SCIENTIFIC SUPPORT PLAN FOR A SUSTAINABLE DEVELOPMENT POLICY

SPSD II

TOWARDS A SPATIAL STRUCTURE PLAN FOR SUSTAINABLE MANAGEMENT OF THE SEA

F. MAES, M. DE BATIST, V. VAN LANCKER, D. LEROY, M. VINCX

MIXED ACTIONS

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PART ONE: TEXT

MA/02/006

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PREFACE

Increasing pressure from activities and limited space on land and at sea demands that society anticipates how the sea can be used in a sustainable way. The North Sea is one of the most exploited areas of water in the world. The Belgian part of the North Sea (BPNS) – with its small size and its central location – lies in the hub of these activities.

The GAUFRE project and the resulting report is the first attempt to deal with the high level of use in the BPNS in a structural manner. The project was made up of an interdisciplinary team of experts, representing legal sciences, socio-economic sciences, as well as experts in marine biology and marine geology, who worked together for two years. Although the information baseline was kept as scientific as possible, this team was further extended to incorporate experts from the spatial planning realm. This rendered the borderline between science and policy both more vague and challenging. New scientific data was collected and existing data was updated. This data was then transferred to GIS maps, which were then used to prepare maps that enabled the data to be interpreted in different ways. The collation of the scientific data on GIS maps and the use of interpretative maps provided a solid starting point for structural planning.

We wish to emphasise that it is not the ambition of the report to produce a final spatial plan for the BPNS. In this respect it is intended to provide a procedure rather than a result. The report is structured in such a way that the reader can travel from a strict scientific discussion of data through to an analysis of that data in interaction with data from other scientific disciplines. This allows the reader to easily move between scientific information and the use of that information, to creatively consider ways in which spatial structure planning might be achieved in the BPNS. Discussion is therefore meant to encourage consideration of how a spatial planning might be prepared rather than to provide a strict guideline.

Our acknowledgements go to the Belgian Science Policy for their financial support and all the members of the "end user committee" who were involved in discussions, data exchange and many formal and informal meetings from the very beginning. We additionally would like to acknowledge the international participants who attended the GAUFRE workshop in 2004. Their expertise and comments were very helpful in terms of our research and final results.

We are happy to present you the results of our work. And we hope that this report will mark the beginning of a fruitful discussion on spatial planning for the Belgian part of the North Sea and the entire North Sea region.

Prof. Dr. F. Maes, coordinator of the GAUFRE project

Dr. J. Schrijvers, project leader

On behalf of our partners

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INTRODUCTION

Spatial structure plans and the sea were until recently terms that were not often used together. Recently, however, the notion of allocating a certain marine space to certain marine uses has become a crucial issue in marine policy and spatial planning for coastal states.

Many countries are beginning to implement or at least recognise the significance of marine spatial planning. Marine and coastal ecosystems not only support much of the world's biodiversity but also significantly contribute to the global economy. However, they are increasingly subject to intense pressure that threatens both the marine environment and the future of the activities that depend on it. It is becoming increasingly urgent to take a more integrated approach to planning and management of the marine environment. Marine spatial planning has already been carried out in the Florida Keys (USA), the Cayman Islands (Caribbean), the Great Barrier Reef and the South-East Regional Plan (Australia), the Eastern Scotian Shelf (Canada), the Galapagos Islands (Ecuador) and South Africa.

The trigger for interest at an European level primarily came about as a result of the Natura 2000 networks and the Bergen Declaration of the 5th International Ministerial Conference on the Protection of the North Sea in 2002. Both of these documents have caused North Sea states to become increasingly concerned about the cumulative effects of using the marine environment on ecosystems and biodiversity. In order to prevent and resolve potential ecological problems Ministers of the North Sea states have agreed to strengthen co-operation in respect of spatial issues in the marine environment.

In Belgium the Bergen Declaration coincided with current discussion and controversy regarding new uses of the sea and seabed. This included such things as making use of wind turbines for green energy production, the increasing demand for cables and pipelines, shipping traffic and recreation, the need for establishing marine protected areas and an ever evolving EU fisheries policy. It is clear that while the principles of spatial structure planning on land are useful as guidelines, they will need to be adapted to the specifics of the marine environment, both in terms of the legislative framework and environmental constraints. Furthermore, international priorities and policy guidelines will need to be taken into account within the framework of national policy guidelines and priorities, such as the second Federal Plan for Sustainable Development 2004-2008 (Action 20. Integrated Management of the North Sea).

It was clear that a study of spatial planning was required for the Belgian part of the North Sea (BPNS). It is in this light that GAUFRE "Towards a Spatial Structure Plan for Sustainable Management of the Sea" was funded by the Belgian Science Policy (BELSPO), in the framework of the Second Scientific Support Plan for a Sustainable Development Policy (SPSD II). The GAUFRE project ran from January 2003 through to April 2005 coinciding with a period of increased international awareness concerning marine spatial structure planning. GAUFRE is one of the first projects within Europe to investigate marine spatial planning in any depth. The aims and objectives of the project can be described on three levels:

- Since few actual marine structure plans and their results can be used as examples, the process, procedure and methodology underlying the preparation of a plan was set as one of the main objectives of the project.
- Rather than leading to a single "finished" marine spatial structure plan for the BPNS, the aim was to actually produce several scenarios and proposals for a spatial plan.
- The outcomes were meant to provide a starting point for discussion on forms of decision-making and public participation within the context of a marine spatial structure plan.

In the first section (Analysis) we describe the basic framework of the BPNS, which is the subject of the spatial planning project. This section is divided into three specific domains. First of all, the environment is described. This is because a thorough knowledge of the environment is required before a spatial plan is prepared. Prior to GAUFRE, most of the marine projects funded by the BELSPO had stopped at describing the marine environment (projects such as HABITAT and BUDGET within SPSD I, and TROPHOS and MAREBASSE within SPSD II). These projects delivered a valuable starting point. GAUFRE, however, goes beyond the usual description of geological, biological and ecological parameters by providing a simple analysis of how homogeneous zones link and integrate with a whole array of environmental factors. In the second chapter the infrastructure within the BPNS is studied and described. Having dealt with both the environment and infrastructure, the actual uses – both historic, current and future – are then described in detail in a third chapter. The relationships between infrastructure and uses are then analysed in terms of legislation, their existing situation in terms of spatial delimitation and intensity, and their interaction with the environment and other users. The data collated under the Analysis section was entered into a GIS system to create a database of layered marine environment information. The resulting images of spatial delimitation and – where possible – intensity, form the basis of the studies in the second and third section of this project.

The second section (Interaction) is a study of the environment, infrastructure and uses in relation to each other. Only two other marine projects funded by the BELSPO, within their programme for research on sustainable development SPSD (MAREDASM within SPSD I and BALANS within SPSD II), have attempted to take this integrated and interdisciplinary approach. At the start of this part of the project, in January 2004, GAUFRE invited a selected group of experts from around the world to take part in a 2 day brainstorming workshop. Discussions focused on identifying the interactions that exist between different users and how these interactions might be managed in terms of spatial structure plans. A report detailing the outcomes of that workshop is set out under the first chapter of this section. This chapter is followed by three chapters that deal with specific aspects of Interaction, including:

- Suitability: It is clear that infrastructure and uses not only have an effect on the environment, but that the environment also affects them. This chapter concentrates on the importance of understanding how use of the BPNS affects an environment before space is allocated to that use in a planning context.
- Interaction between users and the environment: This chapter focuses on the impact that infrastructure and uses have on the environment's capacity to sustain additional or future uses.
- Interaction among users: In the final chapter, infrastructure and uses are compared with each other. Impacts, constraints and opportunities are listed.

GIS layers were used in the aforementioned chapters to study interactions between the environment, infrastructure and uses. In the next section the GIS layers were used to anticipate potential integrated outcomes.

The third section (Integration) is what really separates this project from many other similar projects. In this section a land use planning framework was applied to the marine area. The basis for this approach was the information gathered under the previous sections (Analysis and Interaction) in the shape of GIS layers and interaction matrices. Instead of sticking to this analytical breakdown, however, a flexible and integrative approach was used. This allowed GAUFRE to create different scenarios for possible spatial structure plans within the BPNS. The key guideline during this process was "sustainability". The GAUFRE study and results were opened to decision makers and stakeholders in a workshop in February 2005. The aim of this workshop was to create a forum for discussing the spatial planning scenarios that had been developed during the course of the project.

It is clear that while this project stops with the development of spatial planning scenarios and the first public workshop, this is only the first step in the development of an operative spatial structure plan for the BPNS. The next step should be for the project's findings to be made available to government, private and public sectors as part of a discussion document. The aim of such a discussion document should be to obtain feedback on support or opposition to any of the scenarios identified for spatial planning within the Belgian part of the North Sea.

SECTION ONE ANALYSIS

SECTION ONE ANALYSIS

Chapter One
Zonation of the Belgian part of the North Sea

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1 LEGAL ZONATION[1]

There are six maritime zones in the North Sea within the jurisdiction of the coastal states: internal waters, territorial seas, contiguous zones, continental shelves, exclusive economic zones, and fishery zones (Map I.1.1a). The high seas are the zone beyond the zones of coastal jurisdiction, governed by the freedom principles. This means that the high seas of the North Sea are open to all states for, *inter alia*, navigation, over-flight, laying of cables and pipelines, exploitation of natural resources, and scientific research. Every maritime zone is measured from the baseline. The baseline can be a normal baseline (the low-water line along the coast as marked on large-scale charts officially recognised by coastal states) or in exceptional cases a straight baseline (where the coastline is deeply indented or a fringe of islands lies in the immediate vicinity of the coast). In every zone the jurisdiction of the coastal states depends on the legal status of the zones in the law of the sea conventions. The latest law of the sea convention is the Montego Bay Convention or the United Nations Convention on the Law of the Sea, signed in 1982, in force since 16 November 1994 for 148 states (status January 2005).

Internal waters

Internal waters are those waters on the landward side of the baseline, under the full sovereignty of the coastal states. They include bays, estuaries, coastal harbours, and waters enclosed by straight baselines.

Territorial sea

The territorial sea is that part of the sea which is adjacent to the land territory and internal waters of the coastal states, up to a limit not exceeding 12 nautical miles from the baseline.

Contiguous zone

The contiguous zone is a zone adjacent to the territorial sea, extending no further than 24 nautical miles from the baselines.

Continental shelf

Beyond the territorial seas in the North Sea, each coastal state is entitled to a continental shelf, which is the natural extension of the land territory. This right does not depend on occupation or any express proclamation. The continental shelf comprises the seabed and the subsoil of the submarine areas up to the outer edge of the continental margin or to a distance of 200 nautical miles from the baseline, where the outer edge of the continental margin does not extend that far. Division of the continental shelf in the North Sea between the coastal states is a result of delimitation agreements concluded in the mid-sixties and early seventies. Later agreements complement or alter former delimitation agreements as a result of the decision of the International Court of Justice in the North Sea Continental Shelf Case of 20 February 1969 (Germany vs. Denmark and the Netherlands). In the nineties, Belgium concluded delimitation agreements with France, the UK, and the Netherlands.

1 This chapter is primarily based on Maes et al., 2000. Limited Atlas of the Belgian Part of the North Sea, OSTC 31 p. Only certain parts of the fishery zones were updated by Fanny Douvere (pers. comm.)

Exclusive economic zone

Under the 1982 Law of the Sea Convention, coastal states are entitled to an exclusive economic zone extending no further than 200 nautical miles from the baselines. In contrast to the continental shelf, an exclusive economic zone must be explicitly proclaimed or installed by the coastal state and includes, besides the seabed and its subsoil, the waters super-adjacent to the seabed. It is expected that the boundaries of the exclusive economic zones in the North Sea will coincide with the boundaries of the continental shelves. If all North Sea states proclaim an exclusive economic zone, there will be no high seas in the North Sea. Belgium, France, United Kingdom, Norway, Sweden, Denmark, the Netherlands and Germany have proclaimed an exclusive economic zone in the North Sea.

Fishery zones

In the late seventies the fishery zones of the North Sea were extended to 200 nautical miles, as requested by the Council of the European Community. The boundaries of the North Sea fishery zones are set by existing agreements as to the limits of the continental shelves.

1.1 BASELINE

The Belgian maritime zones are measured from a normal baseline, which is the low-water line along the coast as indicated on official large-scale charts. The outermost permanent harbour extension of the port of Zeebrugge forms an integral part of the harbour and constitutes part of the coast. Here the baseline is a straight baseline between the two outermost points of the eastern and western outer harbour. The Belgian part of the North Sea is 3600 km^2, legally divided in various zones.

1.2 TERRITORIAL SEA

The Belgian territorial sea extends 12 nautical miles from the baseline. The boundary of the Belgian territorial sea with France consists of a rhumb-line connecting the points expressed in the co-ordinates 02°32’37”E-51°05’37”N and 02°23’25”E-51°16’09”N (1990 Agreement). The boundary of the Belgian territorial sea with the Netherlands consists of an orthodromic line connecting the points expressed in the co-ordinates 03°21’52,5”E-51°22’25”N, 03°21’14”E-51°22’46”N, 03°17’47”E-51°27’00”N, 03°12’44”E-51°29’05”N and 03°04’53”E-51°33’06”N (1996 Agreement). Belgian legislation does not diverge from the principles of the international law of the sea. In the territorial sea Belgium has sovereignty extending to the air space over the territorial sea, its bed and subsoil. This sovereignty means that Belgium is allowed to adopt laws or regulations and punish infringements in respect of all or any of the following general topics: navigation, laying and protection of cables and pipelines, fisheries, prevention of pollution, conservation of living resources, exploitation of non-living resources, scientific research, customs, fiscal matters, immigration, and sanitary regulations.

This sovereignty is limited by the customary right of innocent passage through the territorial sea for ships of all states. Passage has to be continuous and expeditious, except in cases of *force majeure* or distress. Passage is innocent so long as it is not prejudicial to the peace, good order, or security of the coastal state. The meaning of innocent passage is further elaborated in article 19 of the 1982 Law of the Sea Convention. Belgian legislation does not hamper innocent passage or levy charges upon it. It is allowed, however, to charge for specific services rendered, such as rescue or pilotage services, but not in a manner that discriminates among ships of different foreign flags. Furthermore, Belgian laws do not affect the design, construction, manning, or equipment of foreign vessels unless they conform to generally accepted international standards, being those accepted within the International Maritime Organization, or legislation adopted by the European Community. All ships, whether in innocent passage or not, must comply with the law of the coastal state while in its territorial sea.

1.3 CONTIGUOUS ZONE

In the contiguous zone a coastal state may exercise the control necessary to prevent and punish infringements of its customs, fiscal, immigration, or sanitary laws and regulations within its territory or territorial sea.. The Belgian Law on the Exclusive Economic Zone (EEZ) introduces a contiguous zone of 12 nautical miles beyond the territorial sea.

1.4 CONTINENTAL SHELF

The surface of the Belgian continental shelf is about 2017 km^2. The boundary of the Belgian continental shelf with France consists of a rhumb-line connecting the points expressed in the co-ordinates 02°23′25″E-51°16′09″N and 02°14′18″E-51°33′28″N (1990 Agreement). The boundary of the Belgian continental shelf with the UK consists of a rhumb line connecting the points expressed in the co-ordinates 02°14′18″E-51°33′28″N, 02°15′12″E-51°36′47″N and 02°28′54″E-51°48′18″N (1991 Agreement). The boundary of the Belgian territorial sea with the Netherlands consists of an orthodromic line connecting the points expressed in the co-ordinates 02°32′21,599″E-51°52′012″N and 03°04′53″E-51°33′06″N (1996 Agreement).

According to the Law of 13 June 1969 concerning the Continental Shelf, Belgium exercises sovereign rights over its continental shelf for the purpose of exploring and exploiting the mineral and other non-living resources of the sea-bed and subsoil; this also includes living organisms belonging to sedentary species. This means that no one may undertake these activities without express Belgian consent, which is given by means of a permit or concession. The Belgian Law of 20 January 1999 concerning the Protection of the Marine Environment requires an environmental impact assessment for the exploitation of non-living resources on the continental shelf.

