference point of 10,000 tonnes mussel biomass. For this reason, the blue mussel fisheries in LS do meet the medium sustainability criterion. In SH, however, there is no limit reference point or TAC in place and area closures do not guarantee overexploitation of the mussel stock. For this fishery to meet the medium criterion some effort or harvest control should be in place – this can take the form of a TAC, limit reference point or area closures which are amended in accordance with spat fall assessments.

Intertidal mussel beds in LS are not fully protected as some intertidal mussel beds are fished. Unless the intertidal is completely closed to the mussel fishery – as is the case in NL, DK and SH, this fishery cannot meet the strong sustainability criterion.

Sabellaria reefs in NL, DK and DE. While this indicator was certainly not the focus of this study, it became apparent that significant knowledge gaps exist with regards to the distribution and even existence of *Sabellaria* reefs in the Wadden Sea. Although specific targets relating to *Sabellaria* are included in the 2010 Wadden Sea Plan, a routine monitoring program on the occurrence and development of *Sabellaria* reefs – despite having been strongly recommended for many years – has not been adopted so far (Vorberg *et al*, 2009). In order to meet even the weak sustainability criteria for this indicator, the precautionary principle should be applied and measures should be put in place which can protect this habitat type should its presence be reported or recorded. In order to move towards stronger sustainability, a routine monitoring programme, as recommended in the Quality Status Report by Vorberg *et al* (2009) should be adopted.

Zostera beds in NL, DK and DE. In the trilateral Wadden Sea, regular monitoring takes place and the intertidal is legally protected from mussel fishing and NL and DE. For this reason, the medium and strong criteria were met for intertidal *Zostera*, but not for subtidal *Zostera* which is not protected from fishing. To move towards strong sustainability a system should be in place which ensures that fisheries are not hampering the regeneration or spread of *Zostera* beds in the subtidal. The fact that no subtidal *Zostera* beds are currently present in DE does not validate the absence of a protection system.

Marine mammals in NL and DE. In NL strong sustainability was met as AA evaluate the fishery's impacts on marine mammal populations and disturbance is minimised where possible. In DE, management measures to systematically prevent entanglement of marine mammals in DE ASC installations would be the minimum requirement for weak sustainability. The absence for frequent AA in LS and SH further make the achievement of medium and strong sustainability impossible.

Birds in NL. Significant measures are already in place (TAC, food reservation policy for birds, area closures) to minimise any impact on the food availability for birds. However, as long as the wild seed fishery takes place, strong sustainability cannot be met. As previously stated, the gradual phasing out of this fishery to be replaced by ASCs would bring the Dutch mussel fishery a step closer to strong sustainability. At this stage, however, this cannot be guaranteed, since research into the impact of ASCs on ecosystem carrying capacity (and therefore food availability for birds) is ongoing (see Section 3.1.1).

Birds in DE. There are no specific measures in place (TAC, food reservation policy) which protect the food requirements for birds from mussel fishing. The only measures in place which could contribute to protection are the area closures set by the respective National Parks, the limit reference point set by LS and the minimum culture period and interdiction to scare birds from cultures in SH. As previously discussed, the area closures in SH do not guarantee overexploitation of the mussel stock and can therefore not protect the food availability for birds. Furthermore, the limit reference point set by LS does not make a separate allowance for bird food resources. As such, the weak sustainability criterion could not be met for either fishery.

Cockle fisheries

Among the three main fisheries, the Wadden Sea cockle fisheries achieved the highest sustainability overall. DE was on this occasion the highest scorer as no cockle fisheries are allowed in any of the national parks and none take place outside the conservation areas. For the remaining Dutch and Danish cockle fisheries, the achievement of strong sustainability was in most cases based on the annual use of appropriate assessments (NL) or Environmental Impact Assessments (DK) which ought to identify any negative impacts on designated habitats and species and therefore ought to ensure the protection of those features.

Sabellaria reefs in NL and DK. The same observation as for the mussel fisheries applies.

Zostera in NL and DK. In NL, strong sustainability for intertidal *Zostera* fields was met as regular monitoring takes place and this habitat type is protected from fishing. In DK, regular monitoring also takes place, but there are no specific measures in place which protect this habitat type. For this reason, the weak sustainability criterion could not be met.

Birds in NL and DK. Significant measures are already in place (TAC, food reservation policy for birds, area closures) to minimise any impact on the food availability for birds. However, as long as the manual (NL) and mechanical (DK) cockle fisheries take place, and natural beds are not protected from fishing, strong sustainability cannot be met.

Shrimp fisheries

The strong sustainability criteria for Wadden Sea shrimp fisheries were generally not met and both the weak and medium criteria could be met on only some occasions. The analysis has shown that there is significant work to be done to move these fisheries to at least the minimum and intermediate levels of sustainability. The following observations were made in relation to the Wadden Sea shrimp fisheries:

General habitat impacts and subtidal and intertidal mussel beds in NL and DE. The absence of appropriate assessment for the DE shrimp fisheries implies that the protection of designated habitats is only to an extent ensured by defined zero-use areas. This study could not identify to what extent these no-take zones succeed in the protection of these habitats and as such, it is unlikely that the weak sustainability criterion for this indicator is met. A first step in moving towards stronger sustainability for the German Wadden Sea shrimp fisheries would therefore be to recognise the shrimp fishery as a project as defined by the Habitats Directive and make the issuing of fishing licenses subject to regular appropriate assessments. Although AA are carried out in NL, this only occurs every five years. The team considered that the frequency of these AA was not sufficient to accurately assess this fishery's impacts on benthic habitats. The medium criterion was therefore not met. In contrast, the annual AA carried out in DK should ensure that impacts on designated habitats are adequately considered. For this reason the DK shrimp fisheries did meet the strong sustainability criterion.

Sabellaria reefs in NL, DK and DE. The same observation as for the mussel and cockle fisheries applies.

Zostera in NL, DK and DE. In the trilateral Wadden Sea, regular monitoring takes place. Strong sustainability was generally met for the intertidal as this area is legally protected from fishing in NL and *de facto* protected from shrimp fishing in DE and DK. Weak sustainability, however, could not be met by any of the three countries as there are no specific measures which ensure the protection of subtidal *Zostera* fields from fishing. To move towards strong sustainability a system should be in place which ensures that fisheries are not hampering the regeneration or spread of *Zostera* beds in the subtidal. The fact that no subtidal *Zostera* beds are currently present in DE does not validate the absence of a protection system.

Marine mammals in DE. Direct and indirect impacts on marine mammals are addressed in appropriate assessments in NL and DK and minimised where possible. In DE, where no such assessments take place, there appeared to be no systematic way of evaluating these impacts. Although the shrimp fishery is unlikely to significantly impact on marine mammal populations, there must be a system in place which routinely quantifies these types of interactions. For this reason, the team considered that weak sustainability could not be met for the DE shrimp fisheries.

Migratory fish in NL, DK and DE. Bycatch of juvenile shrimp and non-target species including protected species remains a significant issue for shrimp fisheries in general. The 5% threshold for non-target/juvenile species is to a degree conservative, favouring the highly selective fisheries, and it is unlikely that the shrimp fisheries will be able to achieve that threshold even with more selective gear. For this reason, as long as shrimp fisheries take place with the current measures in place, strong sustainability cannot be met in relation to those species which regularly make up shrimp bycatch or discards. This study did not have the scope to quantify the shrimp fishery's impacts on each of those species – for this reason a conservative approach was adopted and weak sustainability not awarded. It would require a separate and more in-depth analysis of the landings of the Wadden shrimping fleet to determine whether weak sustainability can be met. That said, for the Dutch and Danish shrimp fisheries, appropriate assessments evaluate the risk these fisheries pose to protected fish species and therefore do provide a modicum for protection – therefore for those designated species, weak sustainability can be met (although this is not so for DE). However, overall, as this is a fishery with significant (>5%) bycatch and discards, the medium criterion for "Fish" is not met by any of the 3 nations.

Birds in NL, DK and DE. Shrimp fisheries are generally not considered to be a threat to the food availability for birds – in fact the opposite tends to be true with scavenging piscivorous bird species such as gulls benefiting from discarded bycatch - in DK and NL, where AA are carried out, weak sustainability was therefore met. Nevertheless, shrimp play an important role in the ecosystem as both prey and predator and the extent to which shrimp fisheries are affecting this role (in addition to other external pressures such as climate change) remains uncertain. For this reason, the medium and strong sustainability

criteria cannot be met as long as these knowledge gaps exist and the shrimp fisheries take place.

B. LIMITATIONS OF THE ANALYSIS

The above analysis and discussion aimed to i) generate a sustainability framework for the interface between Wadden Sea fisheries and nature conservation and ii) to map the main conservation objectives and the main fisheries onto this framework.

The purpose of the exercise was to consider the relative level of impacts between different fisheries and between different habitats and species, in order to identify i) where improvements could be made to fisheries sustainability and ii) where (and why) the impacts of fisheries fall short of conservation targets.

This exercise is **not** intended to pass definitive judgement on the sustainability or otherwise of Wadden Sea fisheries – it is a comparative and subjective exercise, clarifying the starting position of nature protection authorities in the dialogue with the fisheries sector and other involved stakeholders.

In addition, it is important to note that information about the fisheries and their activities has been based on the sources available – with the exception of targeted interviews, there has been no discussion or review with fisheries stakeholders. Likewise, sources of information such as appropriate assessments have been taken at face value for the purposes of this exercise. It is clear that such assessments vary in quality and detail, as do the data on which they are based. However, a detailed quality analysis of these sources is beyond the scope of this exercise. It is our understanding that the outcomes of some appropriate assessments have been contested and that some have resulted in court cases. It is our view that strong sustainability can only be met if appropriate assessments or other suitable types of environmental impact assessments are robust and based on the best available scientific evidence so that they can withstand scrutiny from the scientific community and stakeholders. The validity of the appropriate assessments (or equivalent) is absolutely central in the concept of strong sustainability from the perspective of nature protection as defined under the Habitats and Birds Directives.

C. OTHER ISSUES TO CONSIDER – MUSSEL IMPORT

One additional issue that arises in relation to mussels fisheries – the import of seed mussels into the Wadden Sea system - is not easy to fit into the above framework. The main issue with importation of seed mussels into the Wadden Sea is the further introduction of invasive species into the ecosystem with the mussels. In fact, the Wadden Sea is already the unwilling host of a variety of invasive and nuisance species, and their impact on the ecosystem, although not well understood, is likely to be significant. The Oosterschelde, to which mussels are regularly imported, has a relatively strict system for ensuring as far as possible that non-native species do not arrive with the mussels. This consists of a detailed survey of the biota of the source mussel bed, which identifies any species non-native to the Oosterschelde, and whether they are already present in the ecosystem via introduction. A second issue is that mussels from some parts of Europe are

not *Mytilus edulis* (as in the Wadden Sea), but *Mytilus galloprovincialis* or naturally occurring hybrids between the two species. The two species are morphologically highly similar and are likely to occupy similar roles in the ecosystem, but maintaining a genetically natural population in the Wadden Sea would probably preclude imports from 'gallo' or hybrid areas (e.g. Spain, west coast of France, far Southwest England).

3.4. CASE STUDIES

Case studies were analysed in to place the Wadden Sea fisheries – in particular shellfish fisheries – in a wider context and enable comparison with management practices and nature conservation issues in other Natura 2000 areas across Europe – in particular the UK and France.

A. THE WASH: MUSSEL FISHERIES AND SHELLFISH-EATING BIRDS

The shellfish fishery in the Wash (Eastern England) is managed under a 'Fishery Order' (1992) by the Eastern IFCA[21]. The Fishery Order covers cockle and mussel fisheries and allows areas to be leased by individual fishermen for relaying (as opposed to outside the fishery order where fisheries are open to anyone with a licence). These areas are allocated by the IFCA, who also manages the fisheries via byelaws (e.g. they can open and close individual beds depending on the density and size structure of the population, can impose TACs and can limit effort). Cockles are fished by suction dredging and hand raking, and mussels by dredge. Natural mussel beds in the Wash are limited to the intertidal, but seed mussels are fished from naturally occurring subtidal beds outside the Wash (Lincolnshire and Norfolk coasts) and relayed on leased areas in the Wash. The source beds are reported to be generally ephemeral, and no limits are put on the mussels taken from them. The Wash and North Norfolk coast adjacent is designated as an SAC, an SPA and a National Nature Reserve. The conservation authority is Natural England.

In the Wash, there has been conflict between shellfish-eating birds and shellfish fishermen for a long time. A study published in 2003 (Atkinson *et al*, 2003) showed a decline in oystercatcher survival in the Wash, including three periods of mass mortality, and linked this to overfishing of the mussel beds. The oystercatchers appeared to rely mainly on cockle populations, which are very variable and linked to weather (winter temperatures notably), but relied on mussels in years of low cockle biomass.

It could be concluded that the key to maintaining oystercatcher survival in the Wash is therefore to ensure that sufficient stocks of intertidal mussels are available to support the population during low cockle years. The study noted that 'recent cultivation of mussels in inter-tidal areas has been beneficial and is an important management tool for maintaining bird populations'.

[21] IFCA = Inshore Fisheries and Conservation Authority. There are 10 around the coast of England, responsible for inshore fisheries management (inside the 6 nautical mile limit).

A more recent study (Caldow *et al*, 2007) concluded that the situation for oystercatchers had improved in comparison to previous years, with food availability modelling suggesting that the population (around 15,000 birds at its peak) was not limited by food resources in the Wash. This appeared to be the result of an increase in the area of intertidal mussel beds in the Wash although it is not clear whether this was due to relaying, natural settlement or both.

Conversely, the study by Caldow *et al* (2007) addressed significant conflict between mussel growers and eider ducks. Eider ducks congregated to feed at the two largest mussel lays in the subtidal, and were estimated to remove about 600 tonnes of mussels from the lays over the course of a winter. Mussel farmers had as a result applied to the IFCA and Natural England for permission to use scarers or even lethal control. The study concluded that the eider ducks were attracted to the mussel lays because this represented a large stock of suitably sized, high quality mussels, at high density. They rely on this food source throughout the winter before switching in late winter to feed mainly on *Ensis directus*, a non-native species of razor clam. The feeding model predicted that based on these two resources, the peak population of 3,000 birds could be sustained with about 4% mortality (roughly the amount found by field studies).

It was found that this population relies not only on mussels being present in the system, but also on those mussels being present in 'hotspots' that provide high quality food with low foraging costs (i.e. on artificial lays rather than natural beds, in this case). The birds also rely on the introduced species in the system (*Ensis)* and the study noted that these two resources together have the capacity to support much higher populations of eider ducks than have ever actually been observed in the Wash. Conversely, and in contrast to the oystercatchers, the natural stocks of mussels and cockles appeared to be unimportant to eider duck populations.

B. MUSSEL FISHING IN THE RIVER EXE, ENGLAND

The Exe estuary in Southwest England is a 'ria' (drowned estuary) with a bar across the mouth (Dawlish Warren) and very strong tidal flows. It is designated an SAC, a Site of Special Scientific Interest and an SPA for wading birds (no eider ducks are present in this area). The estuary has a long history of growing mussels – in the 19th century, tending the mussel beds was the job of the young and the old, while the strongest men fished at sea. Between the arrival of the railway around 1850 and the First World War, two trains a day of mussels were sent to London from the Exe. After the war, the activity declined, and now only one mussel company operates in the river.

In a typical year, mussel settlement occurs outside the mouth of the estuary on beds which are subtidal and very ephemeral – they may only last a few months before being lost to wave action combined with the strong tidal currents in the area. The mussel company is given permission to fish these beds at will, subject to appropriate assessment, and to relay the mussels inside the estuary where they are less likely to be washed away.

However, Natural England periodically specify that mussels are relaid in a particular area (e.g. high in the intertidal) in order to support bird populations, and the mussel company complies with these requests, even though the areas in question are less economically viable. This situation is similar to the Wash, in that artificial (relaid) mussel beds in the intertidal are considered to be an important tool in oystercatcher conservation.

The mussel company leases a large area of the estuary bed, but confines its relaying to areas away from important resources such as seagrass beds and cockle beds.

Although the company theoretically has the right to relay in these important areas, any attempt to do so would result in an additional appropriate assessment being required by Natural England, which would almost certainly fail. In practice, since the company values the good relations that it has with Natural England, and since it has sufficient space elsewhere, it does not attempt to touch areas of high conservation value.

Oystercatchers in the estuary are in decline, but a recent survey by the Devon and Severn IFCA of mussel and cockle stocks (supported by the mussel company who provided vessels and manpower) showed that there was significantly more food available than the population required.

The study concluded that shellfish fisheries in the River Exe are not linked to this decline in oystercatchers. The actual cause, however, remains to be identified.

C. SHELLFISH FISHERIES IN THE RIA D'ETEL, MORBIHAN, FRANCE

The Ria d'Etel is on the south coast of Brittany, just east of the city of Lorient. It is designated as an SAC. Management and monitoring for nature conservation is the role of local government – in this case a rather complex arrangement of 'syndicats intercommunals' – groupings of communes around the ria. The main shellfish activity in the ria is oyster growing – mainly Pacific oyster but also native (European) oysters. Despite problems with an introduced disease, the activity has returned to viability and profitability in the last year or so. Oyster growers lease areas for a 'parc' where oysters are grown, and have a facility on shore with a depurating tank; generally speaking, however, these businesses are relatively artisanal in nature.

In addition to oyster growing, there is a fishery for cockles and 'palourdes' (*Ruditapes* spp.). The cockle fishery can be conducted in two ways – either individuals lease areas where they have the sole right to fish, or can reseed cockles (not palourdes), or they may fish the public areas. Shellfish fishing is only by hand ('à pied' – on foot) in either case. The reseeding of cockles is an exception in Morbihan – there is only one area from which undersized cockles can be fished for reseeding. This is at the foot of the Arzal dam (across the Vilaine estuary further east from the Ria d'Etel) which often receives a significant spatfall but where the cockles are killed by periodic freshwater release from the dam.

The pêche à pied for cockles and palourdes is managed by the Comité Local de Pêche (local fisheries committee), who have the mandate for inshore fisheries management in

France. These organisations are somewhat akin to the IFCAs in England, but unlike the IFCAs do not include representatives of conservation bodies – only of fisheries. The Comité carries out a spring survey to estimate spatfall and biomass and on that basis decides how many licences to allocate. The cockles are also managed by a daily quota per licence holder, but the palourde fishery is unlimited (except by the number of licencees).

As far as we are aware, there is no consideration of bird populations or factors other than the viability and profitability of the fishery for that year. The syndicat for nature conservation noted that fisheries management was 'not very developed' in the ria, but did not consider it to be a significant issue relative to agricultural pollution and other similar factors. The lower population density and more artisanal nature of most French fishing enterprises may make this type of rather 'laissez faire' management more viable than in more developed areas. It is, however, noteworthy that even though management is basically by the fishermen for the fishermen, it is not a complete free-for-all – there is some measure of control and some acknowledgement of sustainability issues.

3.5. RECOMMENDATIONS

The team derived recommendations from the previous analyses, as to the actions proposed to move Wadden Sea fisheries towards 'strong' sustainability, as defined in Section 3.2.1. Specific recommendations were drawn from the mapping of the mussel, cockle and shrimp fisheries onto the sustainability criteria (Table 11 to Table 13 in Section 3.2.2), considering each area and fishery where the 'strong' criterion was not met. In addition to these specific recommendations by fishery and area, the team also drew out some more general recommendations from the above review as well as the case studies.

A. FISHERY-SPECIFIC RECOMMENDATIONS

Mussel fishery

In relation to mussel fisheries, the Danish fishery met all the strong criteria by default as it is currently closed. Specific recommendations, drawn from those aspects of the German and Dutch fisheries which did not meet the strong criteria, are as follows:

- Although an appropriate assessment (AA) is being carried out every five years in **SH**, this frequency is considered too low to accurately detect impacts of the mussel fishery on all designated habitats and species. We recommend that if AA are being used, they are used on an annual basis.

- In **LS**, no AA are currently being used. As previously discussed, the team considers that the use of scientifically robust AA (or equivalent) is absolutely central in the concept of strong sustainability from the perspective of nature protection as defined under the Habitats and Birds Directives.