1.5 EXCLUSIVE ECONOMIC ZONE

The Belgian EEZ law adheres to the principles laid down in the 1982 Law of the Sea Convention. In its exclusive economic zone a coastal state has sovereign rights for the purpose of exploring and exploiting, conserving and managing the natural resources, whether living or non-living, of the waters super-adjacent to the sea-bed and of the sea-bed and its subsoil. A coastal state also has jurisdiction with regard to the establishment and use of artificial islands, installations, and structures, to scientific research, to the protection and preservation of the marine environment, with due regard to the rights and duties of other states. The latter rights and duties refer to the freedoms of navigation, over-flight, and the laying of submarine cables and pipelines. Belgian EEZ legislation amends the Continental Shelf Law and the Belgian Fishery Laws, *inter alia* by: bringing the exploration and exploitation of sedentary species under the Belgian fishery laws; introducing new legislation proclaiming exclusive Belgian jurisdiction over artificial islands, installations, and structures; introducing consent and procedures to be followed when other states intend to conduct scientific marine research in the Belgian exclusive economic zone; introducing Belgian consent for the laying of cables and pipelines entering its territory or territorial sea or used in connection with exploitation of the continental shelf, operations of artificial islands, installations, and structures within Belgian jurisdiction. In other cases delineation of the course for the laying of cables and pipelines will be subject to Belgian approval. Preservation and protection of the marine environment in Belgium's exclusive economic zone is be regulated by the Law on the Protection of the Marine Environment.

1.6 FISHERY ZONES

In 1978 Belgium installed a fishery zone, whose boundaries are adjusted by the law on the Belgian EEZ to coincide with the boundaries of the Belgian continental shelf. Fishing within the 12 nautical mile zone is exclusively reserved for Belgian fishermen and, under certain conditions, also for French and Dutch fishermen. Outside the 12 nautical mile zone, the general principle of free access applies. In the area between 3 and 12 nautical miles, Dutch fishermen are allowed to catch all species of fish and French fishermen are allowed to catch herring (EC Regulation 2371/2002). The Treaty of the BENELUX Economical Union (1958) allows Dutch fishermen to fish within 3 nautical miles. A Belgian-French Agreement (1975) allows French fishermen to catch herring and sprat in the Belgian territorial sea, between 3 and 6 nautical miles for vessels whose gross tonnage does not exceed 60 tons or whose engines do not exceed 400 horse power, and within the 3 nautical miles zone for vessels whose gross tonnage does not exceed 35 tons or whose engines do not exceed 250 horse power. All vessels whose gross tonnage exceeds 70 tons are not allowed to fish within 3 nautical miles from the baseline. Fishing is totally prohibited on the Paardenmarkt, as indicated on the official charts, because war munitions have been dumped there. Fisheries are entirely within the competence of the European Union, which determines on a yearly basis the total allowable catch (TAC) for certain important North Sea species and sets technical standards for fishing nets (mesh size) and the minimum size or weight of fish landed. Each TAC is divided up among the Member states in the form of quotas. Since 1995 the European Union introduced a new management instrument called "the fishing effort regime", which establishes a link between captures (fish) and fishing capacity (boats). Management of fishing effort is undertaken by the fishery sector, and is generally guided by the parametres of the fishing gear used and species fished.

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2 GEOPHYSICAL ZONATION

2.1 INTRODUCTION

A geophysical zonation of the Belgian part of the North Sea (BPNS) was carried out with the aim of delineating zones with similar physical characteristics. Several datasets can be consulted for this purpose: geological or Tertiary substratum, bathymetry, surficial sediments, and hydrodynamic regime. However, the final aim is to combine this zonation with a zonation based on biological datasets in order to delineate zones with similar environmental characteristics. As such, a base map could be created to counter-balance the impact of anthropogenic activities.

2.2 GEOPHYSICAL CHARACTERISATION OF THE BELGIAN PART OF THE NORTH SEA

The BPNS is characterised by a number of sandbanks that can be grouped as Coastal Banks (Nieuwpoort Bank, Stroombank, Wenduine Bank), Flemish Banks (Oostdyck, Buiten Ratel, Kwinte Bank, Middelkerke Bank, Oostende Bank), Hinder Banks (Fairy Bank, Westhinder, Noordhinder, Oosthinder, Bligh Bank) and the Zeeland Ridges (Thornton Bank, Goote Bank, Akkaert Bank) (Map I.1.2a. Bathymetry of the Belgian part of the North Sea). The Coastal Banks and the Zeeland Ridges are quasi parallel to the coastline, whilst the Flemish and Hinder Banks have a clear offset in relation to the coast.

From a hydrodynamic point of view, the tidal current velocities reach their maximum value during flooding (NE) in the near coastal zone and along most of the Flemish Banks region. The maximum current velocity is in the ebb direction (SW) along the Hinder Banks and along some of the swales of the Flemish Banks. High currents of up to 1.6 m/s have been modelled at the Westerschelde estuary (throat), running in a SE-NW direction. The zone of high current velocity extends north of the Paardenmarkt shoal with values of 1 - 1.2 m/s and is roughly E-W oriented. High currents of up to 1.4 m/s are also found to the north of the BPNS, towards the main channel of the Southern Bight of the North Sea. A synthesis of the hydrodynamic regime and sediment transport processes are discussed in Lanckneus et al. (2001), based on results from the Management Unit of the Mathematical Modelling of the North Sea and Scheldt Estuary.

The Quaternary cover and Tertiary substratum have been mainly discussed in De Batist & Henriet (1995) and a synthesis of all research is presented in Le Bot et al. (2003). The sandbanks are the most pronounced Quaternary features. From case studies on the Middelkerke Bank and the Kwinte Bank, it has been shown that the body of the sandbank is not a homogeneous pile of sand, but merely a stacking of distinct sedimentary units. The sediments in the different units can be diverse in nature and vary from clay to coarse sands and gravel. Only the upper unit is representative of the present hydrodynamic regime.

In the area of the Flemish Banks and the Hinder Banks, the Tertiary substratum is mainly composed of clay whilst to the east, a rapid succession of tertiary formations exist of which the composition alternates between sandy and clayey sediments. The thickness of the Quaternary is less than 2.5 m along most of the deeper areas (swales in between the banks). At these locations the Tertiary substrate can be eroded locally and hence these older sediments can take part in the sediment transport process (Lanckneus et al. 2001).

From a morphological point of view, most of the sandbanks are covered with large to very large dunes with an average height of 2-4 m and a wavelength of around 200 m (Lanckneus et al. 2001). Generally, the highest dunes are observed at the northern extremity of the Flemish Banks (up to 8 m) and in the northern part of the Hinder Banks region. Higher dunes are also observed along the kinks or discontinuous parts of sandbanks. Fields of large dunes also occur at the western extremity of the Goote Bank and abundantly in the deeper parts of the Hinder Banks (up to 11 m). Closer to the coast their occurrence is merely restricted and the sandbanks are generally devoid of bedforms (Van Lancker et al. 2001).

It is clear that the nature and differentiation of the surficial sediments is related to the unique configuration of the sandbank-swale systems whereby the interaction of the current with the large-scale morphology is responsible for a hydraulic sorting of the sediments. The sand fraction (0.063 to 2 mm) preferentially takes part in the build-up of the sandbanks whilst the coarser sands, gravel (> 2mm) and the silt-clay fraction (<0.063 mm) are merely found in the swales. Where large fields of dunes occur the sediments are generally coarser (Van Lancker 2001). The gravely deposits in the swales are merely relict sediments that are hardly moved by the present hydrodynamic regime and as such they are not renewable. Generally, the finest sediments can only deposit in the deeper swales or where muddy sediments are abundantly present in the water column. The surficial sediments of the BPNS generally become coarser in an offshore direction.

2.3 GEOPHYSICAL ZONATION

The geophysical zonation could be based on a combination of the above-mentioned data, at least of those that are more or less available over the BPNS. However, it should be kept in mind that the final aim is to identify homogeneous zones that are also ecologically relevant, and hence important in determining the nature of biological groups. As such, the geological substratum will add limited value to the zonation. This is because in most cases the Quaternary cover is responsible for the ecological structure. The hydrodynamic regime yields different zones, still these are of rather broad-scale and its predictive capability towards the ecology is far less than the sediment nature. Degraer et al. (2002; 2003) and Van Hoey et al. (2004) showed that the macrobenthos is strongly linked to well-defined ranges in grain-size distribution along a gradient of fine, medium to coarse sand. The sedimentological maps that currently exist do not have enough detail or the suitable variables to explain the variability in the occurrence of macrobenthos. Accordingly, more research is needed in order to prepare more detailed and well-interpolated maps of the sedimentological point datasets. Present research is heading into that direction and results are expected in the course of 2005 (Gent University, Renard Centre of Marine Geology). Given the limitations mentioned above, only discrete sampling results have been used for the purpose of the present project. Map I.1.2b shows the distribution of the surficial sediment sampling points. The colour indicates the median grain-size. The maps already give a good indication of the variation in sediment nature and distribution. It also shows the coarsening trend in the median grain-size towards the North.

The best dataset for the zonation process is the bathymetry as the point data are available covering the whole BPNS. As such, a digital terrain has been modelled covering the BPNS. From this, it was aimed to delineate the large morphological entities such as sandbanks and swales. To separate the flanks of the sandbanks from the swales, a slope map was used. The latter was calculated from the digital terrain model. Foreshore zones have also been delineated. The limits of the zones have been refined taking into account other variables, such as the tertiary substratum and the current regime. This process gave rise to 76 zones. The surface area of the zones can differ significantly. Although a large number of zones has been defined, this amount seems manageable, especially considering that they are clearly identifiable in respect of end-users (distinct morphological units, often named on charts). Map I.1.2c represents the zones superimposed on the bathymetry based digital terrain model.

2.4 CONCLUSION

Various physical datasets have been evaluated to serve as a basis for a geophysical zonation of the Belgian part of the North Sea. In combination with an ecological zonation, both approaches should lead to a delineation of zones that are more or less homogeneous in nature. These homogeneous zones could then be used as an environmental base map against which anthropogenic activities can be balanced.

The bathymetry was the least spatially biased and most detailed dataset for the geophysical zoning process. Together with a slope map, the bathymetry was used to delineate sandbanks from the deeper parts and from the foreshore.

Towards a correlation of the physical data with the biology on the scale of the BPNS, knowledge on the spatial distribution of the the surficial sediments is most important. At this stage, only sedimentological point data was used, as no detailed full-coverage sediment maps were yet available. However, it is clear that on sandy shelves, the sediment nature often shows a good correlation with the bathymetry of the seafloor. As such, it can be assumed that the delineated physical zones have similar sediment characteristics on a broad-scale and as such they have the potential of being ecologically relevant.

The delineated zones represent the larger morphological units of the BPNS. As such, they are clearly identifiable in respect of end-users.

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3 ECOLOGICAL ZONATION

3.1 INTRODUCTION

Due to its ecological importance and obvious presence within the marine ecosystem, the macrobenthos is the most intensively investigated marine (benthic) ecosystem component. Data on the spatial distribution of macrobenthic species and species assemblages is available for many areas worldwide. Being ecologically important and well known, the spatial distribution patterns of the macrobenthos are often used to ecologically adjust marine management (i.e. ecosystem-based decision making and management).

Though in many cases the macrobenthic spatial distribution is relatively well known, this information is restricted to the level of sampling stations. Full-coverage spatial distribution maps are lacking.

In general, two strategies could be followed to attain full-coverage distribution maps: (1) spatial extrapolation based on sampling point information (i.e. spatial extrapolation) and (2) combining (full-coverage) data on the abiotic benthic habitat and quantitative knowledge of the macrobenthic habitat suitability (i.e. predictive modeling).

Spatial extrapolation, although attractive, is perilous since community structures often change within very short distances. Degraer et al. (2003) demonstrated that even a dense grid of sampling stations (120 sampling stations in 5x5 km area) did not allow for spatial extrapolation of the macrobenthic community distribution patterns. Furthermore, spatial extrapolation has the disadvantage of producing a rather static map: whenever new data becomes available, the whole extrapolation exercise has to be repeated. Predictive modeling, on the other hand, allows the objective production of distribution maps to a level of detail determined by the availability of abiotic data. In areas where detailed abiotic habitat information is present, small-scale patchiness within the macrobenthos will be detected. Once the predictive model is set, this strategy further easily allows for the updating of spatial distribution information as more detailed abiotic habitat data become available.

The BPNS has a surface area of only 3600 km^2, but includes a wide variety of soft sediment habitats. The area is characterized by a highly variable and complex topography, due to the presence of several series of sandbanks. Consequently, sediment types are highly variable throughout the area. Since the spatial distribution of the macrobenthos is largely dependent on the physical environment, a high diversity of macrobenthic life can be expected (Degraer et al., 1999).

Detailed knowledge on the macrobenthos of the BPNS became available through several Flemish and Belgian research projects. Based on a combination of datasets (data from 728 macrobenthos samples), Van Hoey et al. (2004) summarized the soft sediment macrobenthic community structure. They discerned between three sub-tidal communities: (1) the *Abra alba – Mysella bidentata* community, (2) the *Nephtys*

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cirrosa community and (3) the *Ophelia limacina – Glycera lapidum* community. Next to these communities, several transitional species assemblages connecting the three communities were defined.

Each community was restricted to a specific habitat. Sediment grain size distribution (i.e. median grain size and sediment mud content) was found to be the major structuring physical variable. The BPNS's high macrobenthic diversity, in combination with a detailed knowledge of the macrobenthic community structure, makes it an ideal case study area for the development of a predictive model to attain a (full-coverage) spatial distribution map of the macrobenthos.

This study aims to achieve the following objectives:

- a quantitative identification of the macrobenthic communities' habitat preferences;
- the construction of a habitat suitability model for each macrobenthic community in the BPNS; and
- a maximisation of the knowledge on the macrobenthic spatial distribution in the BPNS, combining the habitat suitability model and fine scale abiotic habitat data.

3.2 MATERIALS AND METHODS

3.2.1 DATASETS

Within the framework of several projects 1197 macrobenthos samples were collected from the BPNS between 1994 and 2004. The samples were all collected with a Van Veen grab (sampling surface area: 0.1 m^2) and sieved over a 1 mm mesh-sized sieve. All organisms were identified to species level, whenever possible, and species-specific densities (ind/m^2) were determined.

Before analysis, a thorough data quality control was performed. Non- representatively sampled species were excluded from the dataset. A first set of such species consisted of non-macrobenthic species, such as hyperbenthic mysids, fish and pelagic larvae, which cannot representatively be sampled with a Van Veen grab. A second set consisted of rare species. Rare species were defined as any species with a frequency of occurrence of less than 2 % and encountered with a maximum of three individuals per sample.

Because datasets, derived from different research projects, were combined, the dataset was checked for inconsistent species identifications. In case of inconsistent species identifications (e.g. *Bathyporeia*, *Capitella* and *Ensis*), the species were lumped to the taxonomically highest common denominator.

To avoid temporal autocorrelation, temporal series were excluded from the analysis.

After data quality control the final dataset comprised of 773 samples and 123 species.

To maximise the applicability of the habitat suitability model only frequently measured and/or widely available environmental variables were included in the database. A first set of environmental data was composed of *in situ* measured variables, such as median grain size, sediment mud content, water depth and distance from the coast. Other environmental variables were taken from models. Depth (in case depth was not measured *in situ*) and slope were estimated on the basis of detailed bathymetric maps (unpubl. data E. Verfaillie, UGent-RCMG).

After setting the predictive model, the model was offered physical data derived from the RCMG dataset (unpubl. data V. Van Lancker & E. Verfaillie, UGent-RCMG). This dataset comprises sedimentological data of 6829 sampling stations, situated within the BPNS.

3.2.2 COMMUNITY ANALYSIS

The community structure was investigated by several multivariate techniques: Group-averaged cluster analysis based on Bray-Curtis similarity (Clifford and Stephenson, 1975), Detrended Correspondence Analyses (DCA) (Hill and Gauch, 1980) and Two-Way Indicator Species Analysis (TWINSPAN) (Hill, 1979; Gauch and Whittaker, 1981), based on the final dataset with 773 samples and 123 taxa. For cluster analysis and DCA the data was fourth-root transformed prior to analysis. TWINSPAN was run using both the species density data and the presence/absence data.