- Area closures are in place in **Germany**; however these do not prevent over-exploitation of the mussel stock in some years. The team therefore advocates stronger harvest control rules which enable control over the total quantity of removals of mussels from the system. This could be done for example via an annual TAC, which should be set with reference to annual stock assessments and the feeding requirements of birds, taking into account other distribution and other resources which may be available (see Wash case study);

- **LS** is currently the only region where mussel fishing takes place in the intertidal. Closure of intertidal mussel beds to fishing would move this fishery towards stronger sustainability;

- Where no data are available on the distribution of *Sabellaria* reefs, the precautionary principle should be applied and this applies to **all Wadden Sea regions**. This could involve a reporting system where reports of *Sabellaria* occurrence by fishermen and other stakeholders are systematically recorded and the information is shared with fishing operators so that areas of known *Sabellaria* occurrence can be actively avoided. In parallel with this it is recommended that a routine monitoring programme is put in place and that this is a concerted effort between the various Wadden Sea

regions (under for example TMAP). Once the distribution of *Sabellaria* in the Wadden Sea is known (if any) protection measures should be put in place.

- Although regular monitoring of *Zostera* fields does take place throughout the Wadden Sea region, there appears to be a lack of consistency in terms of protection measures applying to the mussel fishery, with the intertidal being protected from the mussel fishery in The Netherlands and Germany (and *de facto* in Denmark where the mussel fishery is closed) but not the subtidal. For strong sustainability to be met, regular monitoring of both intertidal and subtidal *Zostera* fields should be undertaken in all regions, and known beds should be protected. As was the case for *Sabellaria*, where data are not available, the precautionary principle should be applied. A concerted approach towards data and information collection (even if this is anecdotal, such as in The Netherlands) and the establishment of protection measures for subtidal beds is recommended.

- Although NL ASC installations are equipped with enclosures it was not clear whether these are part of the ASC licensing conditions in **Germany**. Taking into account the worst-case scenario, entanglement of marine mammals therefore remains a possibility. In the absence of appropriate assessments, the rate of entanglement in ASC installations, should be measured and measures taken to prevent entanglement if necessary.

- In **NL**, ASC installations will expand significantly in the near future. It is important that cumulative impacts are considered in the appropriate assessments for each separate ASC installation. This is of particular importance from the perspective of general disturbance to birds and mammals and from the perspective of ecosystem carrying capacity. As ASC installations are also being introduced in **Germany**, equivalent studies (in the absence of AA) should ensure that cumulative impacts are qualified and quantified on a regular basis.

Cockle fishery

In relation to mussel fisheries, the German fishery met all the strong criteria by default, since cockle fishing is not permitted inside or outside the conservation areas. Specific recommendations for the Dutch and Danish fisheries, drawn from the aspects of the fisheries that did not meet the strong criteria, are as follows:

- Where no data are available on the distribution of *Sabellaria* reefs, the precautionary principle should be applied and this applies to **all Wadden Sea regions**. This could involve a reporting system where reports of *Sabellaria* occurrence by fishermen and other stakeholders are systematically recorded and the information is shared with fishing operators so that areas of known *Sabellaria* occurence can be actively avoided. In parallel with this it is recommended that a routine monitoring programme is put in place and that this is a concerted effort between the various Wadden Sea regions (under for example TMAP). Once the distribution of *Sabellaria* in the Wadden Sea is known (if any) protection measures should be put in place.

- As long as the cockle fishery takes place, strong sustainability from the perspective of birds and habitats may not be met. Meeting the strong criterion would require the protection of all natural cockle beds which may not be a desired outcome for the actors involved. The medium criterion was met for all fisheries however (with the exception of the *Zostera* (in Denmark) and *Sabellaria* components) and this may be the maximum achievable form of sustainability.

- Here also, the team makes the same recommendation for *Zostera*, as presented in the mussel section above.

Shrimp fishery

The shrimp fishery is, according to our analysis, the least sustainable of the three main fisheries in the Wadden Sea. Specific recommendations for this fishery are as follows:

- Use of frequent AA (by the team's standard this is annual) by **all Wadden Sea regions** to assess the impacts of this fishery on all designated habitats and species, as well as on the wider ecosystem. Despite the fact that this is such an intense fishery – particularly off the coasts of NL and DE, there are significant knowledge gaps and annual AA are currently only carried out by DK.

- In parallel with the recommendation for annual AA, the team recommends a concerted and strategic approach to develop and implement a research plan which specifically aims to fill the knowledge gaps that affect the shrimp fishery. This includes empirical data on habitat impacts, fleet-specific data on bycatch and discards, modelling of population-level impacts on bycatch and discards, and modelling on trophic level impacts from the fishery. We acknowledge that efforts are being made in The Netherlands for example, where research into the effects of shrimp trawls on benthic habitats is ongoing. However, we emphasise that these efforts would be best shared between the various regions.

- Here also, the team makes the same recommendation for *Sabellaria* and *Zostera*, as presented in the mussel section above.

- VMS currently only allows the surveillance of vessels of over 15 m length. Smaller vessels which have the potential to reach fishing or shrimping grounds closer inshore are not monitored. It is recommended that a vessel monitoring system for all fishing vessels (including shrimp vessels) is developed. As the fishery is within coastal range the use of appropriate low-cost technology such as AIS or GSM-based recording systems which require no separate operating costs would be a viable option. These data would provide information on all fishing locations and fishing effort, allowing more strict surveillance and informing on the establishment of future management actions such as zoning.

B. GENERAL RECOMMENDATIONS

In this section the team presents more general recommendations, some of which are drawn directly from the analysis above, and some of which more generally from the process of review and discussion presented in Tasks 1 and 2.

Use of Appropriate Assessments

If correctly implemented, appropriate assessments (AA) are a very powerful tool for assessing fishery impacts within the context of Natura 2000 and for deriving management requirements, particularly in a changing environment where an adaptive approach is required. Although this recommendation has already been made above, the team stresses that the use of scientifically robust AA (or equivalent) is absolutely central in the concept of strong sustainability from the perspective of nature protection as defined under the Habitats and Birds Directives. The use of regular (if possible annual) impact assessments by all Wadden Sea regions would also level the playing field and may facilitate the dialogue between the fishery managers, the industry and environmental NGOs at a trilateral level.

Data gaps

Throughout this study, it has become apparent that some significant knowledge gaps remain with regards to baseline ecological data in the Wadden Sea and the effect fisheries may have on that baseline. In order to have complete confidence – to the extent where that is possible – on impact assessments and the assessment of fisheries sustainability, it is necessary to fill those knowledge gaps as much as possible. This will enable some of those Wadden Sea fisheries, currently assessed as only meeting the "weak" sustainability criteria, to move beyond the use of the precautionary principle. While the acquisition of sound qualitative scientific or fisheries data is of course the desired way to achieve this, the team emphasises the importance of local or traditional ecological knowledge (TEK) which – if correctly used – can be a valuabe source of information.

The Quality Status Reports (QSR) of the Wadden Sea, which are issued by the Common Wadden Sea Secretariat already provide an excellent tool for the identification of these types of knowledge gaps. Although we have listed some below, we admit that this list is not exhaustive and therefore recommend an inventorisation of all surveys and data collection programmes which currently take place in the Wadden Sea and which have done so in the past. As previously stated, it is recommended that a concerted and strategic approach to develop and implement a research plan for the Wadden Sea ecosystem from the perpective of sustainable fisheries is adopted, including the use of both scientific and quantitative data collection and TEK. The recommendations provided in Task 3 (see Section 4) would provide a suitable platform to put this in action.

- Research into the ecological value of man-made vs natural mussel beds (also see below)

- Modelling of benthic habitat and community impacts of a large-scale manual cockle fishery

- Effects of ASC installations on ecosystem carrying capacity (with particular reference to food requirements for birds)

- Effects of large-scale ASC installations on water quality within the specific environment of the Wadden Sea

- Empirical studies into the habitat impacts of the shrimp fishery within the specific environment of the Wadden Sea

- Fleet-specific qualification and quantification studies on shrimp bycatch and discards

- Occurrence and distribution of *Sabellaria* reefs, with particular research into the ecology and dynamics within the Wadden Sea environment.

- Occurrence and distribution of subtidal mussel beds (e.g. with boat-mounted bottom-discrimination equipment such as RoxAnn)

- Better understanding of the factors underpinning bird population fluctuations in the Wadden Sea, with particular reference to climate change

- Continued research into the ecosystem effects of introduced species.

Systematic monitoring

Related to the above, even when data gaps are filled, monitoring needs to be continued on a systematic basis. The framework required for such monitoring already appears to be in place with the Trilateral Monitoring and Assessment Programme (TMAP). TMAP is the common monitoring programme for the Wadden Sea carried out by The Netherlands, Germany and Denmark in the framework of the Trilateral Wadden Sea Cooperation with the aim of providing a scientific assessment of the status and development of the Wadden Sea ecosystem and to assess the status of implementation of the Trilateral Targets (Marencic, 2009). TMAP has been implemented since 1997 and covers the entire Wadden Sea area, spanning a broad range from physiological processes over population development to changes in landscape and morphology (URL 6).

In general, TMAP parameters are part of existing or planned monitoring programs in the three countries and already cover the requirements of the EC Directives and other international agreements (e.g. Ramsar, OSPAR). TMAP parameters are coordinated trilaterally and a number of parameters have been harmonised, including those referring to blue mussel beds. TMAP also benefits from an ecological research component focusing on ecosystem research, which aims at the discrimination between natural fluctuations and human impacts to identify causes of ecosystem changes, as well as the continuous improvement of the monitoring programme and its parameters. So far, however, only a few trilateral research projects have been carried out, such as the joint seal project (1990-1994), the first pilot project on breeding success (1996-1997) and the assessment of contrasting trends in migratory birds (2009) (CWSS, 2010).

It is clear that TMAP provides the ideal framework to implement a systematic and trilateral monitoring programme for the Wadden Sea. We fully agree with the recommendations put forward in the 2010 Wadden Sea Plan (CWSS, 2010) on harmonisation, knowledge sharing, parameters and ecological research. A significant amount of work remains to be done, but it is only through these efforts that the existing knowledge gaps can be filled and appropriate management measures can be taken.

Best practice

The VIBEG agreement, discussed in Section 2.2.4, provides proof that progress can be made by reaching compromise between fisheries stakeholders through a structured and well-informed dialogue. A similar approach would certainly seem the way forward for sustainable Wadden Sea fisheries at a trilateral level. For this to even have a chance of success, however, a first step would be to create a level playing field – particularly how fisheries are regarded by the respective nations in relation to the Habitats and Birds Directives – in particular, this relates to the use of the appropriate assessments which has been discussed previously.

Natural vs. Artificial mussel beds

Mussel fisheries in the Wadden Sea mainly rely on the relaying of mussels fished from natural beds or – increasingly – from ASCs. During the time mussels are relaid on cultures they remain in the system and may serve at least partly similar functions as natural mussel beds. Further investigations into the role of mussel cultures in the Wadden Sea ecosystem are recommended in order to identify possible strategies for optimization.

Adaptive management for environmental change

In a recent study, van der Veer *et al* (unpublished) demonstrated large-scale and long-term changes in the Wadden Sea ecosystem with significant changes in fish community dynamics and declines in mean individual fish weight, total biomass, mean trophic level as well as in the number of resident species. Of particular concern was the decline or disappearance of some cold-water species and their replacement by warmer water fish such as bass (*Dicentrarchus labrax)* and golden grey mullet (*Liza aurata*). These changes in fish community composition and distribution shifts could be due to a number of factors, including declining nutrient inputs with reduced primary productivity, commercial fishing and finally an increasing trend in water temperature. The authors noted an increase in mean annual seawater temperature in the Wadden Sea from 9 – 10 °C in the 1960s to 11 – 12 °C in the last decade, coupled with the reported "regime shift" in North Sea plankton and an abrupt change in the fauna of the Bristol Channel, England and the plankton of the North Atlantic. The study's findings point to large-scale changes in ecosystem structure and function, involving a large number of marine organisms and with potential far-reaching consequences for Wadden Sea fisheries.

Natura 2000 provides a static basis for management – key species and habitats are designated at the start of the process and the objective of the protected area is to maintain these at 'favourable status' even though the ecosystem may be in a state of flux. One

means of addressing this issue would be a process of 'adaptive management' where the baseline situation is constantly assessed. Philosophically, the idea of adaptive management can be regarded as a dangerous manifestation of the 'shifting baselines' syndrome, where we internalise and accept gradual environmental degradation over time. This is true in a sense, but since climate change is a global problem, which fisheries and protected areas have to manage at a local level, adaptive management is probably the only realistic way to maintain a management system (for fisheries or protected areas) that is appropriate to the situation on the ground.

This type of adaptive management is not straightforward. It starts with a detailed understanding of how the ecosystem functions, and how the ecosystem is changing over time. One place to start would be to build further on the existing monitoring framework that is being developed through TMAP and enable the systematic monitoring and analysis of appropriately selected indicators for environmental change and ecosystem processes. The use of appropriate assessments (or equivalent) would also be a valuable tool in this. The TMAP framework would be an ideal platform to bring together this data resource in one place, and enable its analysis so that questions on the impacts of environmental change in the Wadden Sea can be answered and shared with relevant stakeholders, including the fisheries sector, and the various jurisdictions can be supported in working towards adaptive management.

4. TASK 3

The objective of task 3 is to provide recommendations for a process in which shared principles for sustainable fisheries in the Wadden Sea can be elaborated jointly with stakeholders.

The recommendation provided below was set out at a workshop held in January 2012 in Hamburg between MEP, IFM and BioConsult SH. The recommendations presented here reflect the team's views on how the recommendations for principles for sustainable fisheries given in Task 2 can be taken forward in a consultative process to involve all Wadden Sea stakeholders, including nature conservationists, governments and the fisheries sector.

STATE THE PROBLEM

People have fished in the Wadden Sea for many decades and through time, fisheries have changed significantly with respect to technical developments, regulations, economical constraints and consumer demand. In parallel with these changes, the role of the Wadden Sea from a socio-economic perspective has changed. The area is now not only regarded as a source for resource exploitation but serves multiple functions amongst which nature conservation plays a central role. Today all economical activities which take place in the Wadden Sea have to adhere to a series of conditions which limit their impacts on the achievement of pre-defined conservation targets.

In the light of changing fisheries practices with today's abilities to detect and fish any resource with high efficiency and the changing function of the Wadden Sea there can be no doubt that regulation of the fisheries is needed in order to assure both future yields of the fisheries and to maintain ecological functions of the area. It is the understanding of the team that this is common sense amongst all interest groups of the Wadden Sea. Still, there have been intense disputes on which kinds of regulations to apply and who has the legal authority to regulate. While some conflicts are somehow natural and hard to avoid as they represent competition for a limited resource, others are the result of insufficient communication between interest groups, lack of knowledge and inconsistent decision-making processes between countries and regions. Some sources of conflict are listed below:

- **Competition for limited and decreasing resources**. In the light of decreasing mussel stocks, any food reservation policy further restricts the yields of the fisheries. To reduce conflicts, this needs a transparent decision-making process.
- **Different perceptions of the problem**. Fisheries and nature conservation do not always have the same problems. While stock overfishing in mussels may not affect future recruitment and thus not affect future yields of the fisheries, it would directly affect bird populations.

- **Need to adapt to a changing world**. Both fisheries and nature conservation have to respond to changing conditions, but not necessarily in the same way. There are some adaptations, such as the development of seed collectors which may also have some benefits for nature conservation, but others, such as the translocation of mussels, may cause new problems (through the introduction of invasive species, diseases etc.)

- **Knowledge gaps**. EU environmental law demands fisheries to prove that no significant impacts on Natura 2000 conservation targets will be caused. While nature conservation will in the case of knowledge gaps always demand restrictions in order to be precautionary, fisheries will claim their right to fish if a problem has not been proven.

- **Different approaches in different regions**. While the mussel fishery has been banned completely in Denmark, it continues on different levels in the rest of the area. Appropriate Assessments, though based on the same EU directive, are until now very different between Wadden Sea regions and there is no common approach for assessment and decision making.

- **Unclear decision processes**. There is not only a conflict between the fishing industry and the governmental authorities. It is very common that fisheries authorities have different views on Wadden Sea fishing as compared to the nature conservation authorities which may further enhance interest groups to keep contact at first to 'their' authority.

For the Wadden Sea region there seems to be a lack of an institution which could facilitate a discussion between interest groups which could solve or at least mediate such conflicts.

The Common Wadden Sea Secretariat (CWSS) is an administrative body with the primary tasks of supporting, initiating, facilitating and coordinating the activities of the collaboration for Wadden Sea protection, management and monitoring including progress in the implementation of the decisions of the ministerial conferences.

The Wadden Sea Plan (WSP-2010) is a framework for the integrated management of the Wadden Sea Area and sets out a series of Targets, as well as policies, measures, projects and actions to achieve these Targets, to be implemented by the Wadden Sea countries. The Plan is a political agreement (it is a legally non-binding document of common political interest) to be implemented by the competent authorities of the three countries in cooperation, and individually, on the basis of existing legislation and through the participation of interest groups (CWSS, 2010).

Various aspects of the existing framework create problems, including: i) the different interests at play in management of the Wadden Sea between conservation and resource use, ii) the fact that the WSP-2010 is stating political intentions, but is not legally binding for the countries sharing the Wadden Sea, and iii) the participation of interest groups. Collaboration between fisheries industry interests on the one hand and nature conservation interests has not always been harmonious.

The primary objective of the trilateral Wadden Sea Cooperation is "to achieve, as far as possible, a natural and sustainable ecosystem in which natural processes proceed in an undisturbed way.", thus focusing first of all on nature conservation, if possible in co-existence with sustainable human use. In the absence of a legally binding plan Wadden Sea stakeholders have been working in a complex political landscape lobbying for their respective interests. This has resulted in a situation where plans have been implemented differently due to political and administrative differences between the involved countries and regions. The present situation requires solutions as the Wadden Sea countries are faced with mounting pressure for increased management of the environment, combined with a need to provide for an economically viable environment in which a healthy fishing industry can be sustained. Compromises are needed between all parties involved to ensure sustainable utilisation/exploitation of Wadden Sea fisheries resources and any attempt to go beyond legal requirements will clearly need stakeholder dialogue.

One of the current institutional structures at trilateral level is the Wadden Sea Forum, which is an independent platform of Dutch, German and Danish stakeholder organisations in the Wadden Sea Region, established in 2002 following a decision by the 9th Governmental Conference of the Trilateral Wadden Sea Cooperation (WSF, 2010). The remit of the WSF is to enable sustainable development in the Wadden Sea Region by promoting integration of specific cross-sectoral and transboundary strategies, actions and techniques which are environmentally sound, economically viable and socially acceptable.

The WSF has acknowledged its need to "put more value on and to further improve the forum aspect of its work, i.e. the mutual exchange of information, ideas and visions (…) Whenever possible and requested by all sectors involved, a platform for discussions and negotiations on conflict issues will be provided" (WSF, 2010).

It is clear that the WSF already provides a framework for stakeholder engagement in environmental issues in the Wadden Sea. During this study, however, the team identified a key missing element to be an effective and constructive communication link between nature conservationists and the fisheries sector (i.e. which does not involve legal action). Although the findings of the WSF are agreed with, it is recommended that a discussion and negotiation platform which is solely dedicated to Wadden Sea fisheries is established, in which CWSS plays a central, facilitating role, focussing on the implementation of legal requirements for fisheries management and the transition towards strong sustainability.

WADDEN SEA REGIONAL ADVISORY COUNCIL

The 2002 reform of the Common Fisheries Policy introduced Regional Advisory Councils to provide for a more ecosystem-based approach and enable inclusion of stakeholders in EU fisheries management as well as to encourage participation by the fisheries sector and other stakeholders in the formulation and management of the CFP. The RACs are able to submit advice, recommendations and suggestions of their own accord or at the specific request of the European Commission or a Member State concerned on EU fisheries policy. Each RAC consists of representatives of the fisheries sector, including fishers, ship-owners, producer organisations, processors, traders, market organisations, and other

interest groups, including environmental organisations, with several management units based on biological criteria. The proposals for the 2012 CFP reform are that RACs be further integrated in policy implementation.

Based on the findings of this study it is proposed that an analogy to the RAC model be adopted by CWSS for the purposes of facilitating the process in which shared principles for sustainable fisheries in the Wadden Sea can be elaborated jointly with stakeholders and broad support for these principles can be facilitated. The main task for the WS RAC could therefore be to provide the relevant Wadden Sea governmental institutions with advice on fisheries management in the Wadden Sea region.

By building on the existing framework of the Wadden Sea Forum, the establishment of a "WS RAC" could enable the CWSS to generate dialogue which specifically targets fisheries issues in the Wadden Sea, concurrently with promoting the balancing of nature conservation with fisheries interests. CWSS acting as the WS RAC secretariat could provide a forum for discussion and enabling process leading to dialogue and if required compromises between the fishing industry and conservationists. As in the general RAC model, stakeholders will be empowered to respond to scientific assessments. In this respect the first step could be to reach agreement on an adaptive indicator-based fisheries management framework, which is in turn based on scientifically sound assessments and jointly agreed strong sustainability indicators. Another experience from RACs is that although it is impossible to completely avoid differences in opinion, RACs have generally improved the trust between fisheries stakeholders and reduced tension between the parties, creating an atmosphere for compromise.