The outcome of each multivariate analysis was compared to extract consistent groups of samples. Samples that were placed in different sample groups by the different multivariate analyses were considered as inconsistently grouped and were excluded from further analysis. This strategy assures that atypical observations (i.e. inconsistently grouped samples) do not bias any further analysis. The biotic and abiotic characteristics of the sample groups were compared with those given by Van Hoey et al. (2004) to (1) differentiate between communities and transitional species assemblages and (2) check for eventual communities not detected by Van Hoey et al. (2004).

3.2.3 HABITAT PREFERENCE MODELLING

3.2.3.1 Modeling strategy

To assure the incorporation into the model of only distinct sample groups (i.e. macrobenthic communities), transitional species assemblages were excluded from the predictive modeling exercise. Following this strategy, a bias because of multivariate overlapping sample groups is avoided in the model. Although an abstraction of the real complexity within the macrobenthic community structure is consequently forced into the model, the strategy further allows for easy communication about the outcome of the model with environmental managers.

3.2.3.2 Discriminant Function Analysis

Discriminant function analysis was used (1) for detecting the abiotic habitat variables allowing for discrimination between different macrobenthic communities and (2) for assigning samples, for which only abiotic information is available, to a macrobenthic community with a better than chance accuracy.

The standardized beta coefficients for each abiotic habitat variable within the discriminant functions were used to detect structuring abiotic habitat variables: the larger the standardized coefficient, the greater the contribution of the respective variable to the discrimination between groups.

Automatically derived classification functions were used to determine to which macrobenthic community a sample, for which only abiotic information is available, most likely belongs. These new observations were taken from the RCMG dataset.

The Mahalanobis distance (measure of distance between two points in the space defined by two or more correlated variables) is the distance between each sample and the macrobenthic community centroid in the multivariate space defined by the variables in the model. A sample is classified as belonging to the macrobenthic community, of which the community centroid is closest (i.e. where the Mahalanobis distance is smallest).

Not all new samples, taken from the RCMG dataset, could be reliably assigned to a macrobenthic community. To maximize the reliability of the predictions only those samples, that had a Mahalanobis maximum distance of 1 from any macrobenthic community group centroid, were assigned to a macrobenthic community.

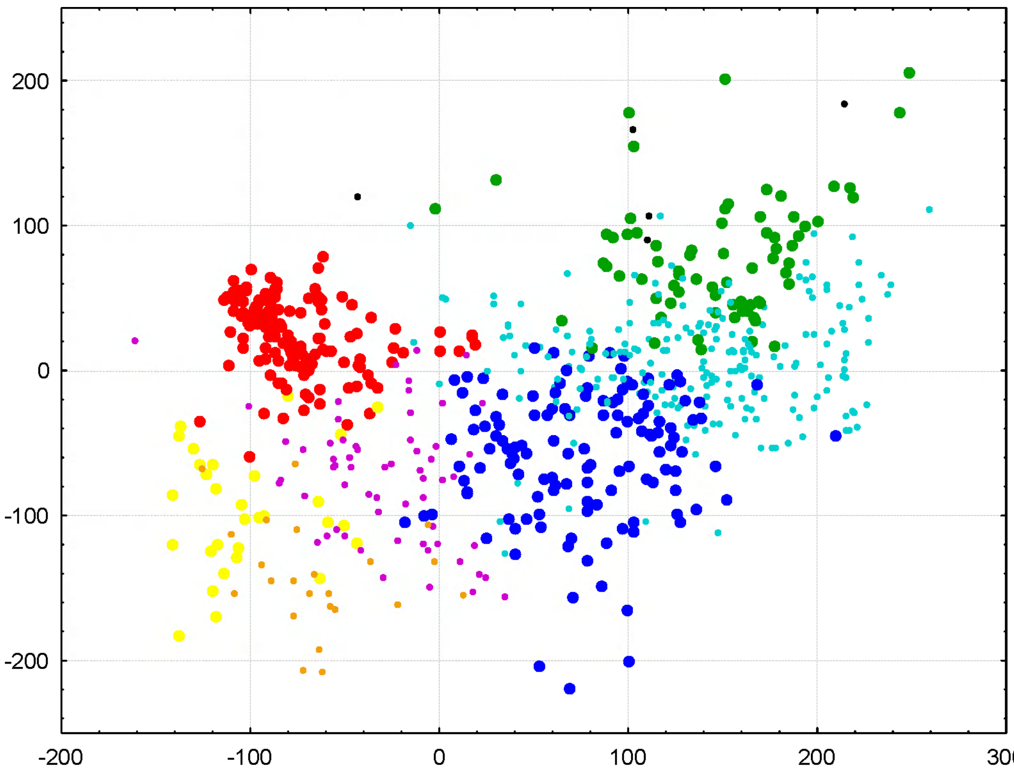
Within this report, details about the statistical analysis were not included. Those details will be presented in Degraer et al. (in prep).

3.3 MACROBENTHIC COMMUNITY STRUCTURE, DISTRIBUTION AND HABITAT PREFERENCES

3.3.1 COMMUNITY STRUCTURE

Based on Detrended Correspondence Analysis, Cluster Analysis and TWINSPAN, 690 samples were consistently assigned to eight sample groups (Figure I.1.3a). In total 83 samples (11 %) were inconsistently grouped and were excluded from further analysis. All groups consisted of between 23 (sample group B) and 228 samples (sample group G), except for sample H, which consisted of no more than five samples. Group H was therefore excluded from further analyses.

Figure I.1.3a. Distribution of the sample groups along the first two axes of the Detrended Correspondence Analysis. •, Group A; •, Group C; •, Group E; •, Group G; •, Group B; •, Group D; •, Group F; •, Group H.



Based on a thorough comparison with the community structure on the BPNS, as described by Van Hoey et al. (2004) (not given), each of the sample groups was assigned to a community or transitional species assemblage. Sample group C corresponded with the *Abra alba* – *Mysella bidentata* community. Sample group E corresponded with the *Nephtys cirrosa* community. Sample group G corresponded with the

Ophelia limacina – Glycera lapidum community. Sample groups D and F were defined as transitional species assemblages, each representing a link between two "parent communities".

Only sample groups A and B could not be linked to any community of Van Hoey et al. (2004). Sample group A matched with the *Macoma balthica* community, as described by Degraer et al. (2003). Sample group B was considered as a new transitional species assemblage.

In conclusion, four macrobenthic communities and three transitional species assemblages were distinguished. A detailed description (biology and environment) of all groups is provided by Degraer et al. (2003) and Van Hoey et al. (2004).

3.3.2 COMMUNITY SPATIAL DISTRIBUTION (Map I.1.3a)

Each sample group had its specific distribution pattern across the BPNS. Sample group A (*M. balthica* community) was restricted to the northeastern part of the coastal zone, while sample group C (*A. alba – M. bidentata* community) dominated all other parts of the coastal zone. In contrast, sample group G (*O. limacina – G. lapidum* community) had a strict offshore distribution. The *N. cirrosa* community (sample group E) was the only community that did not show any distinct pattern. The transitional species assemblages D and F showed a pattern that was strongly linked to the distribution of their parent communities.

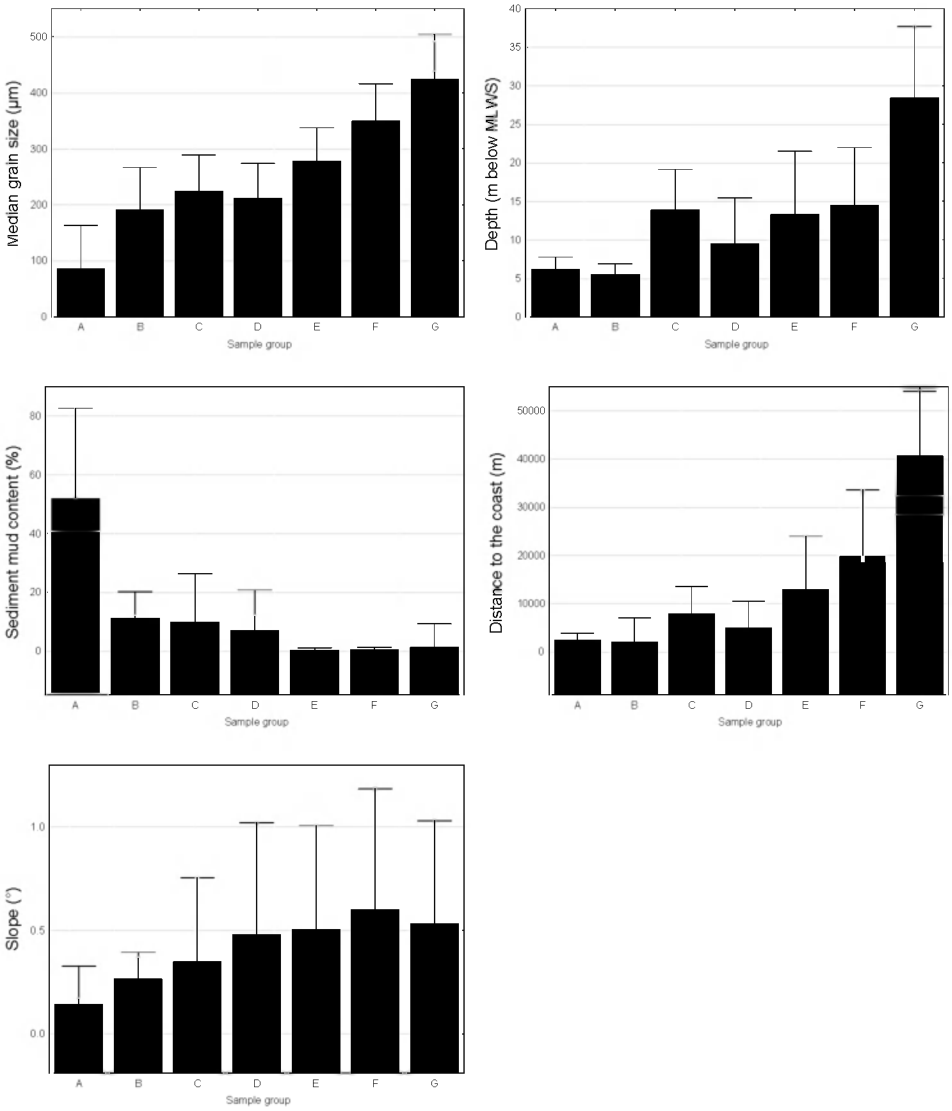
Sample group B had the narrowest spatial distribution. 18 samples out of a total of 23 samples (78 %) within sample group B were found in a small area, west of the harbour of Oostende. Within that area, sample group B comprised 40 % of the available samples.

3.3.3 COMMUNITY HABITAT PREFERENCES

Clear differences in habitat preferences were found for all sample groups and for all environmental variables, taking into account (Figure I.1.3b).

From sample group A to G a preference for increasing median grain sizes was detected. Although less obvious, a similar positive relationship was found for depth, distance to the coast and slope. A negative relationship was detected between sample groups and sediment mud content.

Figure I.1.3b. Habitat preferences of all sample groups. Mean ± standard deviation.



In summary

- Four macrobenthic communities and three transitional species assemblages were distinguished.
- All assemblages showed a distinct spatial distribution pattern.
- All assemblages were found in a distinct habitat.

3.4 COMMUNITY HABITAT SUITABILITY MODELLING

Details about the statistical analysis are not included within this report. Those details will be presented in Degraer et al. (in prep).

Only the macrobenthic communities were selected for the modeling exercise: (1) sample group A or the *M. balthica* community, (2) sample group C or the *A. alba – M. bidentata* community, (3) sample group E or the *N. cirrosa* community and (4) sample group G or the *O. limacina – G. lapidum* community (see arguments in the materials and methods section).

At first several combinations of environmental variables were used to prepare preliminary habitat suitability models. Distance to the coast and slope were never taken into account in the preparation of the preliminary models by the discriminant function analysis and were thus automatically rejected from further modeling exercises. As a result only three environmental variables were taken into account in the preliminary models: median grain size, sediment mud content and depth, of which depth only accounted for a minor predictive part. Because of (1) its relative low predictive power and (2) the indirect causal relationship between depth and community structure, it was decided to exclude depth from the modeling exercise. The final model was thus restricted to the variability explained by median grain size and sediment mud content, extended with the interaction term between both (median grain size x sediment mud content). The correlation coefficient between those three variables was maximal [-0.579]. Since the threshold value of 0.75 was never exceeded, the variables should be regarded as uncorrelated and can thus be used within the final model.

The performance of the final model was tested by means of (1) cross-validation and (2) splitting the data into training cases (70 %) and testing cases (30 %). Both methods showed very similar accuracy, indicative of good model performance. It further allowed for the inclusion of the whole dataset to set into the final model.

Three discriminant functions (i.e. roots) were proposed. The first function, explaining 70 % of the explained variance, was mainly determined by the median grain size. Sediment mud content was most relevant within the second discriminant function, accounting for 23 % of the explained variance. The third function (7 % of the explained variance) was dominated by the interaction term (median grain size x sediment mud content).

Four classification functions (i.e. one per macrobenthic community) were derived (Table I.1.3a).

Table I.1.3a. Community specific weights of all variables taken into the classification functions. Cases are classified to the community rendering the highest score, by applying $S_i = w_{i(\text{Median grain size})}$*(Median grain size) + $w_{i(\text{Sediment mud content})}$*(Sediment mud content) + $w_{i(\text{Interaction term})}$*(Interaction term) + Constant, with i = community i.

	Group A	Group C	Group E	Group G
Median grain size	0.0759	0.0812	0.0908	0.1394
Sediment mud content	0.4717	0.2581	0.2675	0.4150
Interaction term	0.0014	0.0014	-0.0002	-0.0003
Constant	-18.4052	-12.7750	-14.0063	-31.1189

The *a posteriori* accuracy of the final model is 77 % on average, with a minimum of 67 % (sample group C) and a maximum of 88 % (sample group G) (Table I.1.3b). The majority of the sample was thus classified into the correct community (i.e. better than chance accuracy). Incorrectly classified samples were generally assigned to a neighbouring community (A -> C; C -> A or E; E -> C or G; G -> E).

Table I.1.3b. *A posteriori* accuracy and sample classification, rows: observed classifications and columns: predicted classifications.

	A posteriori accuracy	Group A	Group C	Group E	Group G
Group A	71 %	20	6	2	0
Group C	67 %	8	90	33	4
Group E	84 %	0	4	108	17
Group G	88 %	1	0	8	63
Total	77 %	29	100	151	84

In summary

- Median grain size and sediment mud content were the most important community structuring variables.
- The predictive model showed an average *a posteriori* accuracy of 77 %, varying between 67 and 88 % at the level of the four macrobenthic communities.

3.5 THE MODELLED MACROBENTHIC SPATIAL DISTRIBUTION

Taking into account the threshold for reliable assignment of samples (i.e. Mahalanobis distance < 1; see Materials and methods), 2977 samples (or 44 % of the RCMG dataset) were assigned to a macrobenthic community.

A combination of direct observations (i.e. macrobenthos samples: 372 data points) and modeled information (i.e. RCMG data: 2977 data points) renders a macrobenthic community distribution map of the BPNS, including 3349 data points (Map I.1.3b).

The *M. balthica* community (sample group A) is restricted in its distribution to the northeastern part of the BPNS: Coastal Bank area in between Oostende and the Belgian-Dutch border. This community is primarily found in combination with the *A. alba – M. bidentata* community.

The *A. alba – M. bidentata* community has a coastal distribution mainly in the area of the Western Coastal Banks (Belgian-French border to Koksijde), whereas further to the northeast the community is found further offshore: (1) southeastern part of the Flemish Banks, (2) southern part of the Zeeland Banks and (3) northern fringe of the Vlakte van de Raan. The distribution of the community is often interspersed with the *N. cirrosa* and the *M. balthica* community.

The *N. cirrosa* community has a wide distribution at the BPNS: the community is found throughout the whole BPNS, with its center of gravity in the area of the Flemish and Zeelandbanks. The community further dominates the transitional zone between the subtidal and the intertidal environment, as indicated by its high frequency of occurrence at the 0 m depth contour. The *N. cirrosa* community is primarily interspersed by the *A. alba – M. bidentata* and *O. limacina – G. lapidum* community. Along with the *O. limacina – G. lapidum* community, this community is the most abundant community within the BPNS.

Although the *O. limacina – G. lapidum* community can be found throughout the whole BPNS, its center of gravity is clearly situated in the offshore area: Hinderbanks and further north. The community is mainly interspersed with the *N. cirrosa* community. Along with the *N. cirrosa* community, this community is the most abundant community within the BPNS.

In summary

- Applying the model to the RCMG dataset, a detailed spatial distribution map of the macrobenthic communities within the BPNS is attained (3349 data points).
- Each community has a very specific distribution pattern within the BPNS, mainly structured along an onshore-offshore and east-west gradient.

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4 HOMOGENEOUS ZONES

The zones that have been delineated on the basis of the bathymetry and slope of the seabed are basically homogeneous in terms of their morphology (ref. geophysical zonation). The value of the delineation process would be strongly increased if it could be shown that they are also, more or less, homogeneous in terms of sediment nature, and ultimately in terms of their biology.

The zones, resulting from the geophysical zonation, have been used as query polygons of a variety of variables such as sedimentological parameters and in later phase macrobenthic groups. For the purpose of spatial planning, it was preferred to present the data and its associated scatter as it is in the original databases. This means that no interpolations have been done. Figure I.1.4a is a synthesis of the sedimentological nature (median grain-size) of the different zones. Generally, this figure shows that some zones clearly have another median grain-size range than others.

It needs emphasis that only the spread of the median grain-size is given per zone. This means that a cumulative count of occurrence is given whereby each count refers to a median grain-size falling in the range of respectively mud or very-fine, fine, medium and coarse sand. The overall range over which the median grain-size varies is however not solely natural. It must be remembered that the sedimentological database covers a period from 1976 to the present implying that the database is largely scattered. This is partly naturally caused, but also related to the different methodologies used in the grain-size analyses, different calculation procedures for the sedimentological parameters and generally human bias. Nevertheless, it gives a rough indication of the sediments that can be expected. As a synthesis, the average median grain-size per zone is also given in Figure I.1.4a, but purely as a qualitative measure. It is clear that the surface areas of the different zones vary significantly. This means that the spreading around the median grain-size will be for some zones more significant than in other zones. As such, this value is also given and pleads to evaluate the results in a more relative way. Finally, the density of the sampling points per zone is indicated and is one measure of reliability. Table I.1.4a gives a sorting of the zones according to their average median grain-size. Note that there is clear spatial trend with the sediments coarsening in an offshore direction.

Figure I.1.4a. Evaluation of the zones in terms of their surficial sediment characteristics. The Figure shows the spread of the median grain-size (µm) per zone (based on sedisurf@ database, Gent University, RCMG).

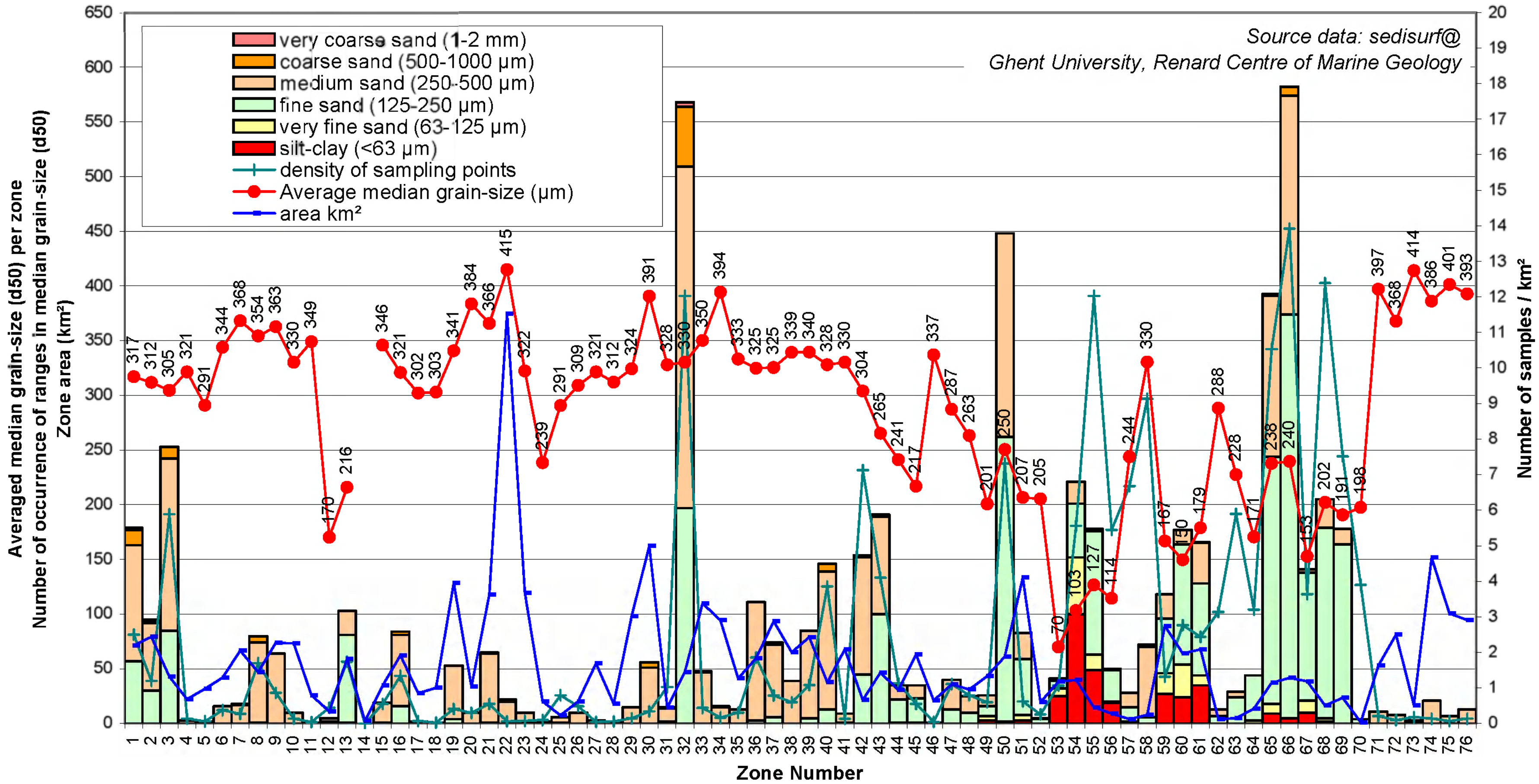


Table I.1.4a. Sorting of zones according to their average median grain-size. The dominant group in which the median grain-size falls is indicated (M: mud; FS: fine sand; MS: medium sand) as well as the number of observations in that group (based on sedisurf@ database, Gent University, Renard Centre of Marine Geology).

Zone	Morphological unit	Name of morphological unit	Dominant group (number of observations)	Average d50 (µm)	Remark
53	swale	Scheur	M (25)	70	N of Zeebrugge
54	sandbank	Wielingen	M (1)	103	
56	swale	Appelzak	FS (29)	114	Near coastal area
55	sandbank	Paardenmarkt	FS (113)	127	
60	sandbank	Wenduine Bank	FS (110)	150	
67	shoreface	deeper shoreface Nieuwpoort-Oostende	FS (117)	153	
59	sandbank	Wandelaar and western prolongation	FS (50)	167	
12	swale	swale Breed Bank - Smal Bank	MS (3)	170	
64	shoreface	deeper shoreface Oostende-Zeebrugge	FS (41)	171	
61	swale	swale south of Wenduine Bank	FS (84)	179	
69	shoreface	shoreface French Border - Oostende	FS (164)	191	
70	shoreface	shoreface west of Zeebrugge	FS (4)	198	
49	swale	swale north of Wandelaar	MS (10)	201	
68	swale	Potje	FS (174)	202	
52	sandbank	Droogte van Schooneveld	FS (4)	205	
51	sandbank	Vlakte van de Raan	FS (51)	207	
13	sandbank	Smal Bank	FS (80)	216	
45	swale	swale south of Akkaert Bank	FS (22)	217	
63	shoreface	shoreface Oostende-Zeebrugge	FS (24)	228	
65	swale	Westdiep - Kleine Rede	FS (226)	238	
24	swale	swale south of the Bergues Bank-In Ruytingen system	FS (2)	239	
66	sandbank	Trapegeer - Broers Bank - Den Oever	FS (369)	240	
44	swale	Grote Rede	FS (21)	241	
57	shoreface	shoreface east of Zeebrugge	MS (13)	244	
50	sandbank	Nieuwpoort Bank - Stroombank system	FS (260)	250	
48	sandbank	Oostende Bank	MS (15)	263	Mainly Flemish Banks
43	swale	Negenvaam	FS (1)	265	
47	swale	swale Middelkerke bank - Oostende Bank	MS (27)	287	
62	sandbank	Br&W Oostende	FS (7)	288	
25	swale	swale Dijck - In Ratel Bank	MS (5)	291	
5	sandbank	sandbank north of Thornton Bank	MS (2)	291	
17	swale	swale west of In Ruytingen	MS (2)	302	
18	sandbank	ebb parabola connecting the Bergues Bank-In Ruytingen system with the Fairy Bank	MS (1)	303	
42	sandbank	Middelkerke Bank	MS (107)	304	
3	swale	Kwinte	MS (157)	305	
26	sandbank	Dijck	MS (10)	309	
2	swale	swale Oostdijck - Buiten Ratel	MS (62)	312	
28	swale	Ruytingen Pas	MS (1)	312	
1	sandbank	Buiten Ratel	MS (106)	317	
16	sandbank	Oostdijck	MS (65)	321	
4	sandbank	western part Rabsbank	MS (3)	321	
27	sandbank	In Ruytingen	MS (3)	321	
23	swale	swale south of Fairy Bank	MS (9)	322	
29	sandbank	Out Ruytingen - Bergues Bank	MS (15)	324	
36	sandbank	Thornton Bank	MS (108)	325	Mainly area of Zeeland Ridges
37	swale	swale south of Goote Bank	MS (66)	325	
40	sandbank	Goote Bank	MS (126)	328	
31	swale	swale south of Flemish Banks	MS (12)	328	
41	sandbank	Akkaert Bank	MS (8)	330	
10	sandbank	Fairy Bank	MS (10)	330	
32	sandbank	Kwinte Bank	MS (312)	330	
58	sandbank	Ravelingen	MS (64)	330	
35	sandbank	western prolongation Goote Bank	MS (13)	333	
46	sandbank	topographic hight south of Akkaert Bank	MS (1)	337	
38	swale	swale north of Buiten Ratel - Kwinte Bank	MS (39)	339	
39	swale	swale Goote Bank - Thornton Bank	MS (80)	340	

Table I.1.4a. Sorting of zones according to their average median grain-size. The dominant group in which the median grain-size falls is indicated (M: mud; FS: fine sand; MS: medium sand) as well as the number of observations in that group (based on sedisurf@ database, Gent University, Renard Centre of Marine Geology) (continuing).

Zone	Morphological unit	Name of morphological unit	Dominant group (number of observations)	Average d50 (µm)	Remark
19	swale	swale Westhinder - Oosthinder	MS (49)	341	Mainly Hinder Banks region
6	sandbank	Bligh Bank	MS (16)	344	
15	swale	swale Bergues Bank - Oostdijck	MS (18)	346	
11	sandbank	Binnen Ratel - Breed Bank	MS (1)	349	
33	swale	swale north of Thornton Bank	MS (47)	350	
8	sandbank	Westhinder	MS (73)	354	
9	sandbank	Noordhinder	MS (64)	363	
21	swale	swale Noordhinder - Westhinder	MS (63)	366	
72	sandbank	sandbank N of Fairy Bank - Noordhinder	MS (8)	368	
7	sandbank	Oosthinder	MS (17)	368	
20	swale	swale Fairy Bank - Noordhinder	MS (10)	384	
74	shoal	shoal outmost N	MS (21)	386	
30	swale	swale Oosthinder - Bligh Bank	MS (51)	391	
76	swale	swale outmost N	MS (13)	393	
34	swale	swale east of Bligh Bank	MS (15)	394	
71	swale	swale N of Noordhinder	MS (11)	397	North of BPNS
75	sandbank	sandbank outmost N	MS (7)	401	
73	swale	swale of sandbank N of Fairy Bank - Noordhinder	MS (2)	414	
22	swale	outmost northern sandwave field	MS (20)	415	

The same querying process can be performed on the biological dataset. The results are encouraging and show that zones exist that are clearly dominant in a particular macrobenthic group. Figure I.1.4b gives the number of observed macrobenthic groups per zone. In Table I.1.4b the zones are grouped according to their dominant macrobenthic group if more than 1 observation is available (n>1). From this a clear S-N and W-E trend can be observed: Group A mainly occurs around Zeebrugge; Group C is dominant in the deeper parts of the near coastal area and on the Smal Bank and Middelkerke Bank; Group E is representative for the sandbank areas and the western shorefaces; Group G is mainly found in the Hinder Banken region and towards the north of the BPNS. It is clear that this trend resembles the trend in the median grain-size distribution.

The query of the macrobenthic groups per zone has been repeated on the extended biological dataset that resulted from the prediction of macrobenthic groups on the basis of the large sedimentological database using the Habitat model (see also ecological zonation). A resume of the predicted macrobenthic groups per zones is now largely dominated by Group E. This implies that the zones show similar macrobenthic groups and no clear delineations can be made; this in contrast to what was expected from the observations. The reasons for this homogeneous result are at least threefold:

Firstly, it needs emphasis that the sediment variables that were used to set-up the predictive Habitat model result from a well-defined and uniform methodology and as such a narrow correlation could be found between the occurrence of macrobenthic groups and their sediment characteristics. This narrow correlation has later been used for predictions using sediment parameters from the sedisurf@ database. As mentioned before, the latter is a compilation of sedimentologcial variables from 1976 onwards and is based on a variety of methodological approaches. Future research will try to find a correlation between both datasets and try to compensate for this difference. The results will likely improve significantly.

Table I.1.4b. Synthesis of the dominant macrobenthic group per zone (A, C, E or G) and its number of occurrence () (based on macrodat@ database, Gent University, Marine Biology Section).

zone	morphological unit	Name of morphological unit	Dominant macrobenthic group (n>1)	Spatial coverage
61	swale	swale south of Wenduine Bank	A (19)	Near coastal area around Zeebrugge
55	sandbank	Paardenmarkt	A (3)	
60	sandbank	Wenduine Bank	A (7)	
43	swale	Negenvaam	C (12)	Mainly the deeper parts of the near coastal area; also some of the Flemish Banks (*Smal Bank and Middelkerke Bank*)
45	swale	swale south of Akkaert Bank	C (13)	
68	swale	Potje	C (15)	
12	swale	swale Breed Bank - Smal Bank	C (2)	
53	swale	Scheur	C (2)	
65	swale	Westdiep - Kleine Rede	C (21)	
37	swale	swale south of Goote Bank	C (3)	
49	swale	swale north of Wandelaar	C (4)	
59	sandbank	Wandelaar and western prolongation	C (4)	
13	sandbank	Smal Bank	C (5)	
44	swale	Grote Rede	C (5)	
42	sandbank	Middelkerke Bank	C (9)	
3	swale	Kwinte	C-E (2-2)	
47	swale	swale Middelkerke bank - Oostende Bank	C-E (2-2)	
62	sandbank	Br&W Oostende	C-E-G (1-1-1)	
51	sandbank	Vlakte van de Raan	E (12)	Mainly on sandbanks and sandy shorefaces
66	sandbank	Trapegeer - Broers Bank - Den Oever	E (18)	
36	sandbank	Thornton Bank	E (2)	
48	sandbank	Oostende Bank	E (2)	
69	shoreface	shoreface French Border - Oostende	E (2)	
32	sandbank	Kwinte Bank	E (27)	
2	swale	swale Oostdijck - Buiten Ratel	E (3)	
31	swale	swale south of Flemish Banks	E (3)	
33	swale	swale north of Thornton Bank	E (3)	
1	sandbank	Buiten Ratel	E (4)	
16	sandbank	Oostdijck	E (5)	
34	swale	swale east of Bligh Bank	E (5)	
50	sandbank	Nieuwpoort Bank - Stroombank system	E (6)	
67	shoreface	deeper shoreface Nieuwpoort-Oostende	E (7)	
9	sandbank	Noordhinder	E-G (4-4)	
30	swale	swale Oosthinder - Bligh Bank	G (10)	Hinder Banken and area north of the Belgian shelf
8	sandbank	Westhinder	G (3)	
20	swale	swale Fairy Bank - Noordhinder	G (3)	
22	swale	outmost northern sandwave field	G (4)	
21	swale	swale Noordhinder - Westhinder	G (5)	
19	swale	swale Westhinder - Oosthinder	G (6)	
10	sandbank	Fairy Bank	G (7)	
72	sandbank	sandbank N of Fairy Bank - Noordhinder	G (8)	
74	shoal	shoal outmost N	G (9)	

Secondly, it is not surprising that a bias occurs towards Group E as most of the sampling points of the sedimentological database are focussed on the sandbank areas and the deeper parts are often undersampled. Moreover, the BPNS is predominantly sandy and as such Group E will allways tend to dominate. Furthermore, Group C is likely to occur in a more patchy way and as such it is rather unlikely that a complete large-scale zone is dominated by this group. As Group C is the most diverse and rich group, any occurrence is very valuable and is preferentially accounted for in any spatial planning activitiy.