The team acknowledges that to a degree similar efforts have been made through the Wadden Sea Forum but that these have not yet been successful. We recommend therefore that a dedicated and targeted approach to addressing fisheries-related issues be adopted and that this is realised by following an RAC approach which is adapted to the Wadden Sea situation. At this stage, it would be premature to recommend which organisations should be represented on the "WS RAC". However, representation should balance nature conservations interest with fisheries interests and allow for participation from the nature protection and fisheries management authorities in all Wadden Sea regions.

RECOMMENDATIONS FOR IMPLEMENTATION OF THE WS RAC

The team's recommendations for the implementation of the WS RAC are generally in line with the EC Council Decision 2004/585/EC of 19 July 2004 on the establishment of Regional Advisory Councils under the Common Fisheries Policy. Note, however, that the team does not recommend the establishment of a RAC *sensu strictu* but rather to use its structure and functioning as a blueprint for the WS RAC.

Structure

We propose that the WS RAC has a three-level structure, composed of the General Assembly, the Executive Committee and the WS RAC Secretariat (Figure 21).

- The General Assembly is composed of selected representatives from local and national governments, the fishing industry and the environmental sector. The General Assembly meets at least once a year to approve the annual report and the overall strategy of the WS RAC and to oversee the work of the Executive Committee.
- The Executive Committee is appointed by the General Assembly and has the political, professional and scientific capacity to adopt the Council's recommendations and present these to the Wadden Sea administrations, facilitated by the WS RAC Secretariat.
- It is proposed that the CWSS assumes the role of the WS RAC Secretariat and provides the appropriate support, including administration, logistics and dissemination of information, to facilitate the functioning of the Council.
- Within the RACs appointed by the European Commission, two thirds of the seats of the General Assembly and the Executive Committee are allotted to the fisheries sector and one third to other interest groups. However, in the case of the WS RAC, this type of representation seems both unbalanced and inappropriate. The therefore team recommends that the composition of both the General Assembly and the Executive Committee is at the discretion of CWSS and selected stakeholders. For example we would recommend that representatives from scientific institutions such as AWI, NIOZ, IMARES and DTU aqua should also participate as key members of the RAC, in addition to those representatives from the governmental, NGO and fishing sector.
- The work of the Executive Committee can be reinforced by a number of Working Groups, which consider particular subjects of interest to the RAC from the more practical perspective and make recommendations on possible courses of action to the Executive Committee. The Working Groups allow a wider range of people to become involved in the RAC, including scientists, fishermen, environmental specialists, economists and others. Here also, we feel that the decision on whether or not to develop Working Groups should be at the discretion of the CWSS.
- Observers could attend the meetings of the Executive Committee and they may include representatives from any of the relevant stakeholder groups.
- It is recommended that both the meetings of the general assembly and the meetings of the executive committee are open to the public unless, in exceptional cases, decided otherwise by a majority of the executive committee.
- To maintain equality, it is proposed that the General Assembly meetings would rotate between the five identified Wadden Sea regions.

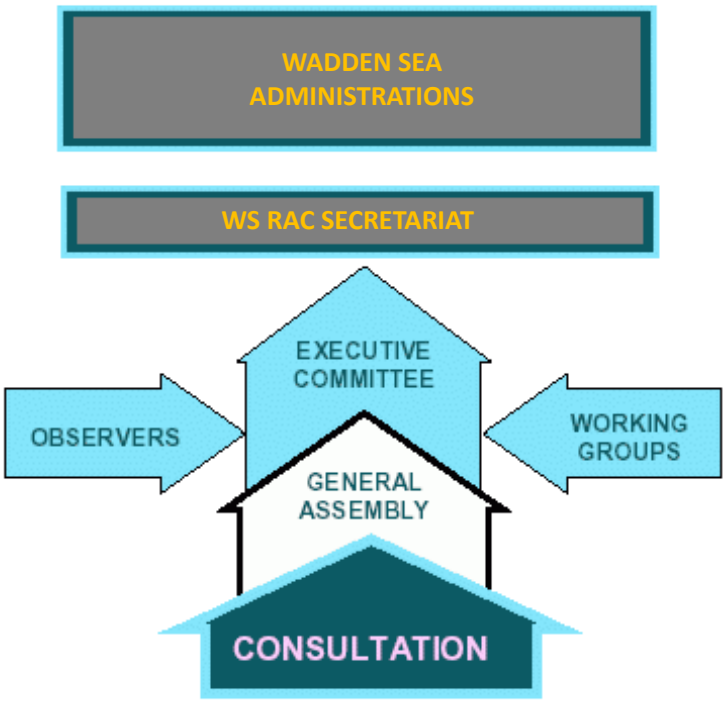

Figure 21. Proposed structure for Wadden Sea Regional Advisory Council. Adopted from North Sea RAC.

Functioning

The functioning of the WS RAC will be dependent on the requirement for transparency in all stages of the decision-making process. Transparency means openness, and full and free availability of information, decisions, and plans. Recommendations adopted by the executive committee should be made available immediately to the general assembly, and, upon request, to any member of the public.

The members of the executive committee should, where possible, adopt recommendations by consensus. If no consensus can be reached, measures should be in place which enable a consensus by majority to be reached while acknowledging any dissenting opinions expressed by members.

Concurrent with this process would be the continued development of political will at a high level to provide the impetus needed to carry through contentious issues. On both the industry and conservation sides, political lobbying has become the norm. It is thus essential that the council process be transparent and does not favour an outcome beyond that required by the legislative situation. It is also important that the necessity of reaching consensus is clear to those engaged in the process and those with political power. The theory is that arguments against the council and against the principles of what the council seeks to achieve are seen to be not acting in the favour of the majority of stakeholders.

Steps for implementation

1. **Preparatory phase**. This is a task to be undertaken by the CWSS in cooperation with selected stakeholders and involves:

(a) Identifying existing political will and obtaining high-level political support

(b) Defining the remit of the WS RAC by drafting a statement of objectives;

(c) Defining the operating principles and structure;

(d) Setting the initial rules of procedure;

(e) Estimating and providing for the annual budget required for the functioning of the RAC;

(f) Drafting a provisional list of stakeholder organisations or actors to be invited to the General Assembly (this may include but not be limited to local and national governments, the fishing industry and the environmental sector)

2. **Initial consultation**. Develop a consultative document that defines the legislative situation, a synopsis of the current ecological and socio-economic situation and a date for the first meeting of the council. Distribute to stakeholders.

3. **1st General Assembly meeting (within 6 months of initial consultation)**. Present the current understanding at the first meeting of the council and set out a timetable for subsequent workshops, consensus-building and action plans

4. **Workshops**. Hold workshops for identified stakeholder groups using professional mediators where required at which the stakeholder group position on the current state of affairs in Wadden Sea fisheries and objectives for Wadden Sea fisheries management is agreed and documented. These workshops are the ideal platform to open up the dialogue on sustainable Wadden Sea fisheries within the context of nature protection. This could include a discussion on the strong sustainability concept and its implications for Wadden Sea fisheries. Stakeholders would be asked i) what they seek to achieve from the fishery, ii) how to determine when these objectives have been achieved and iii) to agree on the control measures and systems that can bring about the desired changes.

Spokespersons are selected for each stakeholder group in order to present the group's position at the 2nd General Assembly meeting.

5. **2nd General Assembly meeting (6 months after 1st GAM).** Discuss and reach consensus on the state of affairs of Wadden Sea fisheries and objectives, including sustainability, for Wadden Sea fisheries management. Procedure is started for the appointment of the Executive Committee.

6. **Appointment of the Executive Committee**.

7. **Drafting of the 1st Annual Strategy** for Wadden Sea fisheries by Executive Committee members and dissemination to General Assembly members. The 1st Annual Strategy outlines the fisheries management objectives agreed at the 2nd GAM and puts forward for discussion the various options available to reach those objectives.

8. 3rd General Assembly meeting (**6 months after 2nd GAM**). Approval of the 1st Annual Strategy and consensus on recommendations to be put forward in the 1st Annual Report.

9. Adoption of the recommendations in the **1st Annual Report** by the Executive Committee. Recommendations are presented to the Wadden Sea Administrations by the Executive Committee, facilititated by the WS RAC Secretariat

10. General Assembly meetings are then held annually. At each GAM, the state of Wadden Sea fisheries is reviewed and a consensus is reached on the Annual Strategy (fisheries objectives) and recommendations on how to achieve those objectives are adopted by the Executive Committee in the Annual Report.

5. REFERENCES

Arndt, O., Dirks, H. and Koch, T. 2004. The Wadden Sea region: a socio-economic analysis. Prognos. 31 pp. Available online at: http://www.safecoast.nl/editor/databank/File/WaddenSeaRegional-analysis-En.pdf (last accessed on 24/02/2012)

Asmus, H. 1987. Secondary production of an intertidal mussel bed community related to its storage and turnover compartments. Marine Ecology Progress Series. **39**: 251-266

Atkinson P.W., Clark N.A., Bell M.C., Dare P.J., Clark J.A. and Ireland P.L. 2003. Changes in commercially fished shellfish stocks and shorebird populations in the Wash, England. Biological Conservation 114: 127-141.

Ayres, R.U., van den Bergh, J.C.J.M. & Gowdy, J.M. 1998. Viewpoint: Weak versus Strong Sustainability; Tinbergen Institute Discussion Papers; Tinbergen Institute: Amsterdam, The Netherland, 1998; pp. 98-103

Beadman, H.A., 2003. Impact of mussel cultivation with special reference to the Menai Strait and Conwy Bay candidate Special Area of Conservation. CCW Contract Science Report No: 580. Countryside Council for Wales

Beadman H.A., Kaiser M.J., Galanidi M., Shucksmith R. & Willows R. 2004. Changes in species richness with stocking density of marine bivalves. Journal of Applied Ecology 41: 464-475

Bealey, B., Bleeker, A., Spranger, T., Bernotat, D., and Buchwald, E. 2009. Comparison of impact assessments in the context of Habitats Directive 6.3 – Topic 1. Background Document for the 'Nitrogen Deposition and Natura 2000: Science & practice in determining environmental impacts' Workshop at the Bedford Hotel and Conference Centre, Brussels, 18th - 20th May, 2009. 20 pp.

Berghahn, R. and Purps, M. (1998) Impact of discard mortality in Crangon fisheries on yearclass strength of North Sea flatfish species. Journal of Sea Research 40, 83-91

Berghahn, R., Waltemath, M. & Rijnsdorp, A. D. (1992) Mortality of fish from the by-catch of shrimp vessels in the North Sea. J. Appl. Ichthyol.8, 293-306.

Buschbaum, C. 2001. Siedlungsmuster und Wechselbeziehungen von Seepocken (Cirrepedia) auf Muschelbänken (*Mytilus edulis* L.) im Wattenmeer. PhD thesis, University of Hamburg, Germany.

By- og Landskabsstyrelsen. 2009: Forslag til Natura 2000-plan 2009-2015, Vadehavet, Natura 2000-område nr. 89: Delplan for: Habitatområde H78 Vadehavet med Ribe Å, Tved Å og Varde Å vest for Varde Habitatområde H86 Brede Å Habitatområde H90 Vidå med tilløb, Rudbøl Sø og Magisterkogen Fuglebeskyttelsesområde F57 Vadehavet. URL:

http://www2.blst.dk/publikationer/naturplanforslag/89_VadehavNatur.pdf. Last accessed December 2011.

Caldow RWG, Beadman HA, McGrorty S, Kaiser MJ, Goss-Custard JD. Mould K and Wilson A 2003. Effects of intertidal mussel cultivation on bird assemblages. *Marine Ecology Progress Series* 259, 173-183.

Caldow R.W.G., Beadman H.A., McGrorty S., Stillman R.A., Goss-Custard J.D., Durell Le V. S.E.A., West A.D., Kaiser M.J., Mould K. & Wilson, A. 2004. A behaviour based modeling approach to reducing shorebird-shellfish conflicts. *Ecological Applications* 14: 1411-1427.

Caldow, R.W.G., Stillman, R.A. and West, A.D. 2007. Modelling study to determine the capacity of The Wash shellfish stocks to support eider *Somateria mollissima. English Nature Research Reports*. Available online at: http://nora.nerc.ac.uk/1589/2/CaldowNEReportPlusApps.pdf

Camphuysen, C. J, Berrevoets, C. M, Cremers, H. J. W. M, Dekinga, A., Dekker, R., Ens, B. J., van der Have, T. M., Kats, R. K. H., Kuiken T., Leopold M. F., van der Meer J., and Piersma, T. 2002. Mass mortality of common eiders (*Somateria mollissima*) in the Dutch Wadden Sea, winter 1999/2000: starvation in a commercially exploited wetland of international importance. Biological Conservation. 106: 303 – 317.

Camphuysen, C. J., Ens, B. J., Heg, D., Hulscher, J. B., VanderMeer, J. and Smit C. J. 1996. Oystercatcher *Haematopus ostralegus* winter mortality in The Netherlands: The effect of severe weather and food supply. *Ardea*, 84a, 469-492.

Campos, J. and Van Der Veer, H. W. 2008. Autecology of *Crangon crangon* (L.) with an emphasis on latitudinal trends. *Oceanography and Marine Biology: An Annual Review*. 46: 65 – 104.

CBS. 2011. CBS, PBL, Wageningen UR (2011). Kokkels in Waddenzee en Zeeuwse Delta, 1990-2010 (indicator 1239, versie 04, 11 januari 2011). www.compendiumvoordeleefomgeving.nl. CBS, Den Haag; Planbureau voor de Leefomgeving, Den Haag/Bilthoven en Wageningen UR, Wageningen.

CWSS. Common Wadden Sea Secretariat, NATURA2000 and Wadden Sea Management, http://www.waddensea-secretariat.org/management/natura2000.html. Accessed November 2011

CWSS. 2010. Wadden Sea Plan 2010. Eleventh Trilateral Governmental Conference on the Protection of the Wadden Sea. Common Wadden Sea Secretariat, Wilhelmshaven, Germany.

CWW. 2007. Wadden Sea Secretariat, HD sites, habitats and species (version 1.0), updated January 11, 2007, http://www.waddensea-secretariat.org/management/natura2000.html. Accessed November 2011

Daly, H. E. 2005. Economics in a full world. Scientific American, Sept. 2005. Vol. 293 (3). 10pp

Dankers, N. and Zuidema, D. R. 1995. The role of the mussel (*Mytilus edulis* L.) and mussel culture in the Dutch Wadden Sea. Estuaries **18**: 71-80

Davis, S. E. B., Howell, T. R. W., Brown, N., Drewery, J., Weetman, A. and Campbell, R. J. 2006. Survey of Solway Cockle Grounds 2006. Fisheries Research Services Internal Report No 13/08. © Crown Copyright 2008

De Mesel, I., Kamermans, P., Wiersinga, W., Jongbloed, R., Tulp, I. and Smit, C. 2009. Passende beoordeling MZIs op percelen. IMARES Wageningen UR. Rapport C129.09. 41 pp.

Dolmer, P., Kristensen, T., Christiansen, M.L., Kristenesen, P.S. & Hoffmann, E., 1999. Short-term impact of blue mussel dredging (*mytilus edulis* L.) on a benthic community. *Journal of shellfish Research*, **18,** 714.

Döring, R. and Muraca, B. 2010. Sustainability science - the Greifswalder theory of strong sustainability and its relevance for policy advice in Germany and the EU. In: Economics of fish resources and aquatic ecosystems: balancing uses, balancing costs : IIFET 2010, Montpellier, 13-16 July 2010

Dyekjaer, S.M., Jensen, J.K. & Hoffman, E., 1995. *Mussel dredging and effects on the marine environment*. ICES C.M. 1995/E:13 ref.K.

EA. 2010. Fisheries and the Water Framework Directive. What does the Water Framework Directive mean for the fisheries industry, and recreational fisheries? Environment Agency publication. Available online at http://www.environment-agency.gov.uk/static/documents/Research/Fisheries_WFD_150410.pdf (Last accessed 04/03/2012).

EC. 2011. Directorate General for Internal Policies. Policy department B: structural and cohesion policies. Fisheries. The North Sea brown shrimp fisheries. Aviat, D. and Diamantis, C. (Eds.). Report reference: IP/B/PECH/IC/2010_102. Available online at: http://www.europarl.europa.eu/studies (Last accessed 1/12/2011).

EEA Hamburgisches. 2010. Factsheet filled with data from Natura 2000 data set. URL: http://eunis.eea.europa.eu/sites/DE2016301. Last updated May 2010. Last accessed May 2012

EEA Hamburgisches (b). 2010. Factsheet filled with data from Natura 2000 data set. URL: http://eunis.eea.europa.eu/sites/DE2016401. Last updated May 2010. Last accessed May 2012

EEA Helgo. 2009. Factsheet filled with data from Natura 2000 data set. URL: http://eunis.eea.europa.eu/sites/DE1813391. Last accessed January 2012

EEA Noordzeekustzone (a). 2004. Factsheet filled with data from Natura 2000 data set. URL: http://eunis.eea.europa.eu/sites/NL2003062, updated February 2004. Last accessed May 2012

EEA Noordzeekustzone (b). 2007. Factsheet filled with data from Natura 2000 data set. URL: http://eunis.eea.europa.eu/sites/NL2003062, updated July 2007. Last accessed May 2012

EEA Niedersächsisches. 2008. Factsheet filled with data from Natura 2000 data set. URL: http://eunis.eea.europa.eu/sites/DE2306301. Last updated March 2008. Last accessed May 2012

EEA Niedersächsisches. 2010. Factsheet filled with data from Natura 2000 data set. URL: http://eunis.eea.europa.eu/sites/DE2210401/general. Last updated March 2010. Last accessed May 2012

EEA Ramsar Wattenmeer. 2009. Factsheet filled with data from Natura 2000 data set. URL: http://eunis.eea.europa.eu/sites/DE0916491. Last updated March 2009 Last accessed May 2012

EEA Stein. 2006. Factsheet filled with data from Natura 2000 data set. URL: http://eunis.eea.europa.eu/sites/DE1714391. Last accessed January 2012

EEA Seevo. 2009. Factsheet filled with data from Natura 2000 data set. URL: http://eunis.eea.europa.eu/sites/DE1813491. Last accessed January 2012

EEA. Vadehavet. 2009. Factsheet filled with data from Natura 2000 data set. URL: http://eunis.eea.europa.eu/sites/DK00AY176, Last updated August 2009. Last accessed May 2012

EEA Vadehavet (b). 2009. Factsheet filled with data from Natura 2000 data set. URL: http://eunis.eea.europa.eu/sites/DK00AY057, last updated August 2009. Last accessed May 2012

EEA Waddenzee (a). 2004. Factsheet filled with data from Natura 2000 data set. URL: http://eunis.eea.europa.eu/sites/NL1000001, last updated February 2004. Last accessed May 2012

Ok EEA Waddenzee (b). 2007. Factsheet filled with data from Natura 2000 data set. URL: http://eunis.eea.europa.eu/sites/NL9801001, last updated July 2007. Last accessed May 2012

EEA Wattenmeer. 2009. Factsheet filled with data from Natura 2000 data set. URL: http://eunis.eea.europa.eu/sites/DE0916391. Last updated: March 2009. Last accessed May 2012

Enemark, J. 1998. Wetlands-related legislation and institutions in the Wadden Sea countries. Case Study prepared for the Technical Consultation on Designing

Methodologies to Review Laws and Institutions Relevant to Wetlands. Gland, Switzerland.

Ens, B.J.; Craeymeersch, J.A.M.; Fey, F.E.; Smaal, A.C.; Brinkman, A.G.; Dekker, R.; van der Meer, J.W. and van Stralen, M.R. 2007. Sublitorale natuurwaarden in de Waddenzee: een overzicht van bestaande kennis en een beschrijving van een onderzoekopzet voor een studie naar het effect van mosselzaadvisserij en mosselkweek op sublitorale natuurwaarden. Rapport / IMARES C077/07.

Ens, B.J., A.C. Smaal & J. de Vlas, 2004. The effects of shellfish fishery on the ecosystems of the Dutch Wadden Sea and Oosterschelde; Final report on the second phase of the scientific evaluation of the Dutch shellfishfishery policy (EVA II). Wageningen, Alterra, Alterra-rapport 1011, RIVO-rapport C056/04, RIKZ-rapport RKZ/2004.031, 212 blz. 100 figs.; 10 tables.; 242 refs.

Garmendia, E., Prellezo, R., Murillas, A., Escapa, M. & Gallastegui, M. 2010. Weak and strong sustainability assessment in fisheries. Ecological Economics 70 (2010) 96-106.

Gascoigne JC, Beadman HA, Saurel C and Kaiser MJ 2005. Density dependence, spatial scale and patterning in sessile biota. Oecologia 145, 371-381.

Gebiet 0916-391. 2011: Detailinformationen für Gebiet 0916-391, Ministerium für Landwirtschaft, Umwelt und ländliche Räume SH: Agrar- und Umweltbericht, http://www.umweltdaten.landsh.de/public/natura/daten/detail.php?&smodus=short&g_nr=0916-391. Last updated: 13.08.11. Laccessed May 2012.

Gebiet 0916-491. 2009: Detailinformationen für Gebiet 0916-491, Ministerium für Landwirtschaft, Umwelt und ländliche Räume SH: Agrar- und Umweltbericht, http://www.umweltdaten.landsh.de/public/natura/daten/detail.php?&smodus=short&g_nr=0916-491. Last updated 12.03.09. Last accessed May 2012

Hickin, V. 2008. Fisheries and Nature Conservation Issues of the Cockle Fishery in the Welsh District of the North Western and North Wales Sea Fisheries Committee. Final Report. North Western & North Wales Sea Fisheries Committee. 36 pp.

Hiddink, J.G. 2003. Effects of suction-dredging for cockles on non-target fauna in the Wadden Sea. J. Sea Res., 50: 315-323

ICES. International Council for the Exploration of the Sea. 2011. ICES Latest Advice. Available at: http://www.ices.dk/advice/icesadvice.asp. (Last visited: 04/12/2011).

Innes, J., and Pascoe, S. 2007. Impact on the profitability of the commercial UK Crangon fishery. CEMARE Res. pap. no.162. Kelle, W. (1976) Sterblichkeit untermaßiger Plattfische im Beifang der Garnelenfischerei. Meeresforsch. 25, 77-89

Jager, Z., Bolle, L., Danhardt, A., Diederichs, B., Neudecker, T., Scholle, J., and Vorberg, R. 2009. Fish. Thematic Report No. 14. In: Marencic, H. & Vlas, J. de (Eds.), 2009. Quality Status Report 2009. WaddenSea Ecosystem No. 25. Common Wadden Sea Secretariat, Trilateral Monitoring and Assessment Group, Wilhelmshaven, Germany.

JMBB. 2010. *Trends in breeding birds in the Wadden Sea 1991-2008*. www.waddensea-secretariat.org, Wilhelmshaven, Germany. URL: http://www.waddensea-secretariat.org/TMAP/Breeding%20Birds/BREB_trends/overviews/2010/trends_until_2008.htm. Last updated: July 6th, 2011. Document accessed: June 2nd, 2012

JMMB. 2010b. *Trends of migratory and wintering waterbirds in the Wadden Sea 1987/88-2008/09*. www.waddensea-secretariat.org, Wilhelmshaven Germany. URL: http://www.waddensea-secretariat.org/TMAP/Migratory_birds.html. Last updated: May 26th, 2011. Document accessed: June 2nd, 2012

Keus, B. and Jager, Z. 2008. Passende beoordeling garnalenvisserij op grond van de Natuurbeschermingswet 1998. 68 pp.

Laursen, K., Blew, J., Eskildsen, K., Gunther, K., Halterlein, B., Kleefstra, R., Luersen, G., Potel, P., Schrader, S. 2010a. Migratory Waterbirds in the Wadden Sea 1987- 2008. Wadden Sea Ecosystem No.30. Common Wadden Sea Secretariat, Joint Monitoring Group of Migratory Birds in the Wadden Sea, Wilhelmshaven, Germany.

Laursen, K., Kristensen, P. S. and Clausen, P . 2010b. Assessment of Blue Mussel *Mytilus edulis* Fisheries and Waterbird Shellfish-predator Management in the Danish Wadden Sea. Ambio. 39: 476 – 485.

Marencic. H. (Ed.), 2009. The Wadden Sea - Introduction. Thematic Report No. 1. In: Marencic, H. & Vlas, J. de (Eds), 2009. Quality Status Report 2009. Wadden Sea Ecosystem No. 25. Common Wadden Sea Secretariat, Trilateral Monitoring and Assessment Group, Wilhelmshaven, Germany.

MEP. 2010. Marine Stewardship Council – Public Certification Report Northern Menai Strait Mussel (*Mytilus edulis*) fishery. 136 pp.

Millat, G. 2010. Gesamtbestandserfassung der eulitoralen Miesmuschelbänke bis 2009 im Rahmen des Monitorings zum Miesmuschelbewirtschaftungsplan. Nationalparkverwaltung niedersächsiches Wattenmeer, Wilhelmshaven.

Nature Agency (*Naturstyrelsen*) 2011: Natura 2000-plan 2010-2015, Natura 2000-område nr. 89 Vadehavet. Delplan for: Habitatområde H78,H86 og H90 Fuglebeskyttelsesområde F57 . URL: http://www.naturstyrelsen.dk/NR/rdonlyres/05F96696-5E04-4367-BE04-394F69220214/0/089Plan.pdf. Last accessed June 2012.

Nehls, G., Büttger, H. and Ruth, M. 2011. Miesmuschelmonitoring und Miesmuschelmanagement im Nationalpark „Schleswig-Holsteinisches Wattenmeer“. Gutachten im Auftrag des im Auftrag des Landesbetrieb für Küstenschutz, Nationalpark und Meeresschutz, Schleswig-Holstein, und des Landesamt für Landwirtschaft, Umwelt und ländliche Räume als obere Fischereibehörde.

Nehls, G. and Ruth, M. 1994. Eiders, mussels and fisheries – continuous conflicts or relaxed relations? Ophelia, Suppl. 6: 263-278.

Nehls, G. and Thiel, M. 1993. Large-scale distribution patterns of the mussel *Mytilus edulis* in the Wadden Sea of Schleswig-Holstein: do storms structure the ecosystem? Neth J Sea Res **31**:181–187.

Nehls, G, Witte, S., Buttger, H., Dankers, N., Jansen, J., Millat, G., Herlyn, M., Markert, A., Kristensen, P. S., Ruth, M., Buschbaum, C. and Wehrmann, A. 2009a. Beds of blue mussels and Pacific oysters. Thematic Report No. 11. In: Marencic, H. & Vlas, J. de (Eds.), 2009. Quality Status Report 2009. WaddenSea Ecosystem No. 25. Common Wadden Sea Secretariat, Trilateral Monitoring and Assessment Group, Wilhelmshaven, Germany.

Nehls, G, Witte, S., Dankers, N., de Vlas, J., Quirijns, F. and Kristensen, P. S. 2009b. Fishery. Thematic Report No. 3.3. In: Marencic, H. & Vlas, J. de (Eds), 2009. Quality Status Report 2009. Wadden Sea Ecosystem No. 25. Common Wadden Sea Secretariat, Trilateral Monitoring and Assessment Group, Wilhelmshaven, Germany.

Nehring, S. (2011): NOBANIS – Invasive Alien Species Fact Sheet – *Crassostrea gigas*. – From: Online Database of the European Network on Invasive Alien Species - NOBANIS www.nobanis.org, Date of access 08/12/2011.

Nehring, S., Reise, K., Dankers, N. and Kristensen, P.S. 2009. Alien species. Thematic Report No. 7. In: Marencic, H. & Vlas, J. de (Eds), 2009. Quality Status Report 2009. WaddenSea Ecosystem No. 25. Common Wadden Sea Secretariat, Trilateral Monitoring and Assessment Group, Wilhelmshaven, Germany.

Neudecker, T. (2002) Fischereilich-ökonomische Überlegungen zu Chancen und Risiken in der Garnelenfischerei - am Beispiel des Schollendiscards (Ein Thesenpapier auf der Basis von EUStudien und Langzeitreihen). Inf. Fischwirtschaft. Fischereiforsch. 49, 101-107.

Neudecker, T., Damm, U. & Purps, M. (1999). Langzeitreihenuntersuchung Fischbeifang aus Garnelenfischerei UFOPLAN-Nr. 294 25 271 Abschlußbericht. 1-223.

Niedersächsische. 2011. Niedersächsische Strategie zum Arten- und Biotopschutz. URL: http://www.nlwkn.niedersachsen.de/portal/live.php?navigation_id=8038&article_id=46103&_psmand=26. Accessed December 2011

Piersma, T., Koolhaas, A., Dekinga, A., Beukema, J.J., Dekker, R., Essink, K., 2001. Long-term indirect effects of mechanical cockle dredging on intertidal bivalve stocks in the Wadden Sea. J. Appl. Ecol. 38, 976– 990.

RCW. Regionaal College Waddengebied. 2010. Brede visie op duurzame visserij in de Waddenzee. 46pp. URL: http://www.provinciegroningen.nl/fileadmin/user_upload/Documenten/Downloads/brede_visie_op_duurzame_visserij_in_de_waddenzee3.pdf (last accessed on 23/11/2011)

Rees E.S. 1996. Environmental effects of mechanised cockle fisheries: a review of research data. A report commissioned by the Ministry of Agriculture Fisheries and Food.

Riesen, W & K. Reise, 1982. Macrobenthos of the subtidal Wadden Sea: revisited after 58 years. Helgoländer Meeresunters. 35: 409-423.

Saurel, C, Gascoigne, J. and Kaiser, MJ, 2004. The Ecology of Seed Mussel Beds: Literature Review. Report to SeaFish from School of Ocean Sciences, University of Wales Bangor Accessed from www.seafish.org/upload/file/main/Seed_mussel_review_June04.doc

Saier, B. 2002. Subtidal and intertidal mussel beds (*Mytilus edulis* L.) in the Wadden Sea: diversity differences of associated epifauna. Helgoland Marine Research, Volume 56, Issue 1, pp. 44-50.

Saier, B., Buschbaum, C. and Reise, K. 2002. Subtidal Mussel Beds in the Wadden Sea: Threatened Oases of Biodiversity. Wadden Sea Newsletter 2002 – 1

Schroeder, A., Gutow, L. and Gusky, M. 2008. Auswirkungen von Grundschleppnetzfischereien sowie von Sand- und Kiesabbauvorhaben auf die Meeresbodenstruktur und das Benthos in den Schutzgebieten der deutschen AWZ der Nordsee. FishPact. MAR 36032/15. Abschlussbericht für das Bundesamt für Naturschutz (BfN). Available online at http://www.bfn.de/habitatmare/de/downloads/berichte/Auswirkungen_von_Grundschleppnetzfischerei.pdf (last accessed 25 June 2012)

SDF DE0916391. 2010. Natura2000 – Standard Data Form. URL: http://natura2000.eea.europa.eu/Natura2000/SDFPublic.aspx?site=DE0916391. Last updated: September 2010. Last accessed May 2012

SDF DE0916491. 2009. Natura2000 – Standard Data Form. URL: http://natura2000.eea.europa.eu/Natura2000/SDFPublic.aspx?site=DE0916491. Last updated: March 2009 Last accessed May 2012

SDF DE2016301. 2011. Natura2000 – Standard Data Form. URL: http://natura2000.eea.europa.eu/Natura2000/SDFPublic.aspx?site=DE2016301. Last updated: May 2011. Last accessed May 2012

SDF DE2016401. 2010. Natura2000 – Standard Data Form. URL: http://natura2000.eea.europa.eu/Natura2000/SDFPublic.aspx?site=DE2016401. Last updated May 2010. Last accessed May 2012

SDF DE2210401. 2010. Natura2000 – Standard Data Form. URL: http://natura2000.eea.europa.eu/Natura2000/SDFPublic.aspx?site=DE2210401. Last updated: March 2010. Last accessed May 2012

SDF DE2306301. 2008. Natura2000 – Standard Data Form. URL: http://natura2000.eea.europa.eu/Natura2000/SDFPublic.aspx?site=DE2306301. Last updated March 2008. Last accessed May 2012

SDF DK00AY057. 2009. Natura2000 – Standard Data Form. URL: http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=DK00AY057, Last updated 01 August 2009. Last accessed May 2012

SDF DK00AY176. 2011. Natura2000 – Standard Data Form. URL: http://natura2000.eea.europa.eu/Natura2000/SDFPublic.aspx?site=DK00AY176#6, last updated December 2011. Last accessed May 2012

SDF Helgo. 2009. Natura2000 – Standard Data Form. URL: http://natura2000.eea.europa.eu/Natura2000/SDFPublic.aspx?site=DE1813391. Last accessed January 2012

SDF NL1000001. 2011. Natura2000 – Standard Data Form. URL: http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=NL1000001. Last updated September 2011. Last accessed May 2012

SDF NL2003062, 2004. Natura2000 – Standard Data Form. URL: http://natura2000.eea.europa.eu/Natura2000/SDFPublic.aspx?site=NL2003062. Last accessed 15/12/2011

SDF NL9801001. 2011. Natura2000 – Standard Data Form. URL: http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=NL9801001. Last updated September 2011.Last accessed May 2012

SDF NL9802001 (2011). Natura2000 – Standard Data Form. URL: http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=NL9802001. Last updated September 2011. Last accessed May 2012

SDF Seevo. 2009. Natura2000 – Standard Data Form. URL: http://natura2000.eea.europa.eu/Natura2000/SDFPublic.aspx?site=DE1813491. Last accessed January 2012

SDF Stein. 2006. Natura2000 – Standard Data Form. URL: . http://natura2000.eea.europa.eu/Natura2000/SDFPublic.aspx?site=DE1714391. Last accessed January 2012

Sewell, J. and Hiscock, K., 2005. Effects of fishing within UK European Marine Sites: guidance for nature conservation agencies. Report to the Countryside Council for Wales, English Nature and Scottish Natural Heritage from the Marine Biological Association. Plymouth: Marine Biological Association. CCW Contract FC 73-03-214A. 195 pp.

Sewell J., Pearce S., Bishop J. and Evans, J.L.. (2008). Investigations to determine the potential risk for certain non-native species to be introduced to North Wales with mussel seed dredged from wild seed beds. CCW Policy Research Report No. 06/3. pp 82

SGS. 2011. Marine Stewardship Council – Public Certification Report Dutch Blue Shell Mussel Fishery. 216 pp.

Steenbergen, J., Kraan, M., Tulp, I., Quirijns, F., van Kooten, T. and Poos, J.J. 2011. To manage or not to manage? Discussion paper on brown shrimp (*Crangon crangon*) fisheries. IMARES report available at: http://www.nsrac.org/wp-content/uploads/2011/10/management-shrimp-v111025.pdf (last visited 01/12/2011)

Simpson, A and Watling, L. 2006. An investigation of the cumulative impacts of shrimp trawling on mud-bottom fishing grounds in the Gulf of Maine: effects on habitat and macrofaunal community structure. ICES Journal of Marine Science, 63: 1616 -1630.

URL 1: Vissen binnen de grenzen van Natura2000. Afspraken over het visserijbeheer in de Noordzeekustzone en Vlakte van de Raan voor de ontwikkeling van natuur en visserij. Available at: http://www.rijksoverheid.nl/documenten-en-publicaties/convenanten/2011/12/13/vissen-binnen-de-grenzen-van-natura2000.html (Last accessed 20/01/2012).

URL 2: Press release issued by the Registrar – Inadmissibility decision Cooperatieve Producentenorganisatie van de Nederlandse kokkelvisserij U.A. v. The Netherlands. Available at: http://cmiskp.echr.coe.int/tkp197/viewhbkm.asp?sessionId=79213133&skin=hudoc-en&action=html&table=F69A27FD8FB86142BF01C1166DEA398649&key=5073&highlight= (Last accessed 01/02/2012)

URL 3. Available at: http://www.won-3.nl/visserij.htm (Last accessed 01/12/2011)

URL 4. Meerjarenafspraken voor handkokkelvisserij in de Waddenzee. Available at: http://www.rijksoverheid.nl/onderwerpen/waddenzee/nieuws/2011/06/01/meerjarenafspraken-voor-handkokkelvisserij-in-de-waddenzee.html (Last accessed: 01/12/2011)

URL 5. Perspectief garnalenvisserij. Available at: http://www.rijksoverheid.nl/documenten-en-publicaties/convenanten/2011/12/13/perspectief-garnalenvisserij.html (Last accessed: 01/02/2012)

URL 6. The Trilateral Monitoring and Assessment Program (TMAP). Available at: http://www.waddensea-secretariat.org/TMAP/About-TMAP.html (Last accessed: 01/02/2012)

Van Berkel, B.M. and Revier, J. M. 1991. Mussel fishery in the international Wadden Sea, consistent with "wise use"? Landscape and Urban Planning. **20**: 27-32.

Van der Graaf, S., Jonker, I., Herlyn, M., Kohlus, J., Fogh Vinther, H., Reise, K., de Jong, D., Dolch, T., Bruntse, G. and de Vlas, J. 2009. Seagrass. Thematic Report No. 12. In: Marencic, H. & Vlas, J. de (Eds.), 2009. Quality Status Report 2009. WaddenSea Ecosystem No. 25. Common Wadden Sea Secretariat, Trilateral Monitoring and Assessment Group, Wilhelmshaven, Germany.

Van der Hammen, T. and Poos, J. J. 2010. Investigations of a stock assessment in brown shrimp (*Crangon crangon*). Part 2: Biomass model. IMARES Report number C072/10 revised version.

Van der Veer, H. W., Dapper, R., Henderson, P. A. and Witte, J. IJ. Unpublished. The Wadden Sea in transition: the sequential loss of biomass, top predators and resident species.

Van Overzee, H., Leijzer, T., Jansen, J., Goudswaard, K., Kesteloo, J. and Quirijns, F.J. 2008. Overzicht van visserij op de Waddenzee. IMARES. Rapport C118/08.

Vorberg, R. 2000. Effects of shrimp fisheries on reefs of *Sabellaria spinulosa* (Polychaeta). – ICES Journal of Marine Science, 57: 1416–1420.

Vorberg, R., Fey, F. and Jansen, J. 2009. Mapping of subtidal habitats. Thematic Report No. 13. In: Marencic, H. & Vlas, J. de (Eds.), 2009. Quality Status Report 2009. WaddenSea Ecosystem No. 25. Common Wadden Sea Secretariat, Trilateral Monitoring and Assessment Group, Wilhelmshaven, Germany.

Walter, U. & Becker, P. H. (1997) Occurrence and consumption of seabirds scavenging on shrimp trawler discards in the Wadden Sea. ICES Journal of Marine Science 54, 684-694.

Wadden Sea Forum. 2010. "WITHOUT FRONTIERS: Achievements in cross-border, cross-sector, communication and cooperation". Report of the Wadden Sea Forum. 60 pp. Available online at: http://www.waddensea-forum.org/archive/ReportsArchive/Forum/WSF%20Final%20Report-web-screen.pdf (last visited on 06/03/2012).

Westphalen, A. 2006. Assoziierte Lebensgemeinschaften von natürlichen Muschelbänken und Muschelkulturflächen im Wattenmeer. Diplomarbeit, Institut für Zoologie, Anthropologie und Entwicklungsbiologie an der Biologischen Fakultät der Georg-August-Universität zu Göttingen.

Wijsman, J.W.M. and Smaal, A.C. 2007. Risk analysis of mussels transfer. Ijmuiden: Wageningen IMARES - Institute for Marine Resources & Ecosystem Studies, Report Number: C044/06, 2006. 105p.

WUR. Wageningen UR. 2011. URL: http://www.kennisonline.wur.nl/Eleni/WOT-05-406 (Last accessed on 18/01/2012).

Zinke, 2009. Zinke Environment Consulting, High level review of EC directives for collaboration and harmonisation. Identifying priorities for trilateral collaboration of the Wadden Sea, June 2009.

APPENDIX I

REGULARLY OCCURRING MIGRATORY BIRDS NOT LISTED IN ANNEX I OF THE EC BIRDS DIRECTIVE

The assessments of Conservation status and Populations are based on the Explanatory Notes for the Natura2000 Standard Data Forms. These can be seen in appendix IV of the present document.

WADDENZEE (NL) - NL9801001 (SPA) (from SDF NL9801001, 2011).