Thirdly, one could argument that a zonation on a broad-scale, as in this case, might have limited ecological relevance. This pleads for a more detailed approach which also implies the availability of good quality data. Crucial in this is a detailed and holistic substrate map as this determines, in highest rank, the occurrence of macrobenthic communities. On-going research is heading into this direction.

CONCLUSION

A zonation of the Belgian part of the North Sea has been performed on the basis of morphologically homogeneous areas. This has resulted in 76 zones that are clearly identifiable towards end-user communities. In a later phase, it was shown that per zone the surficial sediments have more or less similar sedimentological characteristics. The tables that are provided can be used as a first rough estimate of the median grain-size per zone and give a better insight into the spatial distribution of the surficial sediments.

Given the strong link between the sedimentological variation and the occurrence of macrobenthos, it was demonstrated that the delineated zones have relevance towards the occurrence of macrobenthic groups. This information is highly valuable in qualitative terms to any spatial planning project.

However, it was not possible to attribute sedimentological or macrobenthic variables to locations in a uniform way throughout the BPNS. As such, it is presently not possible to upgrade the zoning process of geophysical and ecological data into a quantitative base map, which can be used for the evaluation of anthropogenic activities and impact analysis. On-going research activities on the parameterisation and modelling of both physical and biological variables and their interaction will help the development of a more quantified and holistic approach in the future.

Figure I.1.4b: Evaluation of the zones in terms of the occurrence of macrobenthic groups; number of occurrences of observed macrobenthic groups per zone (based on macrodat database, Gent University, Section Marine Biology).

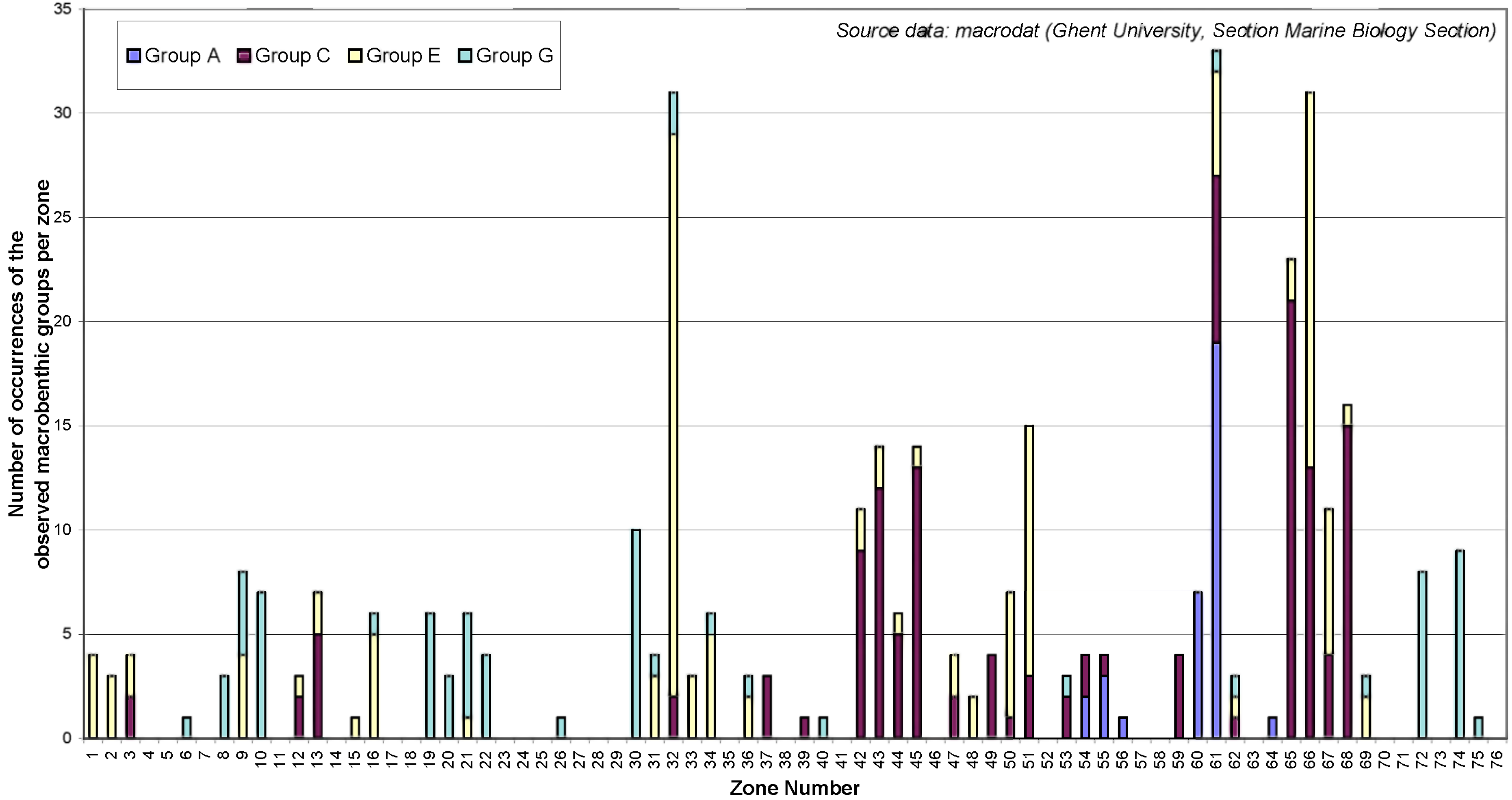
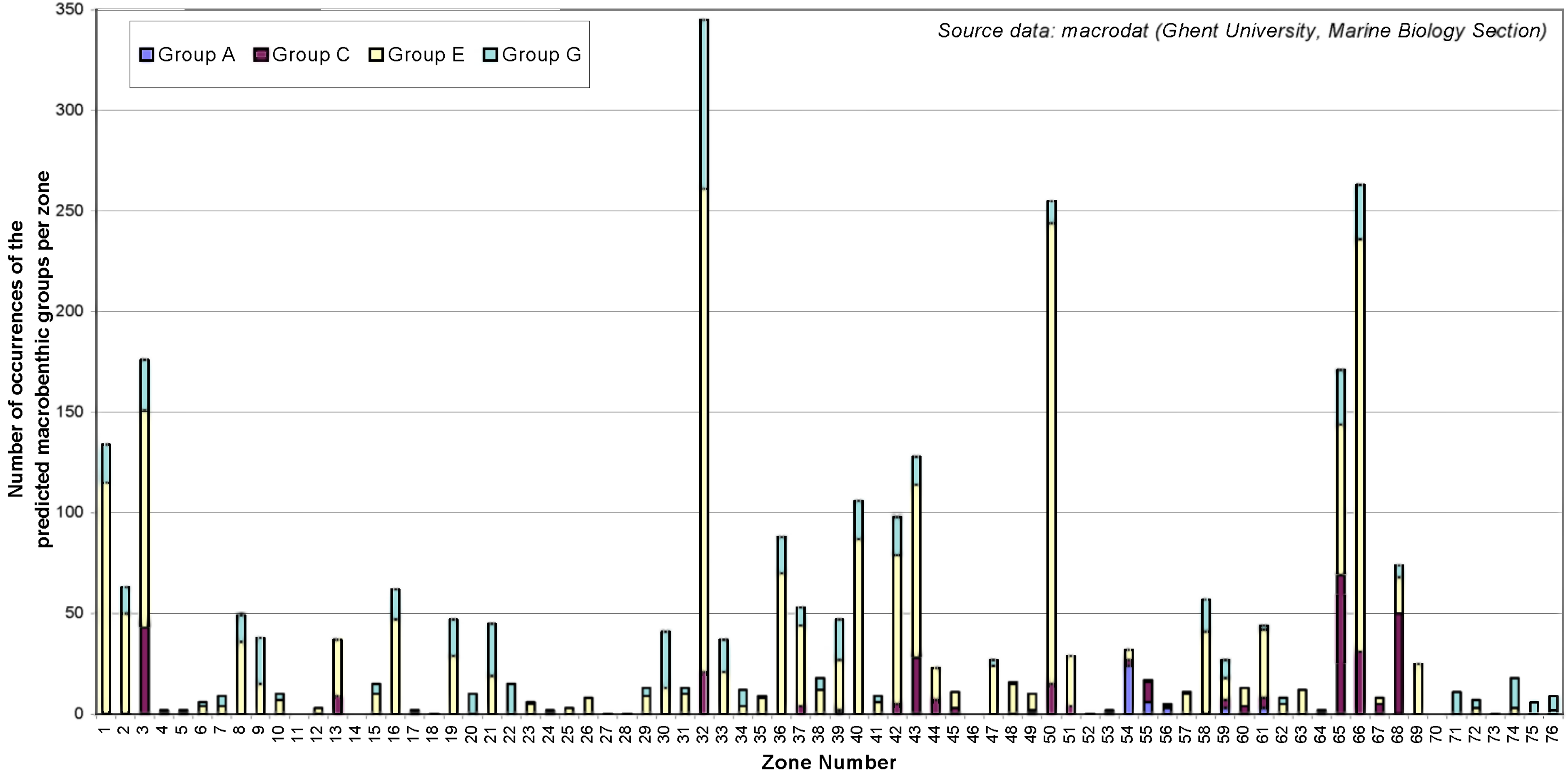


Figure I.1.4c: Evaluation of the zones in terms of the occurrence of macrobenthic groups; number of occurrences of predicted macrobenthic groups per zone (based on a prediction of macrobenthic groups using the sedimentological database of Gent University, Renard Centre of Marine Geology).



SECTION ONE ANALYSIS

Chapter Two
Infrastructure in the Belgian part of the North Sea

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1 CABLES AND PIPELINES

1.1 DESCRIPTION

The Belgian part of the North Sea (BPNS) is dissected by various cables and pipelines. Both electricity and telecommunication cables can be considered as 'cables'. At the moment there are no electricity cables on the BPNS. This is likely to change however, as the potential location of wind energy parks in the BPNS would require cables to transport the energy onshore. There are only gas pipelines and no oil pipelines on the BPNS.

The total length of all telecommunication cables and gas pipelines together (BPNS related) is approximately **1077 km**. The length of the telecommunication cables is **914 km** and the length of the gas pipelines is **163 km**.

There are **27 telecommunication cables**, of which only 16 are being used. The total length of the used cables is 718 km, whilst the cables in disuse have a length of 196 km.

There are **3 gas pipelines**; the Interconnector (between Bacton on the southern coast of the United Kingdom and Zeebrugge), the Zeepipe (between the Sleipner area on the Norwegian continental shelf and the Distrigaz terminal in Zeebrugge) and Norfra or Franpipe (between the Draupner E platform on the Norwegian continental shelf and Dunkirk on the northern coast of France). At this moment, Belgium only imports methane gas through offshore pipelines from Norway (Zeepipe) and the United Kingdom (Interconnector). Statoil manages and controls the Norwegian pipelines, while the Federal Public Service Economy, SMEs, Self-employed and Energy is responsible for the regulations. Fluxys is the Belgian operator. Through Zeepipe and Interconnector 2.5 million tons of gas was imported in 2003

Submarine cables (Drew et al. 1996)

There are two kinds of submarine telecommunication cables: *coaxial* (or analogue) cables and *fibre optic cables.* The coaxial cables were laid between 1950 and 1988. Only one is still in use on the BPNS: UK-Netherlands 9. The diameter of those cables ranges from 40 to 100 mm. In the 1980's, the fibre optic cable was introduced. The heart of this cable is a set of tiny glass fibres, with each fibre about the thickness of a human hair. Lasers shoot pulses of light through the glass fibres of the cables. One cable can contain between six and twenty-four glass fibres. The diameter ranges typically between 20 to 50 mm. The disadvantage of this kind of cables is the fragility of glass compared to copper. Beam trawl or dredging activities striking a fibre cable can easily render it useless without actually parting it.

Before the installation of a cable, a *route survey* takes place, examining bathymetry, slopes, sediment types and other activities or obstacles (e.g. pipelines, old cables or material discarded on the bottom). Specialized ships lay the cables. In areas where a lot of activities take place, cables are usually buried in the seabed, to protect them. In many coastal areas, the burial depth ranges between 0.6 to 0.9 m. Cable ships with ploughs usually bury the cables as they are laid.

Moving sediment and especially bedform dynamics may cause exposure of the cables. In the North Sea there are strong currents that can create sand waves up to 10 m high. Sections of cables may become exposed, suspended between the tops of mounds of sand. This causes a great risk of cable damage.

By 2003, more than US$ 56 billion will be invested in the fibre-optic undersea market, with about 1000000 route km in place (Coffen-Smout et al. 2000).

Pipelines (Pille 1999; Maes et al. 2000; http://www.statoil.com; http://www.interconnector.com).

Zeepipe is in operation since 1 October 1993 and has a length of 814 kilometres. Zeepipe is operated by Statoil and carries roughly 13 billion cubic metres of gas per year, with a daily capacity of 41 million cubic metres. The Sleipner A-Zeebrugge pipeline is a 40-inch pipeline. Any residual liquids and particles are stripped out at the Zeebrugge terminal, where the gas is also metered and pressure regulated for onward delivery for consumption, mainly in France and other southern European countries.

The Norfra pipeline (Franpipe) has a diameter of 42-inch and is 840 kilometres long. It is a high-pressure natural gas pipeline that runs from the Draupner E platform on the Norwegian continental shelf to Dunkirk on the northern coast of France. The line is operational since 1998 and transports 40 million cubic metres of gas per day and has a capacity of 15 billion cubic metres per year. Before the installation, pre-sweep activities for seabed leveling took place. Afterwards pre-trenching of stiff clay at the crossing of the Westhinder shipping lane was undertaken. The pipeline was laid by a aybarge and finally protected with at least 1 m of gravel laid on top of it. The final pipeline level is 0.70 m below the seabed.

Figure I.2.1a: The pipelines Zeepipe and Norpipe (Franpipe) in the North Sea (http://www.statoil.com)

Interconnector is a 235 kilometres gas pipeline between Bacton on the South coast of England and Zeebrugge, transporting gas from the Leman gas field on the Britisch continental shelf. Interconnector became operational in October 1998. The Interconnector pipeline is bi-directional and can be configured for either UK export (forward flow) or UK import (reverse flow). Interconnector operates in swing with a reverse flow (capacity of 8.5 billion cubic metres/year) in winter and a forward flow in summer (capacity of 20 billion cubic metres/year). It is expected that the UK will become a net importer of gas and the reverse flow will rise up to 16.5 billion cubic metres per year in December 2006 and 23.5 billion cubic metres per year after December 2006. The pipeline has a diameter of 40 inches and is made of carbon steel. A layer of asphalt enamel provides corrosion protection to the external surface of the offshore pipeline. In addition, as a backup, cathodic protection is provided by aluminium 'bracelet' anodes clamped around the pipe. A concrete weight coating is added to keep the pipeline stable on the seabed.

Figure I.2.1b: The pipeline Interconnector in the North Sea (http://www.interconnector.com)

1.2 SUB-USES AND DESCRIPTION

For the placement of cables and pipelines, trenches are dug. The cables and pipelines are put in the trenches and are then covered. The digging of trenches is undertaken by either jetting (a jet trencher digs the trench with jets of water) or ploughing. Jet trenchers are also used for digging trenches for pipelines.

1.3 LEGISLATIVE FRAMEWORK

(updated by Cliquet A.)

1.3.1 Spatial delimitation

Legislation

An authorization is needed for the placement of cables and pipelines; the pipeline trajectory has to be approved by the King.

International legislation and Belgian implementation:

(Wagner 1995; Cliquet et al. 2004; Maes and Cliquet 2005)

- International Convention for the Protection of Submarine Cables, 14 March 1884 (Cable Convention).
    - Implementation in Belgium:
        - Law of 18 April 1888 on the approval of the International Convention For The Protection of Submarine Cables, *BS* 21 April 1888.
        - Law of 18 April 1885 on the punishments for the provisions of the International Convention for The Protection of Submarine Cables, *BS* 21 April 1888.

- United Nations Convention on the Law of the Sea, Montego Bay, 10 December 1982.
    - Implementation in Belgium:
        - Law of 18 June 1998 on the approval of the Convention on the Law of the Sea of 10 December 1982 and the Agreement relating to the implementation of Part XI of the United Nations Convention on the Law of the Sea of 10 December 1982 of 28 July 1994, *BS* 16 September 1999.

- Convention between Belgium and Norway on the transport of gas by pipeline from the Norway continental shelf and other areas to Belgium, Oslo, 14 April 1988.
    - Implementation in Belgium:
        - Law of 19 September 1991 on the approval of the Convention between Belgium and Norway on the transport of gas by pipeline from the Norway continental shelf and other areas to Belgium and the exchange of letters on the interpretation of article 2, § 2 on the Convention, *BS* 20 September 1993.

- Convention between Belgium and Norway on the "Norfra" gas pipeline on the Belgian continental shelf, Brussels, 20 December 1996.
    - Implementation in Belgium:
        - Law of 13 May 2003 on the approval of the Convention between Belgium and Norway on the "Norfra" gas pipeline on the Belgian continental shelf, *BS* 29 October 2003.

- Convention between the government of Belgium and the government of the United Kingdom of Great-Britain and Northern Ireland on the transport of gas by pipeline between Belgium and the United Kingdom, Brussels, 10 December 1997.
    - Implementation in Belgium:
        - Law of 26 June 2000 on the approval of the Convention between the government of Belgium and the government of the United Kingdom of Great-Britain and Northern Ireland on the transport of gas by pipeline between Belgium and the United Kingdom, *BS* 12 September 2002.

National legislation

(Cliquet et al. 2004 ; Maes and Cliquet 2005) :

- Law of 13 June 1969 on the exploration and exploitation of non-living resources of the territorial sea and the continental shelf, BS 8 October 1969; amended by the Law of 20 January 1999 on the protection of the marine environment in the marine areas under Belgian jurisdiction, *BS* 12 March 1999; Law of 22 April 1999 on the Belgian exclusive economic zone in the North Sea, *BS* 10 July 1999.

- Law of 20 January 1999 on the protection of the marine environment in the marine areas under Belgian jurisdiction, *BS* 12 March 1999; as amended.

- Royal Decree of 12 March 2002 on provisions for the laying of electricity cables that enter the territorial sea or national territory or that are placed or used for the exploration of the continental shelf, the exploitation of mineral resources and other non-living resources thereof or for activities of artificial islands, installations or structures under Belgian jurisdiction, *BS* 9 May 2002.

- Royal decree of 7 September 2003 concerning the procedure of permit and authorization of certain activities in the marine areas under Belgian jurisdiction, *BS* 17 September 2003, err. BS 25 September 2003 .

- Royal decree of 9 September 2003 concerning the rules of the environmental impact assessment in application of the law of 20 January 1999 on the protection of the marine environment in the marine areas under Belgian jurisdiction, *BS* 17 September 2003.

1.3.2 Type and intensity

No prelimary legislative restrictions on type or intensity of cables or pipelines exist. However a permit and an environmental impact assessment is required for excavation of trenches and raising of the seabed (art. 25) according to article 28 of the Law of 20 January 1999 on the Protection of the Marine Environment in the Marine Areas under Belgian jurisdiction. For the installation of cables and pipelines a permit must be granted and the direction must be approved by the competent minister (art. 4, Continental Shelf Law and Royal Decree of 12 March 2002 on provisions for the installation of electricity cables that enter the territorial sea or national territory or that are placed or used for the exploration of the continental shelf, the exploitation of mineral resources and other non-living resources thereof or for activities of artificial islands, installations or structures under Belgian jurisdiction).

1.4 EXISTING SITUATION

1.4.1 Spatial delimitation

(Map I.1.2a)

Source

- Federal Public Service Economy, SMEs, Self-employed and Energy
- Ministry of the Flemish Community, Hydrographic Service

Reliability margin

The cables and pipelines that are in use are known. The ones in disuse are not followed up upon.

Future perspectives

Future cables and pipelines have to be placed as close as possible to existing installations. Electricity cables for the future wind energy parks are planned.

1.4.2 Type and intensity

(Map I.1.2b)

Intensity per unit area

1077 km cables and pipelines per 3600 km² (total surface of BPNS) = 300 m per 1 km²

1.5 INTERACTION

1.5.1 Suitability for user

Details – if applicable – can be found in the chapter that is specifically dedicated to "Suitability"

1.5.2 Impact on other users

Details – if applicable – can be found in the chapter that is specifically dedicated to "Interaction among users"

Spatial conflict

There is a spatial conflict between the cables and pipelines and:

- shipping routes
- military exercise areas
- Oostende dumping zone
- future electricity cable
- old industrial dumpsite
- dredged zones
- aggregate extraction zones
- nature protection
- fisheries

There are safety distances for both the cables and the pipelines that have to be respected. Those distances are not legal yet, but they are complied with as a matter of practice (Schotte 2003 pers.comm.).

Safety distances

Distance from the cables:

- *protected zone*: inside a zone of **250 m** at both sides of a cable:
  - no anchor may be dropped;
  - no activity that can be a risk for the cable, except the construction of another cable, may take place
  - exception: interventions by the owner of the cable for exploitation needs.
- *reserved zone*: inside a zone of **50 m** at both sides of a cable:
  - no installation, cable or pipeline may be constructed.

- exceptions:
  - ~ uni-polar electricity cables protected with the same safety switch
  - ~ arrival and departure points of cables near installations (wind turbines, transformer platform, etc.)
  - ~ cables that have been repaired
  - ~ crossing of cables and gas pipelines
  - ~ maintenance dredging works in the seaways

Distances from the pipelines:

- *protected zone*: inside a zone of **1000 m** at both sides of the pipelines:
  - no sand extraction may take place;
  - no other pipelines may be placed.
- *reserved zone*: inside a zone of **500 m** at both sides of the pipelines:
  - no other installations may be placed, unless they have to cross the pipeline.
  - exception: maintenance dredging works and interventions by the owner of the cable for exploitation needs.

1.5.3 Impact on environment

Details – if applicable – can be found in the chapter that is specifically dedicated to "Interaction between users and the environment".

On the Thornton Bank outside the territorial sea, C-Power N.V. intends to build a wind energy park of 50 turbines, capable of producing 2 MW. In the non-technical summary of this wind energy park (http://www.mumm.ac.be/Downloads/NTS-C-POWER_NL.pdf) the following is mentioned about the impact of the electricity cables on the environment during its construction:

"The sediment quality is influenced temporary during the realization of the cables. The agitation and re-suspension of sediments as a consequence of the placement of the cables will have a small impact on the sediment quality, because of the permanent sediment dynamics in the Belgian coastal waters and because of the limited yard (both considering the mixed sea-floor surface and considering the execution time). The possible small enrichment of the sediments with pollutants in the water column has a small effect because of the small impact of the placement of the cables on the water quality.

During the realization of the cables there is a temporary effect on the water quality, because of a local increase of turbidity in the water column. The placement of the cables will cause the sediments on the sea floor to move. It is a small effect, however, because of the high background movement of sediment in Belgian coastal waters and the limited yard (both considering the mixed sea-floor surface and considering the execution time).

Other significant effects on the water quality are a small increase of pollutants (organic, inorganic, heavy metals), a small disturbing of the O_2 *,C, N and P balance and a small increased BOD (biological oxygen demand)/COD (chemical oxygen demand) factor because of the re-circulation of the sediments. Again it is a small effect because of the limited yard (both considering the mixed sea-floor surface and considering the execution time).*

There are also temporary effects on the fauna and flora during the realization of the cables.

Benthos: due to the large re-colonisation potential of the benthos and the small yard (both considering the mixed sea-floor surface and considering the execution time), the damage of the benthos by sedimentation of suspended materials will be small.

Fish: the disturbing and the frightening of fish, by noise, change of substrate and reduced light penetration is small because of the large possibilities of fish to diverge and the limited yard.

Birds: the disturbing of the birds, by noise and the disturbing of nourishment source is small because of the large possibilities of birds to flee and the limited yard.

Flora: the disturbing of the flora by an increased re-suspension of particles is small because of the high mobility factor of the phytoplankton and its large re-colonisation potential and because of the limited yard.

Due to the placement of the cables there is a small temporary increase of noise, which has a small impact offshore because of the limited yard (considering the vessels, the surface and the execution time). Because of the long distance to the coastline the increase of noise doesn't have an impact onshore.

Roughly it can be stated that the temporary impact of the realization of the cables is small, because of the following reasons: (i) the limited duration in time of the placement of the cables, (ii) the limited number of vessels, compared to the permanent shipping traffic offshore Oostende and Zeebrugge, (iii) the total surface of the mixed sea-floor because of the placement of the cables is estimated to be maximally 100.000 m² (jetting), being less than 0,5 % of the total surface of the windmill park.

The temporary increase in turbidity during the activities has a small impact, because of the permanently high background values of the sediment dynamics in the Belgian coastal waters. There is almost no permanent impact of the cables during the realization of the placement."

It is likely that the already existing cables and pipelines on the BPNS have a similar impact on the environment.

Biological

Impact on benthos:

Small

One year after the cable has been laid: no significant changes in zoobenthos species composition, abundance or biomass (Andrulewicz et al. 2003)

Impact on fishes:

Small

Impact on birds:

Small

Impact on flora:

Small

Geological/physical

Small

One year after the cable has been laid: no visible mechanical disturbances on the dynamic sandy bottom (Andrulewicz et al. 2003).

The sandwaves or dunes, present on the BPNS, may pose specific challenges to the subsea engineering works. The migration and changing characteristics of sandwaves can influence the design bed level for a structure, present a hazard to navigation and expose pipelines and cables, increasing the risk of damage Whitehouse et al. (2000) examines the current understanding of the behaviour of sandwaves in relation to the practicalities of cable laying operations.

Hydrological

Small

1.5.4 Impact on socio-economy

Social

Employment:

- Engineers
- Technical people (private telecommunication companies)

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Zeepipe and Franpipe (http://www.statoil.com)

Interconnecor (http://www.interconnector.com)

ECOLAS Environmental Consultancy & Assistance
Bart De Wachter & Annemie Volckaert

2 ENERGY

2.1 DESCRIPTION

There is no off-shore oil or gas-exploitation within the Belgian part of the North Sea (BPNS). There are, however, three gas pipelines located on the floor of the BPNS.

In addition there is one on-shore wind-energy project that is currently running at the harbour of Zeebrugge. A proposed expansion of this wind-energy project was recently rejected. Since 2001 several proposals for the construction of off-shore wind-energy parks in Belgium have been submitted. An overview of these proposals can be found in Appendix 1. Currently N.V. C-Power has obtained all the necessary permits to start construction of a further wind farm on the Thorntonbank, which is approximately 27 km from the coast. The project Seanergy (TV Electrabel – Ondernemingen Jan De Nul) has also received the domain concession on the Vlakte van de Raan (in the Belgian territorial see) and the environmental permit, but the execution is currently suspended due to a legal case at the Council of State.

Emphasis is placed on wind-energy projects in the following paragraphs.

2.2 SUBUSES AND DESCRIPTION

Not applicable.

2.3 LEGISLATIVE FRAMEWORK

(updated by Cliquet A.)

2.3.1 Spatial delimitation

Competent authority

The competent authorities for wind-energy development are:

- Coastal zone: Flemish government (Zeebrugge)
- Belgian marine area (12-miles zone (territorial sea), 24-miles zone, EEZ = BPNS): Federal (wind-turbines at sea);
- Domain concession: Ministry of Economic Affairs, Directorate Energy
- Environmental permit: Ministry of Public Health, Food Safety and Environment
- Electricity cables: Ministry of Economic Affairs

Legislation

(Cliquet et al. 2004 ; Maes and Cliquet 2005)

Wind-energy is currently not jurisdictionally restricted to specific zones within the BPNS.

The following procedure needs to be followed prior to the construction and exploitation of wind farms within the BPNS. The following permits need to be obtained:

- a domain concession;
- an environmental permit for the construction and exploitation of the wind farm;
- a permit for the construction and exploitation of submarine electricity cables.

Procedure for granting a domain concession (Federal – Min. Of Economic Affairs):

- Royal Decree of 20 December 2000 on the conditions for granting a domain concession for the construction and exploitation of installations for energy production from water, streams or wind in the marine areas under Belgian jurisdiction, *BS* 30 December 2000.
- Procedure (10 months):
  - Submit application to CREG (Commission for the Regulation of Electricity and Gas)
  - Advice to the minister or Secretary of State of Energy by CREG mainly based on financial-economic motives and security
  - Decision by the minister of Energy (Ministerial decision)
    - ~ Come into effect after accreditation of environmental permit

Procedure for environmental permit (Federal: MUMM & Minister of Public Health, Food Safety and Environment and Minister of the North Sea):

- Law of 20 January 1999 on the protection of the marine environment in the marine areas under Belgian jurisdiction, *BS* 12 March 1999; as amended: an Environmental Impact Assessment (EIA) is needed for each activity that requires a permit or authorisation (art. 28).
- Royal decree of 7 September 2003 concerning the procedure of permit and authorization of certain activities in the marine areas under Belgian jurisdiction, *BS* 17 September 2003, err. BS 25 September 2003 .
- Royal decree of 9 September 2003 concerning the rules of the environmental impact assessment in application of the law of 20 January 1999 on the protection of the marine environment in the marine areas under Belgian jurisdiction, *BS* 17 September 2003.
- Procedure (6-12 months):
  - EIA (Environmental Impact Assessment) by MUMM based on EIS
  - Public consultation (during 45 days)
  - Submit EIS (Environmental Impact Study) by applicant
  - Advice of MUMM to the federal minister of Environment based on EIA and public consultation
  - Decision by minister Environment whether environmental permit should be granted

Procedures concerning electricity cables:

- Royal Decree of 12 March 2002 on provisions for the laying of electricity cables that enter the territorial sea or national territory or that are placed or used for the exploration of the continental shelf, the exploitation of mineral resources and other non-living resources thereof or for activities of artificial islands, installations or structures under Belgian jurisdiction, *BS* 9 May 2002.

- Royal Decree of 19 December 2002 concerning the technical reglementation for the management of and access to the public electricity net, *BS* 28 December 2002: Federal: administrator of electricity net ELIA.

- Flemish Decree of 18 May 1999 concerning the organisation of spatial planning, *BS* 8 June 1999, as amended: to get a planning permit for a land cable (Flemish Region: AROHM)

Other International legislation:

- Directive 2001/77/EC of the European Parliament and of the Council of 27 September 2001 on the promotion of electricity produced from renewable energy sources in the internal electricity market, *Official Journal L 283, 27 October 2001*: for Belgium 6% by 2010.

Other national legislation:

- Law of 22 April 1999 on the Belgian exclusive economic zone in the North Sea, *BS* 10 July 1999: expansion of the Belgian jurisdiction outside the territorial waters for among other things windenergy production + application on the needed cables.