		Conservation status[2]
A054	*Anas acuta*	(B) Good
A056	*Anas clypeata*	(B) Good
A051	*Anas crecca*	(C) Average or reduced
A050	*Anas penelope*	(B) Good
A053	*Anas platyrhynchos*	(B) Good
A051	*Anas strepera*	(A) Excellent
A043	*Anser anser*	(A) Excellent
A039	*Anser fabalis*	(A) Excellent
A169	*Arenaria interpres*	(B) good
A062	*Aythya marila*	(C) Average or reduced
A046	*Branta bernicla*	(B) Good
A067	*Bucephala clangula*	(C) Average or reduced
A144	*Calidris alba*	(B) Good
A149	*Calidris alpina*	(B) Good
A143	*Calidris canutus*	(C) Average or reduced
A147	*Calidris ferruginea*	(B) Good
A137	*Charadrius hiaticula*	(C) Average or reduced
A130	*Haematopus ostralegus*	(C) Average or reduced
A183	*Larus fuscus*	(B) Good
A157	*Limosa limosa*	(B) Good
A070	*Mergus merganser*	(B) Good
A069	*Mergus serrator*	(B) Good
A144	*Numenius arquata*	(B) Good
A391	*Phalacrocorax carbo*	(B) Good
A141	*Pluvialis squatarola*	(B) Good
A005	*Podiceps cristatus*	(B) Good
A063	*Somateria mollissima*	(C) Average or reduced
A048	*Tadorna tadorna*	(B) Good
A161	*Tringa erythropus*	(C) Average or reduced
A164	*Tringa nebularia*	(B) Good
A162	*Tringa totanus*	(B) Good
A142	*Vanellus vanellus*	(A) Excellent

NOORDZEEKUSTZONE (NL) - NL9802001 (SPA) (from SDF NL9802001, 2011)

		Conservation status
A169	*Arenaria interpres*	(B) Good
A062	*Aythya marila*	(C) Average or reduced
A144	*Calidris alba*	(C) Average or reduced
A149	*Calidris alpina*	(C) Average or reduced
A143	*Calidris canutus*	(C) Average or reduced
A137	*Charadrius hiaticula*	(C) Average or reduced
A130	*Haematopus ostralegus*	(B) Good
A065	*Melanitta nigra*	(C) Average or reduced
A144	*Numenius arquata*	(B) Good
A391	*Phalacrocorax carbo*	(B) Good
A141	*Pluvialis squatarola*	(B) Good

A063	*Somateria mollissima*	(C) Average or reduced
A048	*Tadorna tadorna*	(B) Good

NATIONALPARK NIEDERSÄCHSISCHES (LOWER SAXONY NATIONAL PARK) (LS) - DE2210401 (SPA) (from SDF DE2210401, 2010)

		Conservation status
A295	*Acrocephalus schoenobaenus*	(B) Good
A297	*Acrocephalus scirpaceus*	(B) Good
A247	*Alauda arvensis*	(B) Good
A200	*Alca torda*	(B) Good
A054	*Anas acuta*	(A) Excellent
A056	*Anas clypeata*	(B) Good
A051	*Anas crecca*	(B) Good
A050	*Anas penelope*	(B) Good
A053	*Anas platyrhynchos*	(B) Good
A055	*Anas querquedula*	(B) Good
A051	*Anas strepera*	(B) Good
A041	*Anser albifrons*	(B) Good
A043	*Anser anser*	(B) Good
A040	*Anser brachyrhynchus*	(B) Good
A039	*Anser fabalis*	(B) Good
A028	*Ardea cinerea*	(B) Good
A169	*Arenaria interpres*	(B) Good
A059	*Aythya ferina*	(B) Good
A061	*Aythya fuligula*	(B) Good
A046	*Branta bernicla*	(B) Good
A044	*Branta canadensis*	(B) Good
A067	*Bucephala clangula*	(B) Good
A144	*Calidris alba*	(B) Good
A149	*Calidris alpina*	(B) Good
A143	*Calidris canutus*	(B) Good
A147	*Calidris ferruginea*	(B) Good
A148	*Calidris maritima*	(B) Good
A367	*Carduelis flavirostris*	(C) Average or reduced
A136	*Charadrius dubius*	(B) Good
A137	*Charadrius hiaticula*	(B) Good
A036	*Cygnus olor*	(B) Good
A248	*Eremophila alpestris*	(C) Average or reduced
A153	*Gallinago gallinago*	(B) Good
A130	*Haematopus ostralegus*	(B) Good
A184	*Larus argentatus*	(B) Good
A812	*Larus canus*	(B) Good
A183	*Larus fuscus*	(B) Good
A187	*Larus marinus*	(B) Good
A179	*Larus ridibundus*	(B) Good
A157	*Limosa limosa*	(B) Good
A271	*Luscinia megarhynchos*	(B) Good
A066	*Melanitta fusca*	(B) Good
A065	*Melanitta nigra*	(B) Good
A069	*Mergus serrator*	(B) Good
A260	*Motacilla flava*	(B) Good
A144	*Numenius arquata*	(B) Good
A158	*Numenius phaeopus*	(B) Good
1360	*Oenanthe oenanthe*	(B) Good
A391	*Phalacrocorax carbo sinensis*	(B) Good
A375	*Plectrophenax nivalis*	(C) Average or reduced
A141	*Pluvialis squatarola*	(B) Good
A005	*Podiceps cristatus*	(B) Good
A006	*Podiceps grisegena*	(B) Good
A008	*Podiceps nigricollis*	(B) Good
A188	*Rissa tridactyla*	(B) Good

A381	*Saxicola torquata*	(B) Good
A063	*Somateria mollissima*	(B) Good
A004	*Tachybaptus ruficollis*	(B) Good
A048	*Tadorna tadorna*	(B) Good
A161	*Tringa erythropus*	(B) Good
A164	*Tringa nebularia*	(B) Good
A162	*Tringa totanus*	(B) Good
A199	*Uria aalge*	(B) Good
A142	*Vanellus vanellus*	(B) Good

NATIONALPARK HAMBURGISCHES (HH) - DE2016401 (SPA) (from SDF DE2016401, 2010)

		Conservation status
A046	*Branta bernicla*	(A)Excellent
A144	*Calidris alba*	(B) Good
A149	*Calidris alpina*	(B) Good
A143	*Calidris canutus*	(A) Excellent
A137	*Charadrius hiaticula*	(A) Excellent
A130	*Haematopus ostralegus*	(A) Excellent
A144	*Numenius arquata*	(A) Excellent
A141	*Pluvialis squatarola*	(B) Good
A048	*Tadorna tadorna*	(B) Good

S-H WATTENMEER UND ANGRENZENDE KÜSTENGEBIETE (SH) - DE0916491 (SPA) (from SDF DE0916491, 2009)

		Conservation status
A295	*Acrocephalus schoenobaenus*	(A) Excellent
A247	*Alauda arvensis*	(A) Excellent
A200	*Alca torda*	(A) Excellent
A054	*Anas acuta*	(A) Excellent
A056	*Anas clypeata*	(A) Excellent
A051[(1)]	*Anas crecca*	(A) Excellent
A050	*Anas penelope*	(A) Excellent
A053	*Anas platyrhynchos*	(A) Excellent
A055	*Anas querquedula*	(A) Excellent
A257	*Anthus pratensis*	(A) Excellent
A028	*Ardea cinerea*	(A) Excellent
A169	*Arenaria interpres*	(A) Excellent
A046	*Branta bernicla*	(A) Excellent
A088	*Buteo lagopus*	(A) Excellent
A144	*Calidris alba*	(A) Excellent
A149	*Calidris alpina*	(A) Excellent
A143	*Calidris canutus*	(A) Excellent
A147	*Calidris ferruginea*	(A) Excellent
A367	*Carduelis flavirostris*	(A) Excellent
A137	*Charadrius hiaticula*	(A) Excellent
A248	*Eremophila alpestis*	(A) Excellent
A009	*Fulmarus glacialis*	(A) Excellent
A153	*Gallinago gallinago*	(A) Excellent
A130	*Haematopus ostralegus*	(A) Excellent
A184	*Larus argentatus*	(A) Excellent
A182	*Larus canus*	(A) Excellent
A183	*Larus fuscus*	(A) Excellent
A187	*Larus marinus*	(A) Excellent
A179	*Larus ridibundus*	(A) Excellent
A188[(1)]	*Larus tridactylus*	(A) Excellent
A156	*Limosa limosa*	(A) Excellent
A065	*Melanitta nigra*	(A) Excellent
A069	*Mergus serrator*	(A) Excellent
A260	*Motacilla flava*	(A) Excellent

A144[(1)]	*Numenius arquata*	(A) Excellent
A158	*Numenius phaeopus*	(A) Excellent
A171[(1)]	*Oenanthe oenanthe*	(A) Excellent
A323	*Panurus biarmicus*	(A) Excellent
A017	*Phalacrocorax carbo*	(A) Excellent
A375	*Plectrophenax nivalis*	(A) Excellent
A141	*Pluvialis squatarola*	(A) Excellent
A006	*Podiceps grisegena*	(A) Excellent
A008	*Podiceps nigricollis*	(A) Excellent
A276	*Saxicola rubetra*	(A) Excellent
A063	*Somateria mollissima*	(A) Excellent
A048	*Tadorna tadorna*	(A) Excellent
A161	*Tringa erythropus*	(A) Excellent
A164	*Tringa nebularia*	(A) Excellent
A162	*Tringa totanus*	(A) Excellent
A199	*Uria aalge*	(A) Excellent
A142	*Vanellus vanellus*	(A) Excellent

VADEHAVET (DK) - DK00AY057 (SPA) (from SDF DK00AY057, 2009)

		Conservation status
A054	*Anas acuta*	(A) Excellent
A056	*Anas clypeata*	(C) Average or reduced
A051	*Anas crecca*	(B) Good
A050	*Anas penelope*	(A) Excellent
A051	*Anas strepera*[(1)]	-
A043	*Anser anser*	-
A040	*Anser brachyrhynchus*	-
A046	*Branta bernicla*	(B) Good
A047	*Branta bernicla hrota*	(B) Good
A144	*Calidris alba*	(A) Excellent
A149	*Calidris alpina*	(A) Excellent
A143	*Calidris canutus*	(A) Excellent
A130	*Haematopus ostralegus*	(B) Good
A065	*Melanitta nigra*	(B) Good
A070	*Mergus merganser*	-
A069	*Mergus serrator*	-
A144	*Numenius arquata*	(A) Excellent
A158	*Numenius phaeopus*	-
A017	*Phalacrocorax carbo*	-
A141	*Pluvialis squatarola*	(A) Excellent
A063	*Somateria mollissima*	(B) Good
A048	*Tadorna tadorna*	(A) Excellent
A164	*Tringa nebularia*	(B) Good
A162	*Tringa totanus*	(B) Good

APPENDIX II

CONSERVATION OBJECTIVES FOR WADDENZEE

The following tables present the status and conservation objectives for the habitats and species protected under Natura2000 in the Waddenzee and which are relevant for the current study.

Habitats

Habitat	Status	General objective for Annex I habitats	Site-specific objectives
1110 (sandbanks)	Good	Maintain surface area and improve quality	Maintain the functional connection between the subtidal channels and the tidal banks (1140); improve quality by affording better chances for development of part of the mussel banks and by restoring the size and composition of fish stocks
1130 (estuaries)	Excellent	Maintain surface area and improve quality	1130 occurs in the Eems-Dollard, which is not part of this N2000 Site. A separate, joint German-Dutch SAC & management plan will be made for it.
1140 (mudflats)	Good	Maintain surface area and improve quality	Maintain morphological variation, restore tidal mussel banks, expand seagrass beds

Fish

Species	Status	National objective	Specific objective
Twaite shad	Good	Increase population	Maintain size and quality of habitat Note: Wadden Sea is a migration route, so no habitat restoration is needed – this is a task for inland sites, notably in upper Ems (Germany), where the species probably spawns.
River lamprey	Good	Increase population	Maintain size and quality of habitat Note: Wadden Sea is a migration route, so no habitat restoration is needed – this is a task for inland sites, thus restoration of spawning grounds being done in Drentse Aa

Mammals

Species	Status	Objective
Grey seal	Excellent	Maintain size and quality of habitat (population trends are not giving grounds for concern).
Common seal	Excellent	Maintain size and quality of habitat

CONSERVATION OBJECTIVES FOR NOORDZEEKUSTZONE

Fish

Species	Status	National objective
Twaite shad	Good	Maintain size and quality of habitat in order to maintain population
Sea lamprey	Good	Maintain size and quality of habitat in order to increase population
River lamprey	Good	Maintain size and quality of habitat in order to increase population

Mammals

Species	Status	Objective
Grey seal	Excellent	Maintain size and quality of habitat in order to maintain population
Common seal	Good	Maintain size and quality of habitat in order to maintain population (?)
Harbour porpoise	Good	Maintain size and maintain quality of habitat in order to maintain population

Birds

Species	Status	Objective
Red-throated loon / diver - *Gavia stellata*	Good	Maintain size and quality of habitat
Black-throated Loon - *Gavia arctica*	Good	Maintain size and quality of habitat
Common Eider - *Somateria mollissima*	Good	Maintain size and quality of habitat with carrying capacity for a population of on average 5,400 birds (mid-winter abundance). This number applies to the Noordzeekustzone 2.
Common Scoter - *Melanitta nigra*	Good	National target: maintain size and quality of habitat with carrying capacity for a population of on average 68,500 birds (January abundance). Noordzeekustzone 2: maintain size and quality of habitat with carrying capacity for a population of on average 10,700 birds (mid-winter abundance).
Little Gull - *Larus minutus*	Good	Maintain size and quality of habitat

CONSERVATION OBJECTIVES FOR NATIONALPARK NIEDERSÄCHSISCHES (LOWER SAXONY NATIONAL PARK)

The status which is mentioned in the table below was obtained from Niedersächsische (2011)

Habitats

Habitat	Status	Conservation objectives	Measures
1110 (sandbanks)	Favourable Habiat type with currently low need for action regarding conservation and development measures	- good water quality, natural structures (sandbank, distribution of various fine and coarse substrates), natural dynamic processes and stable populations of characteristic species; - natural sub-littoral mussel beds at all stages of life and intact communities; favourable conditions for the re-establishment of benches of the European oyster, sabellaria reefs and sublittoral seagrass meadows; - low disturbance and extensive habitats for populations of harbor porpoise, gray seal, harbor seal, common seal, finte, sea lamprey and river lamprey; - low disturbance of ocean surface as eeding, resting and moulting areas for seabirds such as throated diver, common eider, scoter and sandwich tern; - nutrient and pollutant concentrations in sediment and water column are in background levels; - sandbanks protected to a sufficient extent against mechanical stresses; - benthic and pelagic communities show natural abundances and dominances; - characteristic species have a favouralbe conservation status; - the structure and functions of the sand bank are not strongly impaired by commercial and recreational fishing (for example beam trawl, trawl, gillnet, fishing); - protection against harmful substances; - speed limits as protective measures to reduce collision between ships and marine mammals	
1130 (estuaries)	Unfavourable Habitat type with priority for conservation and development measures	- reach a favourable conservation status of the habitat; - the characteristic animal and plants species of the estuaries occur in stable populations; - small changes by barrages and impairment of the natural channel for migratory fish (transverse structures can by by-passed by fish to a sufficient extent); - ensure estuaries as breeding habitat for highly endangered species of birds (terns, bitterns, black-tailed godwit, Ruff); - ensure estuaries as food habitat for species such as barnacle goose, white-fronted goose, Bewick's swan, shoveler, wigeon, Golden Plover, Ruff); - ensure estuaries as habitats for marine mammals (including common seals, porpoise, gray seal)	- protection against further negative changes to the hydromorphological, hydrodynamic and physico-chemical conditions in the estuaries; - ensure protection against further losses of flood plains and shallow water zones; - Protection of existing spawning and nursery areas of the characteristic species of fish; - attention to the patterns of migratory fish in the operation of sluices and pumping structures
1140 (mudflats)	Favourable (although future prospects considered unknown; further increase in invasive species can be expected)	- good water quality, natural structures, natural dynamic processes and stable populations of characteristic species; - natural sub-littoral mussel beds at all stages of life and intact communities; - low disturbance and extensive habitats for populations of harbor porpoise, gray seal, common seal, finte, sea lamprey and river lamprey; - no forms of fishing (commercial and recreational fishing, for example beam trawl,	

		trawl, gillnet, fishing; mussel fishery) can lead to the impairment of the Wadden soil and its flora and fauna remain unchanged; reduce entries of hazardous substances into the waters (ship paintings, ballast waters, shipwrecks)	
1160 (large shallow bays and inlets)	Currently classified as unknown; no detailed statements can be made about the development prospects Habitat type with currently low action for conservation and development measures	- conservation objectives: good water quality, natural structures, natural dynamic processes and stable populations of characteristic species; - natural sub-littoral mussel beds at all stages of life and intact communities; - favourable conditions for the reestablishment of benches of the European oyster, Sublittoral Sabellaria reefs and seagrass meadows; - low disturbance and extensive habitats for populations of harbor porpoise, gray seal, common seal, finte, sea lamprey and river lamprey; - low-disturbance of ocean surface as feeding, resting and moulting areas for seabirds such as throated diver, common eider, scoter and sandwich tern; - nutrient and pollutant concentrations in sediment and water column are in the amount of natural background levels; - the benthic and pelagic communities have natural abundances and dominances; - the characteristic species are in a favourable conservation status; the structure and functions is not strongly impaired by commercial and recreational fishing (for example beam trawl, trawl, gillnet, fishing); - a moderate displacement effects by invasive species	- protection against harmful substance entering through atmosphere, rivers or traffic; - speed limits (reduce risk of collision between ships and marine mammals)
1170 (reefs)	No assessment of the conservation status can be carried out at this point since no data on the reefs are available Habitat type with priority for conservation and development measures	- preservation and development of a stable inventory of biogenic and geogenic reefs, including various reef-building organisms; - natural sub-littoral mussel beds containing all life stages; - favourable conditions for the reestablishment of Sabellaria reefs; - the traditional communities of the reefs are largely natural or pronounced close to nature; - the characteristic animal and plant species are found in stable populations; - the structure and functions of the reefs are not strongly impaired by commercial and recreational fishing (for example beam trawl, trawl, gillnet, fishing); - commercial and recreational fishing only in the peripheral areas; - sporadic disturbance during migration, resting and moulting periods of typical seabirds; - moderate displacement effects by invasive species	- because there are no findings available to date regarding the structure and function of sub-littoral mussel beds in accordance with a specified criteria (criteria defining favourable status), no protective measures could be initiated until now, as it is practiced for the intertidal mussel beds

Fish

Species	Status	Conservation objectives	Measures
Sea Lamprey (*Petromyzon marinus*)	Abundance of sea lamprey risen steadily in recent years (measures to reduce water pollution and to improve the bank and bed structures and the continuity of rivers have led to potentially suitable spawning habitat)	- maintain and possibly restore the migratory corridors of the species and their spawning areas	- to restore longitudinal continuity and to increase the flow dynamics (by dismantling transverse structures or construction of suitable fish passes); - construction of potential spawning habitats (by building structures); - decline construction of transverse structures on penetrable sections of water bodies (i.e new hydropower plants); - encourage the use of "fish friendly" hydro power technologies; - reduction of nutrients and fine sediment inputs into the aquatic environment; - establishment of habitats in rivers (introduction of gravel banks and elements that promote the formation of river bed structures); - reduction of nutrient and fine sediment inputs into the aquatic environment;

Mammals

Species	Status	Conservation objectives	Measures
Common Seal (*Phoca vitulina*)	Trilaterally (Netherlands, Lower Saxony / Schleswig-Holstein, Denmark), the seal population in the Wadden Sea currently classified as "survivable". Studies from 2009 show a healthy stock situation, there is currently no evidence of disease	- long term, viable, in the context of natural fluctuations in stable populations; - low-disturbance habitats of sufficient size for all life stages; - possibility of unobstructed migrating and communitng movements between the habitats	- protect animals and the development of a healthy population; - protection and development of the food resources of the animals; - reduction of waste and pollutants; - minimization of disturbances at the resting locations; - protect known berths on the inhabited islands; - rules of conduct to visitors when encountering seals at the national parks
Harbor porpoise (*Phocoena phocoena*)	Porpoises can be found more frequently along the coast of Lower Saxony, as compared to a few years ago	- long term, viable, in the context of natural fluctuations in stable populations; - no decrease of the natural range; - suitable low-disturbance habitats of sufficient size for all life stages; - possibility of unobstructed migrating and commuting movements between the habitats	- protection of the habitat; - reduction of by-catch; - reduction of exposure to pollutants; - reduction of underwater noise in the whole North Sea; - protection an development of food resources; - reduction of speed limits;

Birds

Enforcement instructions were developed for 78 bird species. Five of these plans, corresponding to the following bird species, were explored:

Species	Status	Conservation objectives	Measures
Northern Shoveller / Löffelente (*Anas clypeata)*	unfavourable	- preserve and possibly restore the habitat to a favourable conservation status; - maintain and possibly restore a stable, long-term self-sustaining population and the distribution range of the species; - increase the density of breeding pairs in sparsely populated areas.	- preservation, restoration or new creation of lakes, flood channels, lagoons; - creation of flat landing areas with open water surfaces; -no recreational use in the breeding area (swimming, fishing, boating)
Eurasian Bittern / Rohrdommel (*Botaurus stellaris)*	conservation status of the breeding birds is evaluate as unfavourable; conservation status of migratory birds can not be assessed due to insufficient data	- preserve and possibly restore the habitat to a favourable conservation status; - maintain and possibly restore a stable, long-term self-sustaining population and the distribution range of the species; - protection and development of existing reserves; - recolonization of formerly populated areas; preservation and development of a diverse and adequate food source (especially fisch and amphibian fauna).	- rewetting of former wetlands; - development of waters (lakes, ponds, ditches, canals) with wide, shallow waters and landing areas; - development of water-flooded reedbeds and deep water zones (at least 1 m water depth) to promote fish stocks; - Protection of nesting sites from disturbance (driving, and swimming bans during the breeding season); - creation / promotion of an adequate and varied food supply (especially fish and amphibians) by connecting to waters with fish stocks, improving water quality; - creation of deep-water areas and possibly exposure of small fish species; protection from predators
Ruff / Kampfläufer (*Philomachus pugnax)*	unfavourable	- preserve and possibly restore the habitat to a favourable conservation status; - restore a stable, long-term self-sustaining population and the distribution range of the species; - recolonization of formerly populated areas; - Increase the breeding bird population	- preservation and restoration of large and moist grassland areas; - retention / creation of small, open, shallow water and muddy areas for spring migration, and breeding season; - Protection from predators
European Golden Plover / Goldregenpfeifer	unfavourable	- preserve and possibly restore the habitat to a favourable conservation status; - maintain and possibly restore a stable, long-term self-sustaining population and the original distribution range of the species;	- preservation and restoration of large areas of open, free woody plants; - restoration food habitats (possibly re-conversion of arable to wet grassland;

(*Pluvialis apricaria)*		- recolonization of formerly populated areas; - development of a breeding bird population; - recolonization of formerly occupied territories; - secure food habitats for the juveniles	- creation of small open water areas during the breeding season) ; - Protection from predators
Pied Avocet / Säbelschnäbler (*Recurvirostra avosetta)*	unfavourable	- maintain and possibly restore the habitat to a favourable conservation status; - maintain and possibly restore a stable, long-term self-sustaining population and the conservation of the species throughout the entire range; - maintain Sufficient food supply	- reduce the pollution of the Wadden Sea; - Maintaining or restoring natural dynamics in the salt marshes in the National Park Lower Saxony Wadden Sea; - protection and visits management in the vicinity of current and potential breeding sites; - Protection from predators

CONSERVATION OBJECTIVES FOR SCHLESWIG-HOLSTEIN

Habitat	Overarching objectives	Subregion-specific conservation objectives
1110 (sandbanks)	- Ensure a possible sequence of undisturbed natural processes - Conserve the largely natural geomorphological dynamics, - Conserve the largely natural hydrogeological and hydrochemical conditions and physical processes, - Conserve the largely natural sediment and flow conditions in the coastal area - Conserve the highest possible water quality, - Conserve largely undisturbed areas - Conserve the biotope complexes, and the habitat typical structures and functions, in particular from shallow water areas, tidal currents, tidal creeks, mudflats, sandy beaches, beach ridges, spits, drift lines, salt marshes, dunes, heaths, seagrass meadows, reefs, shoals, lagoons and estuarine habitats in their natural expression and islets	n.a
1130 (estuaries)		Preservation of - The biotope complexes and their characteristic structures and functions as mudflats, freshwater and salt marshes, drift lines - the dominant biotope hydrochemical and hydrogeological conditions and physical processes of the coastal waters of the sea, the estuary and its tributaries - the sedimentation and flow conditions and the natural dynamics in the river estuary and riparian area - the ecological interactions with the terrestrial, freshwater and marine environments
1140 (mudflats)		Preservation of - The typical habitat structures and functions of tidal flats and tidal creeks, - The natural occurrence of Quellerarten
1160 (large shallow bays and inlets)		Preservation of - the largely natural morphodynamics of the soil, the shallow water areas and riparian zones, - the largely natural hydro-physical and hydro-chemical water conditions and processes, - the biotope complexes and their characteristic structures and functions as Sandbanks and mudflats
1170 (Reefs)		Preservation of natural areas of the sea bed or shallow water zones, from mechanical (anthropogenic) damage or morphological disturbance, with hard substrates such as boulders, stones, natural mussel banks or *Sabellaria* reefs and sandbanks formed from a mix of these components

Fish

Species	General objective
Sea lamprey *(Petromyzon marinus)* Meerneunauge	Preservation of existing populations
Twaite shad / Allis shad *Allosa fallax / A. alosa*) Finte / Maifisch	Preservation of - the largely natural hydrochemical and hydro-physical conditions of the coastal waters of the sea and rivers in an area of estuaries - largely natural sedimentation and flow conditions as well as an exceptional dynamic in natural estuarine and riparian area - existing populations
River lamprey *(Lampetra fluviatilis)* Flußneunauge	Preservation of existing populations

- Mammals

Species	General objective
Grey seal (*Halichoerus grypus*) Kegelrobbe	Preservation of: - viable stocks and a natural reproduction capacity, including the survival of pups, - semi-natural marine and coastal waters with shallow water and sandy shores, - the natural marine and coastal dynamics,
Common seal (*Phoca vitulina*) Seehund	

	- the lowest possible pollution of the marine and coastal waters, - low-interference resting places, - low-interference areas with low underwater noise pollution, - a diverse fauna (fish, shrimp, mussels, crabs, etc.) as a food source
Harbour porpoise (*Phocoena phocoena)* Schweinswal	Preservation of - viable stocks and a natural reproduction capacity, including the survival of pups, - of pristine coastal waters of the North Sea, especially of productive shallow-water zones to 20 m depth, - low-interference areas with low underwater noise pollution as calving and nursery areas, - food fish stocks, particularly herring, mackerel, cod, whiting and gobies and - ensuring the lowest possible pollution of coastal waters, - avoiding collisions with ships - avoidance of forms of fishing walgefährdenden

SUBREGIONS

Sub-region	Overarching objectives for the region	Specific objectives for bird species
1	Preservation of - the site-typical birds in their natural dynamics - the largely natural geomorphological dynamics, - the habitat typical structures and functions, especially shallow water areas, tidal currents, tidal creeks, mudflats, sandy beaches, primary dunes, beach ridges, drift lines, salt marshes, dunes, meadows, lagoons and estuarine habitats in their natural expression and islets, - the ecological interactions with the terrestrial, freshwater and marine environment, - the largely natural hydro-physical and hydro-chemical water conditions and processes, - the highest possible water quality, - largely undisturbed areas	- Prevention of additional bird mortality from bycatch in fisheries - Preservation of: • suitable nesting, breeding, moulting, transit, staging, wintering areas of sufficient size to ensure natural flight distances, • largely unfragmented areas between breeding, feeding, moulting and resting places, in particular kept free of foreign high vertical structures • natural breeding success • the offshore area as an important food, moulting and resting site for sea birds such as loons and sea ducks • the possibility that the seabird and duck populations may shift according to the hydrographic conditions, the dynamics of the water body and the benthos populations, as well as the changing food supply • of natural food availability ▪ the natural occurrence of benthic organisms as food for wading and water birds ▪ naturally occurring shellfish stocks with site-appropriate accompanying fauna, including as a food source for mourning and eider duck ▪ a natural fish fauna as a food source for loons and other fish-eating species
2	Preservation of - the islets as a breeding, roosting and feeding areas for shorebirds - the typical habitat structures and functions, - the largely natural hydro-physical and hydro-chemical water condition and processes - the highest possible water quality - the largely undisturbed areas	Preservation of: - a favourable conservation status of species and habitats - of suitable nesting, roosting and feeding areas for shorebirds, - few disturbances in the area of breeding grounds and nesting colonies, especially during the settlement and in the breeding and rearing - the natural breeding success - natural food availability - of largely unfragmented areas between breeding, feeding and resting places, in particular kept free of foreign high vertical structures
3	Preservation of natural salt marshes, dunes and cliffs as breeding, roosting and feeding areas for birds	Preservation of: - a favourable conservation status of species and habitats - low disturbance of breeding, rearing, resting and feeding areas

		- the freedom from interference in the range of breeding sites and breeding colonies, especially during the establishment phase, hatching and rearing - of largely unfragmented areas between breeding, feeding and resting places, in particular kept free of foreign high vertical structures
4	Preservation of the breeding, resting and heritage items, and conservation of the function of the polders as a feeding area	Preservation of: - a favourable conservation status of species and habitats - the succession of vegetation - the largely undisturbed areas - the most natural geomorphological dynamics - the most natural hydrogeological and hydrochemical conditions and physical processes - large, contiguous open grassland areas with sufficient wet grassland in intensive agricultural use areas with reeds and tall herb communities as breeding and feeding habitat - the most natural hydro-physical and hydro-chemical water conditions and processes and the hydrological conditions in the area of waters - low noise high water roosting sites, feeding areas and moulting areas with favourable food availability
5	Preservation of - the biotope complexes and their characteristic structures and functions as mudflats, freshwater and salt marshes, beaches - the ecological interactions with the terrestrial, freshwater and marine environment - the sedimentation and flow conditions and the natural dynamics in the river estuary and riparian area - the dominant hydrochemical and hydrogeological conditions and physical processes of the coastal waters of the sea, the estuary and its tributaries - a good water quality and a near-natural river dynamics	Preservation of: - a favourable conservation status of species and habitats - the succession of vegetation - the largely undisturbed areas - the most natural geomorphological dynamics - the most natural hydrogeological and hydrochemical conditions and physical processes - as a low-disturbance areas as possible, which are free of vertical structures - large, contiguous open grassland areas with sufficient wet grassland in intensive agricultural use areas with reeds and tall herb communities as breeding and feeding habitat - undisturbed nesting areas during the settle and breed - low disturbed resting and feeding area, free of vertical structures - the most natural geomorphological dynamics

CONSERVATION OBJECTIVES IN DENMARK

The objectives relate to the conservation status presented in Nature Agency (2011)

HABITATS	
1110	- Habitats evaluated as unfavourable, due to inadequate nutrient conditions - Among the identified threats to sandbanks is the fishing with trawl (physical destruction, removal of bottom flora and enthic fauna) ; oil pollution (from accidents or oil residues from ships in the North Sea - Overall objective: reach good water quality status, as one of the prerequisites for ideal living conditions for the unique pledge and wildlife that characterize the large tidal range and its characteristic landscapes] - Concrete guideline: the development should be progressing in order to achieve favourable conservation status, as long as the natural conditions allows it; the total area of the habitat should be stable or in progress, if the nature conditions allows it.
1130	- Habitats evaluated as unfavourable, due to inadequate nutrient conditions - Among the identified threats to estuaries is the oil pollution (from accidents or oil residues from ships in the North Sea - Overall objective: High priority is given due to its endangered condition at a national bio-geographic level, and appears only in few Natura2000 areas - Concrete guideline: the condition is ensured and the characteristic, natural dynamics maintained. The development should be progressing in order to achieve favourable conservation status, as long as the natural conditions allows it; the total area of the habitat should be stable or in progress, if the nature conditions allows it
1140	- Habitats evaluated as unfavourable, due to inadequate nutrient conditions - Among the identified threats to mudflats is oil pollution (from accidents or oil residues from ships in the North Sea - Overall objective: reach good water quality status, as one of the prerequisites for ideal living conditions for the unique pledge and wildlife that characterize the large tidal range and its characteristic landscapes. A high priority given to mudflats since it makes a significant proportion of area in each of the natural habitats - Concrete guideline: the development should be progressing in order to achieve favourable conservation status, as long as the natural conditions allows it; the total area of the habitat should be stable or in progress, if the nature conditions allows it
1150	Unknown status due to unfamiliarity with the habitat
1160	- Habitats evaluated as unfavourable due to inadequate nutrient conditions - Among the identified threats to large shallow bays is the fishing with trawl (physical destruction, removal of bottom flora and enthic fauna, removal of hard bottom, rocks and shells) - Concrete guideline: The development should be progressing in order to achieve favourable conservation status, as long as the natural conditions allows it; the total area of the habitat should be stable or in progress, if the nature conditions allows it
1170	- Habitats evaluated as unfavourable due to inadequate nutrient conditions - The marine habitat area of biogenic reefs (mussel banks) continues to be affected by the reduction and fragmentation of the surface area, being the result of the intense fishing of mussels in the 1980s. It seems, however, that stocks of mussels are beginning to grow slowly again - Among the identified threats to reefs is the fishing with trawl (physical destruction, removal of bottom flora and enthic fauna, removal of hard bottom, rocks and shells), however, knowledge of the specific boundary of the biogenic reef is still limited; invasive species such as pacific oysters, where there is accelerated spread on the tidal flats, is a problem for several native species and habitats (including mussels and biogenic reef) - Concrete guideline : the condition is ensured and the characteristic, natural dynamics maintained The development should be progressing in order to achieve favourable conservation status, as long as the natural conditions allows it; the total area of the habitat should be stable or in progress, if the nature conditions allows it

FISH	
Alosa fallax	- Twaite Shad's status is written as unknown because it is unknown the species requirements for spawning, and the species'spopulation size - The biggest threats to fishes as twaite shad are the barrages of the streams, since the species cannot come up to their spawning grounds. In addition, the stowage areas for pisciculture are a threat to the natural state of the watercourses - Overall objective: - A high priority and strengthened protection for species such as twaite shad and their habitats. The species are threatened at the national biogeographic level or are scarce (occurring only in 1 to 3 conservation areas in Denmark). - Concrete guideline: - The objective is to achieve favourable conservation status which mean that the habitat's species should form the basis for a breeding population - The area and condition of designated habitat types and habitats for designated species may not go back or impaired.

	- There shall be suitable habitat for twaite shad, assessed as favourable or unknown conservation forecast; that by securing streams with good water quality, suitable living and spawning sites and free passage
Petromyzon marinus	- Sea lamprey's status is written as unknown because of the lack of knowledge about the population size - The biggest threats to fishes as sea lamprey are the barrages of the streams, since the species cannot come up to their spawning grounds. In addition, the stowage areas for pisciculture are a threat to the natural state of the watercourses - Concrete guideline: - the objective is to achieve favourable conservation status which mean that the habitat's species should form the basis for a breeding population - the area and condition of designated habitat types and habitats for designated species may not go back or impaired. - There shall be suitable habitat for the sea lamprey, assessed as unknown conservation forecast; that by securing streams with good water quality, suitable living and spawning sites and free passage
Lampetra fluviatilis	- River lamprey status is written as unknown because of the lack of knowledge about the population size - The biggest threats to fishes as river lamprey are the barrages of the streams, since the species cannot come up to their spawning grounds. In addition, the stowage areas for pisciculture are a threat to the natural state of the watercourses - Concrete guideline: - The objective is to achieve favourable conservation status which mean that the habitat's species should form the basis for a breeding population - The area and condition of designated habitat types and habitats for designated species may not go back or impaired. - There shall be suitable habitat for the river lamprey, assessed as unknown conservation forecast; that by securing streams with good water quality, suitable living and spawning sites and free passage
Salmo salar	- The prognosis is unfavourable for salmon because of obstructions, lack of spawning / nursery areas and degraded water quality due to load with organic matter. Salmon is also threatened by fishing nets in the western parts of the Wadden Sea - The biggest threats to fishes as salmon are the barrages of the streams, since the species cannot come up to their spawning grounds. In addition, the stowage areas for pisciculture are a threat to the natural state of the watercourses - Fishing with gear in the Wadden Sea and gillnets west the islands can be a threat to populations of salmon, but the scale of the fishery is not known at this time - Concrete objective: - The state and the total area of habitat for salmon, evaluated with unfavourable conservation status, should be progress - Concrete guideline - the area and condition of designated habitat types and habitats for designated species may not go back or impaired. - There shall be suitable habitat for salmon by providing passage to suitable habitats in streams and restore suitable spawning and habitat
Coregonus oxyrhynchus	- The prognosis is unfavourable for houting because of obstructions, lack of spawning / nursery areas and degraded water quality due to load with organic matter - The biggest threats to fishes as houting are the barrages of the streams, since the species cannot come up to their spawning grounds. In addition, the stowage areas for pisciculture are a threat to the natural state of the watercourses - Fishing with gear in the Wadden Sea and gillnets west the islands can be a threat to populations of salmon, but the scale of the fishery is not known at this time - Overall objective: - A high priority and strengthened protection for species such as houting, and their habitats. The species are threatened at the national biogeographic level or are scarce (occurring only in 1 to 3 conservation areas in Denmark). Houting is even called a priority species in the EU context. - To ensure streams as suitable habitats for houting. For Houting this requires free passage and a self-reproducing spawning stock in the watercourse. Since houting are acutely threatened by extinction prioritized improved conditions for houting the revival the most appropriate hydrological conditions for wet habitats - Concrete objective: The state and the total area of habitat for Houting, evaluated with unfavourable conservation status, should be progress - Concrete guideline - the area and condition of designated habitat types and habitats for designated species may not go back or impaired. - There shall be suitable habitat for houting, assessed as unknown conservation forecast; that by providing passage to suitable habitats in streams and restore suitable spawning and habitat - There shall be large enough and suitable habitats for houting in streams that drain to the Wadden Sea - The fish houting is one of Europe's most endangered species. It is dangerously close to being eradicated, and only quick action can save it. Therefore, Denmark has gained support from the EU LIFE fund for a restoration project, to save houting. The project includes a wide range of sub-projects in the four southwest Jutland streams connected to the Wadden Sea (Varde, Sneum, Ribe and Vidå), and it also have significant positive effects on habitats and other species

MAMMALS	
Phoca vitulina,	- The prognosis is favourable or consider beneficial for seals, which occurs with stable or growing populations in the area - The marine areas are burdened with environmentally hazardous substances originating from shipping, port activities and from the North Sea via long-distance transport from the major European rivers and to a lesser extent local watercourses. Concentrations of certain hazardous substances is at a problematic level and constitutes a threat to the seals among other species Specific objective: - The state and the total area of habitat for common seal -considered favourable conservation forecast- is to be stable or in progress - Ensure suitable habitat on the sea for the common seal - EnsurE good water quality and good feeding conditions in the Wadden Sea
Halichoerus grypus	- The prognosis for grey seal is evaluated as unknown due to the lack of knowledge of species occurrence and requirements to habitat - Among the threats to grey seal are accidents and releases of oil residues from ships in the North Sea - overall objective: - A high priority and strengthened protection for species such as gray seals and their habitats. The species are threatened at the national biogeographic level or are scarce (occurring only in 1 to 3 conservation areas in Denmark). - Specific objective: - Conservation or restoration of favourable conservation status - guidelines - Ensure suitable habitat on the sea for grey seals - Ensure good water quality and good feeding conditions in the Wadden Sea - Reduction of traffic to ensure there is sufficient large and suitable habitat for gray seal
Phocoena phocoena,	- The prognosis for porpoise is evaluated as unknown due to the lack of knowledge of species occurrence and requirements to habitat - Fisheries are considered a threat against harbor porpoise, since animals can bes trapped and drown in the nets - Overall objective: - A high priority and strengthened protection for species such as porpoises, and their habitats. The species are threatened at the national biogeographic level or are scarce (occurring only in 1 to 3 conservation areas in Denmark). - Specific objective: - Conservation or restoration of favourable conservation status - Guideline - Ensure suitable habitat on the sea for Harbor porpoises - Ensure good quality and good food conditions in the Wadden Sea - Reduction of traffic to ensure there is sufficient large and suitable habitats for Harbor porpois
Lutra lutra(	- The prognosis for otter is evaluated as favourable: occurs with stable or growing populations in the area - Specific objective: - conservation or restoration of favourable conservation status - ensure appropriate and undisturbed habitats and streams