- Law of 29 April 1999 concerning the regularisation of the electricity market, *BS* 11 mei 1999, as amended: concessions for wind farms in the Belgian marine waters max. for 30 years (art.6)

Future perspectives:

- The closing of certain areas in the framework of NATURA 2000.
- The Belgian Government has issued a zoning plan, which allows a total of 2000 MW of wind-energy to be generated offshore. This plan zones the Thorntonbank as an area in which wind-energy can be developed.

2.3.2 Type and intensity

Intensity per area-unit

There are no juridical restrictions on the number of wind-turbines per area or on the distance of the concession area from the coast.

To keep mutual influence of the wind-turbines to a minimum (array losses < 10%), the distance between two rows should preferably be 5 times the rotor diameter in the crosswind direction and 8 to 10 times the rotor diameter in the prevailing wind direction (Van Hulle et al. 2004).

Frequency per unit of time

Considering the current capacity of the HV-grid connection the wind farm production should not exceed 500 MW, otherwise reinforcements are needed (Van Hulle et al. 2004).

2.4 EXISTING SITUATION

2.4.1 Spatial delimitation

(Map I.2.2a)

At this moment no offshore wind farms are installed within the BPNS.

C-Power N.V. has obtained the necessary permits - a domain concession (MB 27/06/2003), the environmental permit (MB 14/04/2004) and cable permit (MB 13/02/2004) - to start construction and exploitation of a wind farm on the Thorntonbank, which is approximately 27 – 30 km from the coast. In April 2004 the necessary seafloor investigations were started.

C-Power has chosen a split location, which doesn't in any way overlap with the Navy's anti-mine and target practice areas and maintains a minimum distance of 500 metres from the cables and gas pipes and from the individualised sand concession. Taking this safety zone into account a total area of 26.4 (10.7 + 15.7) km² will be taken.

The layout configuration of the wind-turbine park comprises of 60 turbines (3.6 MW) with a rotor diameter of 100 metres. The 60 wind-turbines are developed to the East (6*6=36; area = 8.8 km²) and to the West (6*4=24; area = 5.0 km²) of the Interconnector gas pipeline and the Concerto South 1 telecommunication cable.

The submarine cable between the offshore transformer platform and the public 150kV grid (Sas Slijkens in Bredene) on land is responsible for transporting the power that has been generated. The offshore cable line consists of two 150 kV cables with an inter-distance of 100 m (2 m depth), with the exception of the shipping traffic zone where the cables are laid at a distance of 500 m (4 m depth) from each other.

The SEANERGY project has received a concession (MB 27/03/2002) and the permits (MB 25/06/2002 and 10/02/2003) for the construction and exploitation of a wind-turbine park and the electricity cables on the Vlakte van de Raan. The concession is approximately 12.5 km from the coast. Currently, legal cases still running at the Council of State resulted in the suspension of the execution of the project. The project exists of 50 2 MW turbines in 5 rows of 10 monopile turbines, taking up an area of 5.8 km² (excluding safety zones).

The construction will also include two measurement masts and a transformer platform. The electricity transport is ensured by one 150 kV submarine cable. The electricity cable will run from the tranformer platform to the port of Zeebrugge, crossing the shipping route Het Scheur.

Source

Ecolas NV., 2003. Milieueffectenrapport voor een offshore wind-turbine park op de Thorntonbank. In opdracht van C-Power N.V.

Web page C-power: www.c-power.be (16/09/2004)

Web sites MUMM: www.mumm.ac.be/NL/Management/Sea-based/windmills.php

Tractebel Development Engineering. 2001. Milieueffectenrapport voor het bekomen van een machtiging en een vergunning voor de bouw en de exploitatie van een windturbinepark.

Reliability margin

The prerequisite permits will ensure that the proposed location of the wind-turbines (coordinates) is not changed at a later date.

Future perspectives

In the context of the Flemish Electricity Decree (17/07/2000) regulating the opening of the electricity markets, power suppliers are obliged to supply at least 3% of electricity from renewable energy sources to their customers in 2004 (and in 2010 minimum 5%). This was estimated on a total of 560 GWh renewable energy (land and sea) per year.

Consequentially a number of applications for the construction and exploitation of offshore wind-energy parks in the Belgian part of the North Sea have been submitted since 2001. Only one project is still in the running: Sea-energy on the Vlakte van de Raan (50 wind-turbines – total capacity of 100 MW). Besides projects on the BPNS, an additional application was made for a wind-energy project in the intertidal zone (SPE). However, this proposal was recently rejected. An overview of all projects is given in Appendix 1.

2.4.2 Type and intensity

(Maps I.2.2b-c)

Intensity per area-unit

At present a total of 23 wind-turbines (yearly production of 17.500 MWh) are exploited by Interelectra in the harbour of Zeebrugge (eastern longitudinal embankment). They provide electricity to 5000 families. Strictly taken they don't make part of spatial planning at sea as they are built on the breakwater itself (part of harbour).

The approved wind farm of C-power on the Thorntonbank will have a maximum installed capacity of 216 MW, which corresponds to an estimated annual electricity production of approximately 0.7 TWh (www.c-power.be). The Seanergy wind park has a planned maximum installed capacity of 100 MW.

Total energy consumption in Belgium is approximately 80 TWh per year (Annual report of BFE - 2001). At present only 2% of this total is generated from renewable sources. This means that Belgium must generate a further 4% of "green electricity" or about 3.2 TWh by 2010.

The intensity per area unit (maximum installed capacity per km^2 of concession zone) of the C-power poject corresponds to 15.7 MW / km^2, whereas that of the Seanergy project corresponds to 17.2 MW / km^2. Estimates of electricity production differ between different projects, not only because the installed turbines differ in technical specifications and mutual distance, but also because estimates depend on assumptions of windintensity and operational hours.

Intensity (expressed in MW / km^2) depends on the size of the windturbines. In general a distance between windturbines should be minimally 5 rotor diameters because turbulence behind the rotor decreases the efficiency of downwind-turbines. Larger distances between turbines increase efficiency, but result in lower intensity (expressed as turbines /km^2 or installed capacity /km^2).

Source:

Ecolas NV, 2003. Milieueffectenrapport voor een offshore wind-turbinepark op de Thorntonbank. In opdracht van C-Power N.V.

Web site C-power: www.c-power.be (09/01/2005)

Reliability margin:

High.

Future perspectives:

Several other projects have been submitted without positive results (see Appendix 1).

With regard to the future of the Seanergy project, the future and effective execution will depend on the outcome of the legal cases.

The wind-energy potential in terms of installed capacity is proportional to the available sea surface area and to the assumed wind power density. The available area amounts to 2101 km², after excluding the 3 miles zone and all hard exclusion zones (Van Hulle et al. 2004). In Van Hulle et al. (2004) it has been demonstrated that for purposes of potential estimation, the power density for the relevant future can be reasonably assumed to be constant and equal to 10 MW per km².

Turning the total available BPNS area into a giant wind farm would result in 21 GW of installed wind power capacity, sufficient to produce an amount of energy needed to cover a major part of the annual electricity consumption of the country. Optimisation of the site is strongly determined by the project investment cost, which is mainly driven by water depth and distance to the shore (Van Hulle et al., 2004)

The installed wind power capacity is further limited by configuration of the electrical grid. The present Belgian HV grid configurations do not allow more than 0.5 GW wind power to be taken from offshore. Expansion of wind power beyond this capacity would involve additional measures in the electrical power network (Van Hulle et al. 2004).

Frequency per unit time

Not applicable for windenergy production.

2.5 INTERACTIONS

Source:

- Ecolas NV., 2003. Milieueffectenrapport voor een offshore wind-turbine park op de Thorntonbank. In opdracht van C-Power N.V.
- Van Hulle, F., Le Bot, S., Cabooter, Y., Soens, J., Van Lancker, V., Deleu, S., Henriet, J.P., Palmers, G., Dewilde, L., Driesen, J., Van Roy, P. and R. Belmans, 2004. Optimal Offshore Wind Energy Developments in Belgium. Part I. Sustainable production and consumption patterns. Report SPSD II. 153 p.

2.5.1 Suitability for user

Biological suitability

Not applicable

Geological/physical suitability

- E.g. sinking in bottom, cable laying, compactness of bottom
- Changes in bottom structure and composition: at each wind-turbine's location the sandy bottom will be replaced by a hard underground footing (the pedestal of the wind-turbine). Because of changes in the currents (see further) the sediment surrounding the wind-turbine can undergo certain changes. For example, the supply of silt can change in places where the velocity of tidal currents is broken by the base of the wind-turbines.
- In principle there are no zones excluded with regards to soil properties for the installation of mono-pole foundations for wind-turbines. However, in particularly narrow areas the soil structure could possibly include some hazards, including: the Tertiary stone layers, the most heterogeneous Quaternary deposits (scour hollows) and zones with important deformations (Van Hulle et al. 2004). The most geotechnical suitable soils are clay and clayey sands, which show homogeneous natural and geotechnical properties without stony inclusions (Van Hulle et al. 2004).
- The wind resources at sea are very favourable because of the much higher values of wind speed than on land. On the BPNS, the average wind speed varies in a range from 8.4 to 10.1 m/s at heights of between 70 m and 150 m above sea level. In the first 20 km from the coast, the average wind speed increases quite fast with distance, however, from 20 km distance onwards the increase is very modest. In addition, the increase of wind speed with height is very moderate from 70 m onwards. In this respect, it is recommended to try to exploit the resource not too far from offshore and to be modest with tower heights, in view of optimal generation costs (Van Hulle et al. 2004).

Hydrological suitability

- Effects of currents, waves and sand movements on the construction has to be checked by use of models (e.g. WAVE, Delft 3D).
- Hydrological constraints are so far not being investigated in detail, but presumably there is no problem for the BPNS (m.m. 3E). It is, however, clear that going beyond 30 m water depth does not make sense in terms of adding to the potential (Van Hulle et al. 2004).

2.5.2 Impact on other users

Spatial conflict

Tourism:

- Positive: options for new diving sites with specific fauna and flora, new attraction for pleasure craft
- Negative: danger zone for diving because of currents; disturbance of natural view (less than when placed on land), possible sound nuisance during construction and exploitation phase depending on distance from the coast; Exclusion because of safety reasons

Shipping:

- Positive: none
- Negative:
  - nuisance of shipping traffic during repair/ construction wind-turbines
  - collision danger (additional chance estimated for C-Power windfarm: 1 accident per 200 year, with a leak of 50-75 ton oil)
  - interaction with electricity cables
  - loss of area
  - "shadow effect" on radar system because of turning blades, false echoes
- Exclusion because of safety reasons

Fisheries:

- Positive: new fishing areas for oyster or mussel culture (potential for aquaculture)
- Negative:
  - Conflict fishermen: In gullies sandbank: beam trawl fishery; on top of sandbanks: shrimp fishery
  - Loss of fishing grounds of several square meters; following aspects should be taken into consideration:
    - ~ Within 20-mile zone of the Belgian coast, no real poor areas can be found (areas without value for the fishermen (as fishing ground (direct) or spawning ground (indirect).
    - ~ Coastal fishery has handed in a lot of fishing ground during the last decades (to the harbour of Zeebrugge, the shipping routes to the harbour of Oostende, Zeebrugge and the Western Scheldt, etc.)
  - Disturbance of fishery during construction

Sand extraction:

- Negative: loss of exploitation area and exclusion for safety reasons

Military use:

- Negative: possible interference with radar transmission (low level air-defense radar) (Van Hulle et al. 2004) and exclusion for safety reasons

2.5.3 Impact on environment

Biological

- Positive:
  - Offshore wind-turbine foundation can to a limited extent act as artificial reefs for rocky shore fauna and flora, thus increasing the amount of food available for fish (Van Hulle et al. 2004). Examples are sponges, polyps, sea anemones, nude slugs, mussels, barnacles, crabs and lobsters, algae;
  - fishery free, biological rich zones; possible new spawning grounds or "child chambers" for fishes;
  - during construction negative effects (noise, vibrations), but these will be only temporarily;
  - saving of primary energy: Due to the proposed windenergy goal (land and sea) of 560 GWh per year against 2004 (omzendbrief 17/07/2000) 120000 ton coal, 3700 ton oil equivalent and 60 million m^3 natural gas/methane was estimated as being saved.

- Negative:
  - Disturbance of benthic-communities of soft sediments during construction phase (cable phase: afterwards recovery correct sediment)
  - Loss of area for fishes and invertebrates according to the size of the erosion protection layer (e.g. Thorntonbank: 0.1 km²)
  - Disturbance of spawning ground of certain fish species
  - Possible danger for collision of birds (tracking route) or deterrence of birds: impact depends a.o. on the protection status of birds. Little is known about the real impacts of operating offshore wind farms on birds. The most extensive study available showing factual results is a three year study of the impact of Tuno Knob on Eider Duck populations by the Danish National Environmental Research Institute. This study concluded with the statement that offshore wind-turbines have no significant effect on water birds (Van Hulle et al. 2004). On the other hand a recent study of Everaert et al. (2002) on the impact of wind-turbines on birds in Flanders (Belgium) stated that in accordance with other European studies wind-turbines do have an effect on birds (casualty, change in behaviour). They conclude that important bird areas and migration routes should be avoided when locating offshore wind farms. The impact is, however, species and site specific and local studies are essential to estimate the potential impact on birds. In the study a safety distance of 150- 300 m from the turbines would be sufficient for most waterbirds.
  - Changes in the current-regime can lead to changes in community structure in and around the location area. The SW-NE orientated rest current along the Belgian coast is responsible for the transport of sediments, nutrients and fish larvae. A change in this current can have an effect on the transport of larvae as on the supply of nutrients, which can have huge consequences for the fish stocks. The changes in the current regime can also disturb the morphology of the spawning grounds and "child chambers" of several fish species. The rest current is also of importance for the adult fish. Migration for food or for reproduction forms an essential part in the dynamics of fish populations. A disturbance of this process can have severe consequences on the fish stocks. Many migration routes along the Belgian and Dutch coast follow the SW-NE pattern, so together with the rest-current. This is the case for the cod, twhting and plaice and several pelagic fish species (like haring, sprat, mackerel). The location of permanent structures in these migration routes could lead to some serious problems.
  - Noise and vibrations can disturb fishes and sea-mammals: interference with their orientation mechanisms. Available knowledge about the effect of underwater noise and vibration on marine life suggests that the underwater noise generated by offshore wind farms will be in the same range of frequencies as existing sources such as vessels, wind and waves (Van Hulle et al. 2004). In order to prolong machine life, vibration should be "designed-out" as far as possible (Van Hulle et al. 2004).
  - Possible effect of electrical and magnetic radiation of cables on organisms

Geological/physical

- Positive: effects mostly temporarily
- Negative:
  - Temporarily disturbance of bottom structure during construction, cable laying and dismantlement
  - Disturbance of bottom because of the installation of an erosion protection layer. Diameter depending on the diameter of wind-turbine (F.ex. wind-turbine with 4-5 m Ø: stone dump of 48 m Ø or e.g. Thorntonbank: 1800 m² around the wind-turbine; total 0.1 km²))
  - Effect of sediment transport on bottom: research needed

- Bottom pollution: indirect

Hydrological

- Positive: breaking of power of currents/ waves
- Negative:
  - Temporary increase of turbidity during construction, cable laying and dismantlement
  - Obstruction hydrodynamics restricted
  - Accidental leaks also limited

2.5.4 Impact on socio-economy

The socio-economic impact is mainly based on the most recent study for the BPNS:

Van Hulle, F., Le Bot, S., Cabooter, Y., Soens, J., Van Lancker, V., Deleu, S., Henriet, J.P., Palmers, G., Dewilde, L., Driesen, J., Van Roy, P. and R. Belmans, 2004. Optimal Offshore Wind Energy Developments in Belgium. Part I. Sustainable production and consumption patterns. Report SPSD II. 153 p.

Some additional socio-economic data from other literature is given in Appendix 3.

Economic

Offshore wind-energy potential in the Belgian part of the North Sea (BPNS):

The wind-energy potential in terms of installed capacity is proportional to the available surface area and to the assumed wind power density. The available area amounts to 2101 km², after excluding the 3 miles zone and all hard exclusion zones (sand and gravel, shipping routes, military use, dredging zones, industrial waste and dumping zones, cables and pipelines) (Van Hulle et al. 2004).