BIRDS	
General about birds	- The marine areas are burdened with environmentally hazardous substances originating from shipping, port activities and from the North Sea via long-distance transport from the major European rivers and to a lesser extent local watercourses. Concentrations of certain hazardous substances is at a problematic level and constitutes a threat to the birds among other species. - Some bird species are threatened by various forms of drainage of their habitats in open habitats (reed swamps, meadows and marshes) - For some bird species fishery is assessed as a threat to the species' habitat and food resources. Fishing can exert significant pressure on the environment by removing a portion of the fish populations and by physical influences from the use of trawling gear, where disturbance of moulting and foraging birds may occur - Mussel fishery can reduce the marine fauna and phytobenthos and may therefore constitute a threat to the food source for certain species of breeding and migratory birds
Annex I Birds Directive	
Barnacle Goose *Branta leucopsis*	- The prognosis is favourable or evaluated favorably for migratory bird barnacle goose which rests in stable or growing population in the Wadden Sea area - Threats: *not mentioned in the document* - Specific goals and objectives: - The state and the total area of habitats must be stable or increasing, so that there are grounds for roosting / foraging populations of at least 3.000 barnacle goose **[F57]** 1.150 barnacle goose **[F60]** 18.800 barnacle goose **[F67]** - General guidelines: - Migratory bird barnacle goose – ensure suitable undisturbed foraging and staging areas of sufficient size on salt marshes in the marshlands
Black Tern *Chlidonias niger*	- The prognosis is unfavourable or evaluated unfavorably for breeding bird black tern on the basis of inappropriate hydrology,disturbances and predation - Threats: Reduction and fragmentation of suitable living habitat; Fishing: Traffic in fishing in the streams in the area can cause local disruption of breeding bird species such as black tern - Overall objective: - black tern: a high priority given that are endangered at the biogeographic,national level - Specific goals and objectives**:** - The state and the total area of habitats must be in progress, so that there are enough suitable breeding and foraging sites in at least 3 sub-areas for black tern, and basis for stocks for at least 60 par black tern - General guidelines: - Breeding bird black tern – Secure and restore suitable and undisturbed breeding areas with high water levels, restoration of ponds with flydebladsvegetaion and humid streets of the marshes - For reasons of highly endangered population of breeding bird black tern, it is increased significantly the area and number of marshes with undisturbed wetlands and ponds. - Concrete guidelines - Many endangered and scarce breeding bird habitats are not protected as a whole (either in relation to physical changes or disturbances), and therefore protection purposes should be particularly in relation to such meadows and cultivated fields, which are essential breeding and feeding grounds for species such as black tern
Bar-Tailed Godwit *Limosa lapponica*	- The prognosis is favourable or evaluated favorably for migratory bird bar-tailed godwit which rests in stable or growing population in the Wadden Sea area - Threats: changes in the saline lakes (these lakes are an important living habitat, some species are partially dependent on these salt waters; changes in these waters will bring changes in the feeding and roosting areas around the lakes - Specific goals and objectives for the area - The state and the total area of habitats must be stable or increasing, so that there are grounds for roosting / foraging populations of at least 56.000 bar-tailed godwit **[F57]** and 4.000 bar-tailed godwit **[F60]** - General guidelines: - Migratory bird bar-tailed godwit - ensure appropriate and undisturbed roosting and foraging areas of high sandbanks, tidal flats, salt marshes and at marshes
Ruff *Philomachus pugnax*	- The prognosis is unfavourable or evaluated unfavorably for breeding bird ruff on the basis of overgrown with grass and tall herbs, overgrown with woody plants, cultivation / transformation, drainage and ditching, area reduction / fragmentation, inappropriate hydrology, improper operation, disturbances and predation - Threats: Reduction and fragmentation of suitable living habitat; Overgrown with trees, shrubs and tall herbs (degrades living conditions, become breeding sites for predators as kestrels, crows, magpies and foxes); Overgrazing or too little or lack of grazing (influences function as habitat for breeding birds); The conflict between different recreational activities (disturbances by human activity reduces and degrades the quality of the areas where the birds prefer to breed); Prædation; Disturbance during the breeding season, hunting - in addition to agricultural activities - is the most common disturbing factor; Inappropriate hydrology as a result of drainage and ditching (affecting watercourses physical conditions, water level and water quality); Intensive farming on permanent pasture rotation land in the conservation area (area function as habitat for meadow birds) - Overall objective: - Ruff: a high priority given that are endangered at the biogeographic,national level - Specific goals and objectives for the area - The state and the total area of habitats must be in progress, so that there are enough suitable breeding and foraging sites in at least 2 sub-areas for ruff **[F52] [F65] [F60] [F51] [F67]**; and that there are basis for stocks for at least 12 par ruff **[F52]** 4 par ruff **[F65]** 5 par ruff **[F60]** and 10 par ruff **[F51] [F67]**

	- General guidelines: - Breeding bird ruff - safeguard and restore suitable breeding areas with high water and low vegetation of salt marshes and at marshes, and to ensure a sufficiently large number of breeding sites with low predation
Golden Plover *Pluvialis apricaria*	- The prognosis is favourable or evaluated favorably for migratory bird golden plover which rests in stable or growing population in the Wadden Sea area - Threats: Overgrazing or too little or lack of grazing by livestock is a threat to natural diversity in open habitats as meadows and swamps. Particularly large reductions of grazing land in the Conservation Area threatens both botanical species diversity and meadows function as habitat for breeding birds and migratory birds - Specific goals and objectives for the area - The state and the total area of habitats must be stable or increasing, so that there are grounds for roosting / foraging populations of at least 21.000 golden plover **[F57]** 50.000 golden plover **[F60]** and 20.000 golden plover **[F51]** - General guidelines: - Migratory bird golden plover - ensure suitable and undisturbed roosting and foraging areas of high sandbanks, tidal flats, salt marshes and at marshes - Concrete guidelines - Many endangered and scarce breeding bird habitats are not protected as a whole (either in relation to physical changes or disturbances), and therefore protection purposes should be particularly in relation to such area which are essential breeding and feeding grounds for species such as golden plover **[F51]**
Spotted Crake *Porzana porzana*	- The prognosis is unfavourable or evaluated unfavorably for breeding bird spotted crake on the basis of inappropriate hydrology, overgrown with grass and tall herbs og forstyrrelser - Threats: Reduction and fragmentation of suitable living habitat; Inappropriate hydrology as a result of drainage and ditching (affecting watercourses physical conditions, water level and water quality); Fishing: Traffic in fishing in the streams in the area can cause local disruption of breeding bird species such as spotted crake - Overall objective: - Spotted crake: a high priority given that are endangered at the biogeographic,national level - Specific goals and objectives for the area - The state and the total area of habitats must be in progress, so that there are enough suitable breeding and foraging sites in at least 2 sub-areas for spotted crake **[F51] [F60]**, and that there are basis for stocks for at least 1 par spotted crake **[F51]** and 9 par spotted crake **[F60]** - General guidelines: - Breeding birde spotted crake - Increase the area of wetlands and increase the number of ponds, and secure and expand the area of wet meadows with extensive agricultural operation and suitable habitats
Avocet *Recurvirostra avosetta*	- For breeding bird avocet the prognosis is unfavourable or evaluated unfavorably on the basis of overgrown with grass and tall herbs, area reduction / fragmentation, disturbances and predation; for the migratory bird avocet the prognosis is unfavourable or evaluated unfavorably on the basis of disruption and lack of suitable feeding and resting places - Threats: Reduction and fragmentation of suitable living habitat; Overgrown with trees, shrubs and tall herbs (degrades living conditions, become breeding sites for predators as kestrels, crows, magpies and foxes); Overgrazing or too little or lack of grazing (Influences function as habitat for breeding birds); The conflict between different recreational activities (disturbances by human activity reduces and degrades the quality of the areas where the birds prefer to breed); Prædation - Specific goals and objectives for the area - The state and the total area of habitats must be in progress, so that there are enough suitable breeding and foraging sites in at least 5 sub-areas for avocet **[F57];** mindst 2 sub-areas for avocet **[F52] [F53] [F55] [F65] [F60] [F51];** and that there are basis for stocks for at least 300 par avocet **[F52] [F51],** 10 par avocet **[F53] [F55],** 50 par avocet **[F65],** 450 par avocet **[F60],** and 700 par avocet **[F57];** and so that there are grounds for roosting / foraging populations of at least 7.700 avocet **[F57],** 300 avocetr **[F49],** and 5.000 avocet **[F60].** - General guidelines: - Breeding bird avocet– safeguard and restore suitable and undisturbed breeding areas on beaches, salt marshes, islands and islets with low or no vegetation and with a low predation - Migratory bird avocet - secure and expand the area of suitable roosting and foraging areas - Concrete guidelines - The conditions for avocet is assured by a sufficiently large number of breeding sites without disruption and with reduced predation
Common Tern *Sterna hirundo*	- The prognosis is unfavourable or evaluated unfavorably for Breeding bird common tern on the basis of overgrown with grass and tall herbs, disturbances and predation - Threats: Overgrown with trees, shrubs and tall herbs (degrades living conditions, become breeding sites for predators as kestrels, crows, magpies and foxes); Overgrazing or too little or lack of grazing (Influences function as habitat for breeding birds); The conflict between different recreational activities (disturbances by human activity reduces and degrades the quality of the areas where the birds prefer to breed); Prædation - Specific goals and objectives for the area - The state and the total area of habitats so that there are enough suitable breeding and foraging sites in at least 4 sub-areas for common tern **[F57],** 2 sub-areas for common tern **[F52] [F65] [F60],** and 1 sub-areas for common tern **[F55]**; and that there are basis for stocks for at least 140 par common tern **[F52]** 10 par common tern **[F55]** 50 par common tern **[F65]** 125 par common tern **[F60]** and 35 par common tern **[F57]**

	- General guidelines: - Breeding bird common tern – secure and expand the number of suitable, sufficiently large undisturbed breeding sites and reduce predation at breeding areas
Arctic Tern *Sterna paradisaea*	- The prognosis is unfavourable or evaluated unfavorably for: breeding bird arctic tern on the basis of overgrown with grass and tall herbs, disturbances and predation - Threats: Overgrazing or too little or lack of grazing (Influences function as habitat for breeding birds); The conflict between different recreational activities (disturbances by human activity reduces and degrades the quality of the areas where the birds prefer to breed); Prædation - Specific goals and objectives for the area - The state and the total area of habitats must be in progress, so that there are enough suitable breeding and foraging sites in at least 5 sub-areas for arctic tern **[F57],** 2 sub-areas for arctic tern **[F52] [F55],** and 3 sub-areas for arctic tern **[F53] [F65]**; and that there are basis for stocks for at least 320 par arctic tern **[F57],** 190 par arctic tern **[F52]** 120 par arctic tern **[F53]** 100 par arctic tern **[F55]** and 170 par arctic tern **[F65]** - General guidelines: - Ensure and improve suitable habitat for breeding bird arctic tern– secure and expand the number of suitable, sufficiently large undisturbed breeding sites and reduce or eliminate predation at breeding areas
Sandwich tern *Sterna sandvicensis*	- The prognosis is unfavourable or evaluated unfavorably for breeding bird sandwich tern, on the basis of overgrown with grass and tall herbs, disturbances and predation - Threats: Overgrazing or too little or lack of grazing (influences function as habitat for breeding birds); The conflict between different recreational activities (disturbances by human activity reduces and degrades the quality of the areas where the birds prefer to breed); Prædation - Overall objective: - Sandwich tern: a high priority given that are endangered at the biogeographic,national level - Specific goals and objectives for the area - The state and the total area of to be in progress, so that there are enough suitable breeding and foraging sites in at least 2 sub-areas for sandwich tern **[F57]** and 1 sub-area for sandwich tern **[F55] [F65]**; and that there are basis for stocks for at least -50 par sandwich tern **[F65],** 100 par sandwich tern **[F57]** and 1.500 par sandwich tern **[F55]** - General guidelines: - Breeding bird sandwich tern - secure and expand the number of suitable, sufficiently large undisturbed breeding sites and reduce predation at breeding areas - Concrete guidelines - The conditions for sandwich tern is ensured by a sufficiently large number of breeding sites low disturbance level and with reduced predation
Regularly occurring migratory birds	
Shoveler *Anas clypeata*	- The prognosis is favourable or evaluated favorably for shoveler which rests in stable or growing population in the Wadden Sea area - Threats: *not mentioned* - Specific goals and objectives for the area - The state and the total area must be stable or increasing, so that there are grounds for roosting / foraging populations of at least 2.000 shoveler [F57] and 1.850 shoveler [F60] - General guidelines: - Migratory bird shoveler – ensure appropriate and undisturbed roosting and foraging areas of high sandbanks, tidal flats, salt marshes and in at marshes
Dunlin *Calidris alpina*	- Migratory bird dunlin: The prognosis is favourable or evaluated favorably for shoveler which rests in stable or growing population in the Wadden Sea area. Breeding bird dunlin: The prognosis is unfavourable or evaluated unfavorably on the basis of overgrown with grass and tall herbs, overgrown with woody plants area reduction / fragmentation, inappropriate hydrology, improper operation, disturbances and predation - Threats: Reduction and fragmentation of suitable living habitat; Overgrown with trees, shrubs and tall herbs (degrades living conditions, become breeding sites for predators as kestrels, crows, magpies and foxes); Overgrazing or too little or lack of grazing (Influences function as habitat for breeding birds; The conflict between different recreational activities (disturbances by human activity reduces and degrades the quality of the areas where the birds prefer to breed); Prædation; Inappropriate hydrology as a result of drainage and ditching (affecting watercourses physical conditions, water level and water quality); Intensive farming on permanent pasture rotation land in the conservation area (area function as habitat for meadow birds); changes in the saline lakes (these lakes are an important living habitat, some species are partially dependent on these salt waters; changes in these waters will bring changes in the feeding and roosting areas around the lakes), - Specific goals and objectives for the area - The state and the total area of habitats must be in progress, so that there are enough suitable breeding and foraging sites in at least 3 sub-areas for dunlin **[F57]** and 2 sub-areas for dunlin **[F53] [F65]**; and that there are basis for stocks for at least 20 par dunlin **[F53]** and 30 par dunlin **[F65]** - Overall objective: - Dunlin: a high priority given that are endangered at the biogeographic,national level - General guidelines: - Migratory bird dunlin - ensure appropriate and undisturbed roosting and foraging areas in high sandbanks, tidal flats, salt marshes and marshes

	- Breeding bird dunlin - safeguard and restore suitable breeding areas with high water and low vegetation of salt marshes and in marshes, and to ensure a sufficiently large number of breeding sites with low prædation - Concrete guidelines - Many endangered and scarce breeding bird habitat is not protected as a whole (either in relation to physical changes or disturbances), and therefore protection purposes should be particularly in relation to such meadows and cultivated fields, which are essential breeding and feeding grounds for species such as dunlin
Knot *Calidris canutus*	- Prognosis is favourable or evaluated favorably for migratory bird knot which rests in stable or growing population in the Wadden Sea area. - Threats**:** changes in the saline lakes (these lakes are an important living habitat, some species are partially dependent on these salt waters; changes in these waters will bring changes in the feeding and roosting areas around the lakes - Overall objective: - Knot: a high priority and enhanced protection since it is scarce and only occur in 1 to 3 protected areas in Denmark - Specific goals and objectives for the area - The state and the total area of habitats must be stable or increasing, so that there are grounds for roosting / foraging populations of at least 5.000 knot **[F57]** and 81.000 knot **[F60]** - General guidelines: - Ensure appropriate and undisturbed roosting and foraging areas in high sandbanks, tidal flats, salt marshes and marshes
Bewick's Swan *Cygnus columbianus*	- The prognosis is favourable or evaluated favorably for migratory bird bewick's swan which rests in stable or growing population in the Wadden Sea area - Threats: *not mentioned* - Overall objective: - bewick's swan: a high priority - Specific goals and objectives for the area: - The state and the total area of habitats must be stable or increasing, so that there are grounds for roosting / foraging populations of at least 225 bewick's swan - General guidelines: - Migratory bird bewick's swan – ensure undisturbed foraging and staging areas of sufficient size in the marshlands
Shelduck *Tadorna tadorna*	- Prognosis is favourable or evaluated favorably for migratory bird shelduck which rests in stable or growing population in the Wadden Sea area. - Threats**:** changes in the saline lakes (these lakes are an important living habitat, some species are partially dependent on these salt waters; changes in these waters will bring changes in the feeding and roosting areas around the lakes - Overall objective: - Shelduck: a high priority and enhanced protection since it is scarce and only occur in 1 to 3 protected areas in Denmark - Specific goals and objectives for the area - The state and the total area of habitats must be stable or increasing, so that there are grounds for roosting / foraging populations of at least 35.000 shelduck **[F57]** and 19.000 shelduck **[F60]** - General guidelines: - Migratory bird shelduck– ensure appropriate and undisturbed roosting and foraging areas in high sandbanks, tidal flats, salt marshes and marshes

APPENDIX III

THE STATUS OF WADDEN SEA HABITATS DESIGNATED UNDER THE EC HABITATS DIRECTIVE IN THE NETHERLANDS, DENMARK AND GERMANY

	1110 sandbanks		1130 estuaries		1140 mudflats		1160 large inlets		1170 reefs	
DK										
Vadehavet med Ribe Å, Tved Å og Varde Å vest for Varde DK00AY176	% cover:	30%	% cover	1%	% cover	34%	% cover	1%	% cover	4%
	status:	Excellent[A] Unfavourable[B]	status:	Excellent[A] Unfavourable[B]	status:	Excellent[A] Unfavourable [B]	status:	Average or reduced[A] Unfavourable[B]	status:	Average or reduced[A] Unfavourable[B]
SH										
NTP S-H Wattenmeer und angrenzende Küstengebiete DE0916391	% cover:	2%	% cover:	3%	% cover:	27%	% cover:	28.30%	% cover:	0,1%
	status:	Excellent	status:	Excellent	status:	Excellent	status:	Excellent	status:	Good
HH										
Nationalpark Hamburgisches DE2016301	% cover:	20%	n.a.		% cover:	74%	% cover:	3%	n.a.	
	status:	Good	n.a.		status:	Excellent	status:	Excellent	n.a.	
LS										
Nationalpark Niedersächsi-sches Wattenmeer DE2306301	% cover:	14.6%	% cover:	0.9%	% cover:	47.5%	% cover:	29.3%	% cover:	0.5%
	status:	Excellent	status:	Excellent	status:	Excellent	status:	Good	status:	Average or reduced
NL										
Waddenzee NL1000001	% cover:	43%	n.a	n.a.	% cover:	54%	n.a.		n.a.	
	status:	Good	n.a	n.a.	status:	Excellent	n.a.		n.a.	
Noordzeekustzone NL2003062	% cover:	80%	n.a.		% cover:	2%	n.a.		n.a.	
	status:	Average or reduced	n.a.		status:	Average or reduced	n.a.		n.a.	

[A] Status obtained from SDF DK00AY176 (2011), [B] Status obtained from Nature Agency (2011). The difference in the evaluation is addressed in Box 3 of Appendix V

THE STATUS OF WADDEN SEA MAMMAL AND FISH SPECIES DESIGNATED UNDER THE EC HABITATS DIRECTIVE IN THE NETHERLANDS, DENMARK AND GERMANY

SAC	SPA	Grey seal *Halichoerus grypus*	Common Seal *Phoca vitulina*	Harbor porpoise *Phocoena phocoena*	Twaite Shad *Allosa fallax*	River Lamprey *Lampetra fluviatilis*	Sea Lamprey *Petromyzon marinus*
DK							
DK00AY176 - Vadehavet med Ribe Å, Tved Å og Varde Å vest for Varde	DK00AY057 - Vadehavet	Average or reduced[(A)] Unknown[(B)]	Excellent[(A)] Favourable[(B)]	Good[(A)] Unknown[(B)]	Excellent[(A)] Unknown[(B)]	Excellent[(A)] Unknown[(B)]	Excellent[(A)] Unknown[(B)]
SH							
DE0916391 - NTP S-H Wattenmeer und angrenzende Küstengebiete	DE0916491 - Ramsar-Gebiet S-H Wattenmeer und angrenzende Küstengebiete	Good	Good	Good	Good	Good	Average or reduced
HH							
DE2016301 - Nationalpark Hamburgisches	DE2016401 - Nationalpark Hamburgisches	n.a.	Excellent	Good	Good	Good	Good
LS							
DE2306301 - Nationalpark Niedersächsi-sches Wattenmeer	DE2210401 - Niedersächsisches Wattenmeer und angrenzendes Küstenmeer	n.a.	Good	Good	n.a.	n.a.	n.a.
NL							
NL1000001 - Waddenzee	NL9801001 - Waddenzee	Good	Good	n.a.	Excellent	Excellent	Excellent
NL2003062 - Noordzeekustzone	NL9802001 - Noordzeekustzone	Good	Good	Good	Average or reduced.	Excellent	Excellent

[(A)] Status obtained from SDF DK00AY176 (2011), [(B)] Status obtained from Nature Agency (2011). The difference in the evaluation is addressed in Box 3 of Appendix V

APPENDIX IV

DEFINITION OF CONSERVATION STATUS FOR HABITATS

Source: Natura2000 Standard Data Form, Explanatory Notes,
http://ec.europa.eu/environment/nature/legislation/habitatsdirective/docs/standarddataforms/notes_en.pdf

Annex III of the Habitats Directive refers to the *Criteria for selecting sites eligible for identification as sites of community importance and designation as special areas of conservation*

These criteria are defined as:

> STAGE 1: Assessment at national level of the relative importance of sites for each natural habitat type in Annex I and each species in Annex II (including priority natural habitat types and priority species)
>
> A. *Site assessment criteria for a given natural habitat type in Annex I*
>
> (a) Degree of representativity of the natural habitat type on the site.
> (b) Area of the site covered by the natural habitat type in relation to the total area covered by that natural habitat type within national territory.
> (c) Degree of conservation of the structure and functions of the natural habitat type concerned and restoration possibilities.
> (d) Global assessment of the value of the site for conservation of the natural habitat type concerned

The point A.c) *Degree of conservation of the structure and functions of the natural habitat type concerned. and restoration possibilities,* has been defined as followed according to the Explanatory Notes:

This criterion comprises three sub-criteria

i) degree of conservation of the structure
ii) degree of conservation of the functions
iii) restoration possibility

i) Degree of conservation of structure

This sub-criterion should be linked to the interpretation manual on Annex I habitats since this manual provides a definition, a list of characteristic species and other relevant elements.

Comparing the structure of a given habitat type present in the site with the data of the interpretation manual (and other relevant scientific information), and even with the same habitat type in other sites, it should be possible to establish a ranking system as follows, using the 'best expert judgment':

I : excellent structure
II : structure well conserved
III : average or partially degraded structure

In cases where the sub-class "excellent structure" is given the criterion A.c) should in its totality be classed as "A: excellent conservation", independently of the grading of the other two sub-criteria

In cases where the habitat type concerned on the site in question does not possess an excellent structure, it is still necessary to evaluate the other two sub-criteria

ii) Degree of conservation of functions

It can be difficult to define and measure the functions of a particular habitat type on the defined site and their conservation, and to do this independently of other habitat types. For this reason it is useful to paraphrase ' the conservation of functions' by the prospects (capacity and probability) of the habitat type concerned on the site in question to maintain its structure for the future, given on the one hand the possible unfavourable influences and on the other hand all the reasonable conservation effort which is possible.

I: excellent prospects
II: good prospects
III: average or unfavourable prospects

In cases where the sub-class "I: excellent prospects" or " II: good prospects" are combined with the grading "II: structure well conserved" of the first sub-criterion, the criterion A.c) should in its totality by classed "A: excellent conservation" or "B: good conservation" respectively, independently of the grading of the third sub-criterion which should not further be considered.

In cases where the sub-class "III: average or unfavourable prospects"is combined with the grading "III : average or partially degraded structure" of the first sub-criterion, the criterion A.c) in its entirety should be classed as "C: average or reduced conservation" independently of the grading of the third sub-criterion which should not further be considered.

iii) Restoration possibilities.

This sub-criterion is used to evaluate to what extent the restoration of an habitat type concerned on the site in question could be possible.

The first thing to evaluate is its feasibility from a scientific point of view: does the current state of knowledge provide an answer to the 'what to do and how to do it' questions? This implies a full knowledge of the structure and functions of the habitat type and of the concrete management plans and prescriptions needed to restore it, that's to say, to stabilize or increase the percentage of area covered by that habitat type, to re-establish the specific structure and functions which are necessary for its long-term maintenance and to maintain or restore a favourable conservation status for its typical species.

The second question that may be asked is the whether it is cost-effective from a nature conservation point of view?'. This assessment must take into consideration the degree of threat and rarity of the habitat type.

The ranking system should be the following, using 'best expert judgment':

I: restoration easy
II: restoration possible with an average effort
III: restoration difficult or impossible

Synthesis:	**applying to the overall grading of the three sub-criteria**
A: excellent conservation	= excellent structure, independent of the grading of the other two sub-criteria = structure well conserved and excellent prospects independent of the grading of the third criterion
B: good conservation	= structure well conserved and good prospects independent of the grading of the third sub-criterion = structure well conserved and average/ maybe unfavourable prospects and restoration easy or possible with average effort = average structure/partially degraded, excellent prospects and restoration easy or possible with average effort = average structure/partially degraded, good prospects and restoration easy
C: average or reduced conservation	= all other combinations

DEFINITION OF CONSERVATION STATUS AND POPULATION FOR SPECIES

Source: Natura2000 Standard Data Form, Explanatory Notes,
http://ec.europa.eu/environment/nature/legislation/habitatsdirective/docs/standarddataforms/notes_en.pdf

Annex III of the Habitats Directive refers to the *Crteria for selecting sites eligible for identification as sites of community importance and designation as special areas of conservation*

These criteria are defined as:

> STAGE 1: Assessment at national level of the relative importance of sites for each natural habitat type in Annex I and each species in Annex II (including priority natural habitat types and priority species)
>
> A. Site assessment criteria for a given natural habitat type in Annex I
> […]
>
> B. Site assessment criteria for a given species in Annex II
> (a) Size and density of the population of the species present on the site in relation to the populations present within national territory.
> (b) Degree of conservation of the features of the habitat which are important for the species concerned and restoration possibilities.
> (c) Degree of isolation of the population present on the site in relation to the natural range of the species.
> (d) Global assessment of the value of the site for conservation of the species concerned.

The point B.b): *Degree of conservation of the features of the habitat which are important for the species concerned. And possibilities for restoration* has been defined as followed according to the Explanatory Notes.

This criterion comprises two sub-criteria:
i) degree of conservation of the features of the habitat important for the species
ii) restoration possibilities

i) Degree of conservation of the features of the habitat important for the species
Criterion i) requires a global evaluation of the features of the habitat regarding the biological requirements of a given species. The features relating to population dynamics are among the most appropriate for both animal and plant species. The structure of the habitat and some abiotic features should be assessed

The 'best expert judgment' should be used to rank this criterion:

I: elements in excellent condition
II: elements well conserved
III: elements in average or partially degraded condition

In cases where the sub-class "I : elements in excellent condition" or "II: elements well conserved" is given the criterion B.b) should in its totality be classed "A: excellent conservation" or "B: good conservation" respectively. Independent of the grading of the other sub-criterion.

ii) Restoration possibilities.

For this sub-criterion, which only needs to be taken into account when the elements are in an average or partially degraded condition, an approach analogous to that of criterion A.c.iii), should be used, adding an evaluation of the viability of the population under consideration. This should result in the system of grading as follows:

I: restoration easy

II: restoration possible with average effort
III: restoration difficult or impossible

Synthesis:	**applying to classification of the two sub-criteria**
A: excellent conservation	= elements in an excellent condition, independent of the grading of the possibility of restoration
B: good conservation	= elements well conserved independent of the grading of the possibility of restoration = elements in average or partially degraded condition and restoration easy
C: average or reduced conservation	= all other combinations

APPENDIX V

Box 2: Identified threats for the habitats and species of the Danish Wadden Sea

The Natura 2000 plan also refers to the current threats that may affect the possibility of habitats and species of maintaining or reaching their favourable conservation status. With respect to marine habitats, this includes environmentally hazardous substances originating from shipping, port activities and from the North Sea via long-distance transport from the major European rivers and to a lesser extent local watercourses. Concentrations of certain hazardous substances is at a problematic level and constitutes a threat to the marine environment and several species (Nature Agency 2011). In the table below is given a list of possible threats to the habitats and species in the Wadden Sea Area wich are of interest for the current project

Threat[22]	Habitat/species affected
Area reduction and fragmentation of natural habitats;	Biogenic reefs (mussel banks); breeding bird species (dunlin, pied avocet, brant goose, common eider,
River barrages and maintenance (dredging) of streams	fish (access to spawning ground obstructed, lack of nursery grounds)
Trawl fishing;	Reefs, large shallow bays, sandbanks (physical destruction , removal of bottom flora and benthic fauna)
Load of organic matter (discharge of oxygen consuming substances)	Fish (reduction of dissolved oxygen)
Traces of pesticides and contaminants from agriculture an aquaculture	Streams (which discharge into the Wadden Sea)
Oil pollution (accidents, ships from the North Sea)	Sandbanks, estuaries, mudflats Grey seal, birds
Inappropriate hydrology in streams which discharge into the Wadden Sea	Stream's physical conditions, water level, water quality Bird habitats
River barrages (prevent fish from coming up to spawning grounds)	Fish: Houting, Salmon, Sea Lamprey, River Lamprey, Twaite shad
Invasive species (i.e pacific oysters, accelerated spread on the tidal flats)	Indigenous fauna and flora (pacific oysters are a problem for mussels and biogenic reef)
Disturbance (i.e sailing, overflight with aircraft, recreational)	Porpoises, seals, breeding birds areas
Natural predation (human actions improve life conditions for some predators)	Nesting breeding birds
Mussel fishery	Birds (threat the food source of certain species) Reduce marine fauna and phytobenthos
Fishing with gear in the Wadden Sea, and with gillnets west of the islands	Threat of populations of houting and salmon (but the scale of impact of this fishery is not known at this time) Harbour porpoise (bycatch) Bird species (threat to food resources)
Traffic related to fishing	Can cause local disruption of the breeding birds *circus pygargus, circus cyaneus* **[F49];** ***c****ircus aeruginosus, asio flammeus* **[F52];** *botaurus stellaris, circus aeruginosus, porzana porzana, crex crex, chlidonias niger*

[22] Updated according to Nature Agency (2011)

Box 3: Prognosis of habitats and species in the Danish Wadden Sea

The prognosis of the status can be seen in the table below. Note that the prognosis provided in Nature Agency (2011) is different to the status found in SDF DK00AY176 (2011). The difference is based on the evaluation criteria used. The Natura2000 criteria used for the assessment of the SDF DK00AY176 (2011) can be seen in Appendix IV. The Danish criteria were based on the identified threats and the best available knowledge. In addition, the Danish evaluation criteria referred to objectives established in the Water Framework Directive.

The status used in the current report was obtained from SDF DK00AY176 (2011), which is the same source used for the other Wadden Sea regions (NL, SH, LS, HH).

	According to Danish criteria	**According to Natura2000 criteria**
Habitats		
1110 sandbanks	Unfavourable due to inadequate nutrient conditions	excellent
1140 mudflats	Unfavourable due to inadequate nutrient conditions	excellent
1130 estuaries	Unfavourable due to inadequate nutrient conditions	excellent
1150 coastal lagoons	Unknown due to unfamiliarity with the habitat	excellent
1160 large shallow inlets	Unfavourable due to inadequate nutrient conditions	average or reduced
1170 reefs	Unfavourable due to inadequate nutrient conditions	average or reduced
Mammals		Conservation status
Grey seal *Halichoerus grypus*	Unknown on lack of knowledge of species occurrence and requirements to habitats	average or reduced
Eurasian Otter *Lutra lutra*(	Favourable: occurs with stable or growing populations in the area	excellent
Common Seal *Phoca vitulina*	Favourable: occurs with stable or growing populations in the area	excellent
Harbor porpoise *Phocoena phocoena*	Unknown: on lack of knowledge of species occurrence and requirements to habitats	good
Fishes		Conservation status
Twaite Shad *Allosa fallax*	Unknown since the species requirements for spawning, population size and conservation status is unknown	excellent
River Lamprey *Lampetra fluviatilis*	Unknown lack of knowledge about species population size and conservation status	excellent
Sea Lamprey *Petromyzon marinus*	Unknown lack of knowledge about species population size and conservation status	excellent
Houting* *Coregonus oxyrhynchus*	Unfavourable because of barriers, lack of spawning / nursery areas and degraded water quality	excellent
Brook Lamprey *Lampetra planeri*	Favourable: occurs with stable or growing populations in the area	excellent
Salmon *Salmon salar*	(in fresh waster) Unfavourable because of barriers, lack of spawning / nursery areas and degraded water quality	excellent
Birds		Conservation status
Branta leucopsis	Favourable: occurs with stable or growing populations in the Wadden	excellent

	Sea area	
Charadrius alexandrinus	Unfavourable because of vegetation overgrowth, disturbance and predation Migratory: Unfavourable due to lack of suitable feeding and resting places	excellent
Gelochelidon nilotica	Unfavourable because of improper hydrology operation, disturbance and predation	excellent
Larus minutus	*Not specified*	excellent
Limosa lapponica	Favourable: occurs with stable or growing populations in the Wadden Sea area	excellent
Pluvialis apricaria	Favourable: occurs with stable or growing populations in the Wadden Sea area	excellent
Recurvirostra avosetta	Breeding: unfavourable because of vegetation overgrowth, disturbance and predation. Migratory: unfavourable due to lack of suitable feeding and resting places	excellent
Sternula albifrons	Unknown on lack of knowledge of species occurrence and claims to habitats	excellent
Sterna hirundo	Unfavourable because of improper hydrology operation, disturbance and predation	excellent
Sterna paradisaea	Unfavourable because of improper hydrology operation, disturbance and predation	excellent
Sterna sandvicensis	Unfavourable because of improper hydrology operation, disturbance and predation	excellent

APPENDIX VI

MONITORING OF BREEDING BIRDS

The information was obtained from JMBB (2010). *Trends in breeding birds in the Wadden Sea 1991-2008*. www.waddensea-secretariat.org, Wilhelmshaven, Germany. URL: http://www.waddensea-secretariat.org/TMAP/Breeding%20Birds/BREB_trends/overviews/2010/trends_until_2008.htm Last updated: July 6th, 2011. Document accessed: June 2nd, 2012

The monitoring of breeding birds in the Wadden Sea has been carried out by the Joint Monitoring Group for Breeding Birds (JMBB) in the framework of the Trilateral Monitoring and Assessment Program (TMAP) since 1991. The monitoring scheme currently focuses on 35 bird species that are considered characteristic for the Wadden Sea ecosystem. Common breeding birds (8 species) are counted annually in 103 representative census areas evenly distributed over all regions and habitats of the Wadden Sea Cooperation Area. Colonial and rare breeding birds (27 species) are difficult to survey with census areas and are counted by annual complete counts in the entire Wadden Sea. Once every 5 years, a total count of all species, including common species, is carried out (1991, 1996, 2001, 2006, interval now changed to once every 6 years).

The monitoring scheme aims to assess and detect population size, distribution and population trends in Wadden Sea breeding birds. Fieldwork is standardised and carried out according to trilaterally harmonised methods (Hälterlein et al., 1995) by nearly 500 ornithologists, mainly consisting of staff of NGOs, governmental bodies, site managers and volunteers.

A regular update of trends in breeding bird numbers, for those species were trend calculations are possible (at the moment 26 species) and that have been monitored from 1991 onward is presented in the website of the WS Secretariat. Specific info on methods and the census regions can be seen at the webpage http://www.waddensea-secretariat.org/TMAP/Breeding_birds.html

The latest version of the trend is of June 2011. It presents 26 of the 34 breeding birds monitored in the Wadden Sea (the other 7 species are said to be too rare to allow trend calculations). The trend is presented from 1991 – 2008 and it relates to population changes relative to 1996. The trends are shown for

- (WS) the Wadden Sea as a whole,
- (NL) The Netherlands
- (LS/HH) the federal states of Lower Saxony/Hamburg (Germany),
- (SH) the federal state of Schleswig-Holstein (Germany)
- (DK) Denmark

The trend of breeding birds, which is presented below, is given in terms of:

Trend description	Population change	Symbol
strong increase	significant increase of >5% per year	++
moderate increase	significant increase of <5% per year	+
stable	no significant population change	**0**
moderate decrease	significant decrease of <5% per year	-
strong decrease	significant decrease of >5% per year	--
uncertain	no reliable trend classification possible (mostly due to strong fluctuations)	**?**
unknown	data do not allow trend analysis	*Empty cell*

Table: Trend of breeding birds between 1991 and 2008 for the trilateral Wadden Sea and the three countries (JMBB, 2010)

Species	WS	DK	SH	LS/HH	NL
Lesser Black-backed Gull	++	++	++	++	++
Eurasian Spoonbill	++			++	++
Great Cormorant	++		++	++	++
Mediterranean Gull	++			++	++
Common Gull	+	++	+	++	-
Red-breasted Merganser	+				
Great Black-backed Gull	+	**?**	++		
Shelduck	**0**	+	+	**0**	**0**
Sandwich Tern	**0**	++	--	+	+
Little Tern	**0**	+	-	-	**0**
Short-eared Owl	**0**			**0**	-
Oystercatcher	**0**	**0**	-	**0**	-
Gull-billed Tern	**?**		++	--	
Herring Gull	-	++	+	--	-
Common Eider	-	+	-	+	-
Black-headed Gull	-	+	-	-	-
Common Redshank	-	**0**	**0**	-	-
Arctic Tern	-	**0**	-	-	-
Avocet	-	-	+	-	-
Black-tailed Godwit	-	-		-	-
Northern Lapwing	-	-	-	-	-
Eurasian Curlew	-			**?**	-
Hen Harrier	-			+	--
Common Tern	-	--	+	-	-
Great Ringed Plover	-	-	-	--	**0**
Kentish Plover	-	+	--		-

MONITORING OF MIGRATORY BIRDS

The information was obtained from JMMB 2010b. *Trends of migratory and wintering waterbirds in the Wadden Sea 1987/88-2008/09*. www.waddensea-secretariat.org, Wilhelmshaven Germany. URL: http://www.waddensea-secretariat.org/TMAP/Migratory_birds.html. Last updated: May 26th, 2011. Document accessed: June 2nd, 2012

The Joint Monitoring of Migratory Birds (JMMB) program is carried out in the framework of the Trilateral Monitoring and Assessment Program (TMAP), and constitutes an internationally coordinated long-term monitoring program. It covers a large connected eco-region stretching from Den Helder in The Netherlands to Esbjerg in Denmark;

Regular ground counts for most species and areas plus aerial counts for seaducks involves hundreds of observers and several institutes and agencies. Yearly updates of the trend calculation are published on this Wadden Sea Secretariat website.

The trends are presented for 34 waterbird species, species which use the Wadden Sea during stop-over on migration or as a wintering area with large parts of their flyway population. Species which only occur in low numbers or species which cannot be counted with sufficient representativeness have been excluded from the analyses.

Data is presented for the international Wadden Sea and the four regions - The Netherlands, the Federal States of Germany, Niedersachsen and Schleswig-Holstein, and Denmark. Specific info on methods and the census regions can be seen at the webpage http://www.waddensea-secretariat.org/TMAP/Migratory_birds.html

The trend of migratory birds, which is presented below, is given in terms of:

Trend description	Population change	Symbol
strong increase	significant increase of >5% per year	++
moderate increase	significant increase of <5% per year	+
stable	no significant population change	**0**
moderate decrease	significant decrease of <5% per year	-
strong decrease	significant decrease of >5% per year	--
uncertain	no reliable trend classification possible (mostly due to strong fluctuations)	**?**
unknown	data do not allow trend analysis	*Empty cell*

Table: Trend of migratory birds between 1987/88 and 2008/09 for the International Wadden Sea and the three countries

Species	WS	DK	SH	Nds/HH	NL
Eurasian Spoonbill	++	++	++	++	++
Barnacle Goose	++	++	++	+	+
Great Cormorant	++	++	++	++	++
Northern Pintail	+	+	**0**	**0**	+
Sanderling	+	+	**0**	-	++
Great Ringed Plover	+	**?**	+	-	+
Bar-tailed Godwit	+	-	-	**0**	+
Ruddy Turnstone	**0**	**0**	+	+	**0**
Red Knot	**0**	+	-	**0**	**0**
Eurasian Wigeon	**0**	+	**0**	+	-
Northern Shoveler	**0**	+	+	**0**	**0**
Common Redshank	**0**	+	**0**	-	+
Northern Lapwing	**0**	**0**	**0**	**?**	+
Grey Plover	**0**	**0**	**0**	-	+
Eurasian Curlew	**0**	++	-	-	+
Dark-bellied Brent Goose	**0**	-	-	**0**	**0**
Common Greenshank	**0**	**0**	-	**0**	+
Common Gull	**0**	**0**	-	**0**	+
Common Teal	-	**0**	-	-	**0**
Dunlin	-	-	-	**0**	+
Common Shelduck	-	+	-	-	**0**

Black-headed Gull	-	**0**	-	-	**0**
Pied Avocet	-	-	-	-	**0**
Mallard	-	-	-	-	**0**
European Golden Plover	-	-	-	-	**0**
Whimbrel	-	--	**0**	-	**?**
European Herring Gull	-	**0**	-	-	-
Eurasian Oystercatcher	-	+	-	-	-
Spotted Redshank	-	-	-	**0**	-
Great Black-backed Gull	-	**0**	-	-	**0**
Kentish Plover	-	--	-	--	-
Ruff	--	--	-	--	-
Curlew Sandpiper	**?**	**?**	**?**	--	**?**
Common Eider	**no long term trend available - counts started in 1993**				