The power density for near future and far future can be reasonably assumed to be constant and equal to 10 MW per km² (Van Hulle et al. 2004). Turning the total available BPNS area into a giant wind farm would result in 21 GW of installed wind power capacity, sufficient to produce an amount of energy needed to cover a major part of the annual electricity consumption of the country.

Optimisation of the site is strongly determined by the project investment cost, which is mainly driven by water depth and distance to the shore. Economically, it makes a lot of sense to limit the water depth to 20 m and the distance to the coast to 40 km, as the relative contribution from far and deep sites (expensive sites) is not very substantial. (Van Hulle et al. 2004).

The installed wind power capacity is further limited by the limitations posed by the electrical grid. The present Belgian HV grid configurations do not allow more than 0.5 GW wind power to be taken from offshore. Expansion of wind power beyond this capacity would involve additional measures in the electrical power network (Van Hulle et al. 2004).

The main numbers are summarised in Table I.2.2a and I.2.2b

Table I.2.2a: Main figures about the potential in terms of installed wind power capacity (GW) (Van Hulle et al. 2004)

	GW installed wind power	Restrictions
Maximum physical potential	21	Exclusion zones
Economic potential	2.1 - 4.2	15% to 30 % of all areas with max. water depth of 20 m, max. distance to shore of 40 km

2004 status of grid integration absorption capacity	0.5	Based on static load flow calculations, available grid connection points in Zeebrugge and Slijkens

Table I.2.2b: Potential energy annual energy generation (Van Hulle et al. 2004)

	TWh/year	Restrictions
Maximum physical potential	66 - 79	Exclusion zones
Economic potential	6.3 – 12.6	15% to 30 % of all areas with max. water depth of 20 m, max. distance to shore of 40 km

Offshore wind-energy costs:

In the study of Van Hulle et al. (2004) the following estimations were given, taking into consideration a number of assumptions and limitations.

The investment cost estimates range from 1500-2400 Euro/kW with 2005 technology and from 900-1600 Euro/kW with 2015 technology. The ranges are depending on water depth, distance to coast, wind-turbine hub height (70 m and 110 m), and assumptions on technology status. On every sandbank, the investment cost decreases because of cheaper foundations. For instance, on the Thorntonbank, 28 km from the coast, with an average water depth of 16 m, the investment cost is ± 1800 €/kW (2005 level technology). For a given hub height and technology level, the lower values correspond to near shore locations, the higher values to sites at the far end of the BPNS (Table I.2.2c). These values compare well with numbers found in literature.

Table I.2.2c: Range of specific total investment costs (Van Hulle et al. 2004)

Time frame	Hub height (m)	Lowest value (€/ kW)	Highest value (€/kW)
2005	70	1500	2200
	110	1600	2400
2015	70	900	1500
	110	1000	1600

The estimated generation costs range from 65-90 Euro/MWh with 2005 technology and 36-54 Euro/MWh with 2015 technology. Again, the ranges are depending on water depth, distance to coast, wind-turbine hub height (70 m and 110 m), and assumptions on technology status (Table I.2.2d). Increasing hub height is not really yielding better economics.

Table I.2.2d: Summary of generation costs of offshore wind-energy on the BPNS (Van Hulle et al. 2004)

Time frame	Hub height (m)	Lowest value (€/ MWh)	Highest value (€/MWh)
2005	70	65	88
	110	66	90
2015	70	36	53
	110	36	54

In Van Hulle et al. (2004) an example is given of the breakdown of the generation cost for 10MW/km² at a site 30 km in the sea, 70 m hub height, 2005 technology and at a distance of 40 km to the onshore grid connection point (Table I.2.2e). The annual energy production for the particular grid point is 31.6

GWh/yr (for 10 MW). The local water depth is 16 m, the foundation is a monopole and the total installation cost is 1815 €/kW. The calculated generation cost is 7.3 cents per kWh.

Table I.2.2e: Breakdown of generation cost for 10 MW/km², hub height 70 m, improved technology (Van Hulle et al. 2004)

Item	Percentage (%)
Investment costs	63
Operation and maintenance	28
Overhaul	5
Decommissioning	4

The production cost for the same site with 2015 technology decreases to 4.2 € cents/kWh, but the relative contribution of the major cost items are the same as for 2005 technology. The cost breakdown is also identical assuming a 110 m hub height.

Nearshore/farshore wind-energy development:

The importance of distance as a determining factor for costs is also stated by C-power who has made a comparison between the costs for a nearshore and a farshore wind farm (http://www.c-power.be). A farshore wind farm costs approximately 30 % more per installed MW than a nearshore farm.

Table I.2.2f: Comparison costs nearshore versus farshore wind-energy development

	Nearshore (Wenduinebank)	Farshore (Thorntonbank)
Number wind farms	2 * 50 MW	2 * 50 MW
Distance to shore	6 km	27 km
Distance to grid connection (length of cables)	9 km	38 km, crossing 2 main shipping routes
Distance for mobilisation of units (pontoons, etc) 3 knots/h	5 h mobilisation	5 h mobilisation + 5 h demobilisation (20% less working days)
Mean water depth	7 m	15 m
Cost per installed MW	X	X + 30 %

Economical profit in comparison with classical production:

The decrease of external costs (costs due to fuel supply, consumption of resources, human health, corrosion of monuments, greenhouse effect,...) due to avoiding classical production, based on fossil fuel, of 560 GWh electricity, can be estimated to be 38.9 mio Euro yearly. The application of wind-energy avoids 6.94 eurocent/kWh external costs in comparison with the fossil electricity park (anno 1997) (omzendbrief 17/07/2000).

The external costs of wind energy are about 1/10th of these of a STEG (steam and gas), and about 1/40th of a coal plant with smoke gas purification (Omzendbrief 17/07/2000).

Social

Visual impact:

Visual impact can be estimated by means of mapping the zone of the visual influence (ZVI), which shows how many wind turbines are visible from any location and how dominant they appear. Based on previous experiences, it is assumed that it will not be realistic to implement wind farms within the 3 nautical mile zone (corresponding to 5.5 km from the coast) (Van Hulle et al. 2004). Further away the effects have to be judged case by case.

Acoustic noise:

The impact of acoustic noise differs according to the consulted literature:

In the C-power study (Ecolas NV 2003) it was stated that continuous acoustical noise levels under water of 90 – 100 dB (re 1µPa) in the frequency area of 100 Hz to some kHz in shallow coastal waters are not abnormal. Natural sounds are responsible here for the highest contribution. It can be assumed that the noise effect of a wind turbine under water will, in the worst case, be limited to the area between the wind turbines and will not produce noise outside the 500 m safety zone around the windmill park. Theoretical (modelling) calculations show that the above water noise (Lsp) of the wind turbines, in a moderate loaded situation, could be heard up to 10-15 km when 3.6 MW turbines are operated or up to 20-21 km when 5 MW turbines are used. In these calculations the background noise of waves or other surface noises are not taken into account.

In Van Hulle et al. (2004) the level of acoustic noise emission of modern wind turbines is found so low, that from a short distance (less than one km) it is lower than the background noise of the sea and thus not audible any more. This factor does not play any role in excluding areas of the BPNS from wind farming.

Health:

The avoided harmful emissions from the combustion of fossil fuels in power plants for the production of 560 GWh have been estimated at (omzendbrief 17/07/2000):

- 0.42 mio ton CO_2/year (the total difference between the normal evolution without extra measures been taken and the Kyoto-target is estimated at 26 mio ton CO_2) (per kWh approximately 0.7 kg CO_2);
- 1380 ton SO_2/year
- 1050 ton NOx/year
- 122 ton dust/year

Employment:

The approved C-power project is good for the following employment (http://www.c-power.be):

Table I.2.2g: Employment in wind-energy projects

Part	Man years
Project development	43
Fabrication on land	682
Transport/ Construction at sea	460
Exploitation/ maintenance	473
Break-down	255
Total	1913

As Belgium is one of the pioneers in farshore wind energy, the gained experience in the C-power project can create export possibilities for Belgium.

Source

- Van Hulle, F., Le Bot, S., Cabooter, Y., Soens, J., Van Lancker, V., Deleu, S., Henriet, J.P., Palmers, G., Dewilde, L., Driesen, J., Van Roy, P. and R. Belmans, 2004. Optimal Offshore Wind

Energy Developments in Belgium. Part I. Sustainable production and consumption patterns. Report SPSD II. 153 p.

- Web page C-power (http://www.c-power.be)

2.6 REFERENCES

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- Fina-Eolia II documents (February 2003)
- C-Power I documents (May 2002)
- Electrabel - Jan de Nul I documents (April–October 2002)

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Web page EWEA
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Web page harbour Zeebrugge
http://www.zeebruggeport.be

Web page Ministry of Economic Affairs
www.mineco.fgov.be/energy/renewable_energy/wind/home_nl.htm geconsulteerd op 18/08/03

Contact persons:

SPE Zeebrugge windmolens: Ir. Johan Dierick (tel: 09/ 269 50 08; email: JDI@spe.be), website: www.spe.be

Appendix 1: Overview of off-shore wind-energy projects in Belgium (source: http://www.mumm.ac.be/)

Current projects

Project developers	Location	Number wind turbines	Total capacity (MW)	Total area (without surrounding safety area (km²)	Water depth (m)	Shortest distance to coast (km)	Status of the project concerning domain concessions	Status of the project concerning environmental permit
C-Power II	Thorntonbank	60	216-300	13.7-18.1	6-25	27	Concession granted 27.06.03 for the divided layout by the State Secretary of Energy	Environmental permit requested 17.06.2003. Environmental permit procedure stopped on 01.08.2003. New environmental permit request on 10.10.2003. Advice MUMM to Minister 02.03.2004. Environmental permit granted by Minister competent for the Marine Environment on 14.04.2004.
Electrabel-Jan De Nul I (Sea-energy)	Vlakte van de Raan	50	100	5.8	5-10	12.5	Concession granted by the State Secretary of Energy 27.03.02, BS 11 May 2002	Environmental permit granted by the Minister of Environment 25.06.02. Annulation procedure running by Council of State; permit suspended since 25.03.2003. New request for environmental permit on 01.10.2003; declared inadmissable by Minister on 17.10.2003.

Earlier projects

Project developers	Location	Number wind turbines	Total capacity (MW)	Total area (without surrounding safety area (km^2)	Water depth (m)	Shortest distance to coast (km)	Status of the project concerning domain concessions	Status of the project concerning environmental permit
SPE	Harbour Zeebrugge	14	28	/	/	7 mills at sea, 7 on harbour wall	/	Environmental permit requested 12.11.2003. Public Consultation January 2004. Environmental permit denied by the Minister competent for the Marine environment on 14.06.2004.
SPE-Shell	Thorntonbank	110	275-300	20	6-25	27	Unfavourable advice of CREG 17.04.03, concession denied end of June 2003 by the State Secretary of Energy	/
Fina-Eolia II	North of Vlakte van de Raan	36	108-129	8.7	6-20	16.5	Favourable advice of CREG 17.04.03, concession denied end of June 2003 by the State Secretary of Energy	Environmental permit requested 06.02.03, procedure stopped 27.06.03
C-power I	Wenduineban k	50	115	12.5	5-10	5.1	Concession granted by the State Secretary of Energy 26.02.02	Environmental permit denied by the Minister of Environment 05.08.02. procedure under consideration by the Council of State; negative advice
Fina-Eolia I	Vlakte van de Raan	33-40	100	7.3	5-10	8	Concession denied by the State Secretary of Energy 05.07.02	/
Electrabel-Jan De Nul II	Vlakte van de Raan	50*2 en 80*2.5	300	18	5-10	11	Concession denied by the State Secretary of Energy 05.07.02	/

Appendix 2: Technical details of importance for impact study (Ecolas, 2003)

Unit	Characteristics	Diameter	Depth
Monopile	350-500 ton	5 m	20-40 m
Tripod (only at bigger depths)		1.5 m	
Corrosion protection	Spatzone: Epoxy of polyurethaan under water: protective coating by paint thickness wall: over dimensioning		
Erosion protection: not relevant for tripod	Natural stone (2 layers of 1m): Layer 1: gravel (1.5 to 4 cm diameter) Layer 2: stone dump (10-50 cm diam, with 4 m round pole extra heavy stones (60-300 kg))	48 m	
Cables	Inert polyester via cable laying ship or jettrencher 3-fase energy cable of 36 kV (farm) 2 x 3-fase energy cables of 150 kV (farm to land: 40 km) when crossing shipping lane or PEC cable		2 m depth 1 m 2 m > 4m

Appendix 3: Overview ecological and socio-economic data.

	C-Power	**Circular letter[1]**	**ODE-ARNE[2]**	**EWEA[3]**	**Mineco[4]**	**Greenpeace[5]**
Windpark	**Based on power of 216 MW (713 GWh)**	**Based on power of 214 MW (560 GWh)**	**Based on capacity of 214 MW (677 GWh)**	**EU; Based on capacity of 214 MW (677 GWh)**	**Based on capacity of 214 MW (256 GWh) ALSO (30.97 MW and 37 GWh)**	
Ecological						
Saving primary energy		120000 ton coal 3700 ton oil-equivalent 60 million m^3 gas/meth.				
Dependency fossil fuels		Reduced				
Social						
Health/ Environment Avoidance of …/year		0.42 mio ton CO2	0,47 mio ton CO2	6.3 mio ton CO2 (2003) 28 mio ton CO2 (2005)		
		1380 ton SO2		21000 ton SO2 (2003) 94000 ton SO2 (2005)		
		1050 ton NOx		17500 ton NOx (2003) 78000 ton NOx (2005)		
		122 ton dust				
		Other HNS		No more recyclable		
Decrease external cost due to avoiding classical production (fossil fuel)		38.9 mio Euro (6.94 euro/kWh)				
Economical						

[1] Circular letter 17/07/2000 VL. Gemeenschap: Afwegingskader en randvoorwaarden voor de inplanting van Windturbines.
[2] ODE-ARNE brochure 1998: Windenergie Winstgevend.
[3] European Wind Energy Association (EWEA)
[4] België: Mineco
[5] Greenpeace-DEWI study: Offshore wind in the North Sea. Technical possibilities and ecological consideration

	C-Power	**Circular letter**[1]	**ODE-ARNE**[2]	**EWEA**[3]	**Mineco**[4]	**Greenpeace**[5]
Production	713 GWh (51.7 kWh/m²/y)	560 GWh	677 GWh		256 GWh (37 GWh)	
Maximum potential						Offshore Belgium: 24 TWh/year
Families provided		227027	274459		15000	
Investment cost:		311.35 mio Euro (1455 €/kW)	223 mio Euro (1042 €/kW) without net	209 mio Euro (980 €/ KW)	353 mio Euro (1650 – 2200 €/Kw) (0.03 to 0.08 €/KWh)	(963.9 €/kW)
Cost wind-turbine			744 €/kW	700 €/KW (how larger, reduction in cost)	Depends on wind speed and on institutional factors	Depends on distance to shore and water depth
Cost installation, foundation, ground cost			223-298 €/kW	105-280 €/kw 15-40% turbine cost	Depends on size; 30% more than on shore	
Cost "net connection"			??	??	25% more than on shore	
Varia cost (insurance)					12395 €/year for 600 kW turbine 25000 €/year for 1.5 MW	
Operational cost				25 €/kW/yr (200 Kw turb) 15 €/Kw/yr (500 Kw turb)		4.5 €/kWh
Maintenance cost			1-2% of investment cost 4.45 mio Euro		2% of investment (first 10Y) 12% from 11 year	
Return		42.1 mio Euro/year	52.02 mio Euro/year (0.077 Kw/h)			
Job creation		1280		15-19 people/MW		
Direct		550				
Indirect		550				Double as direct
Consultancy		180				

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3 COASTAL DEFENSE

In this chapter the defense of the coast against natural coastal processes like erosion is considered, including all defense structures or processes on the Belgian beach. The beach is the zone between the mean low water line and the beginning of the dunes (dune foot). The part between the mean low water line and the mean high water line is called the "wet beach"; the part between the mean high water line and the dune foot is called the "dry beach". The slope of the "wet beach" is usually much less steep than that of the "dry beach". The part below the mean low water line is called the "feeder berm" (Dutch: vooroever; for the different parts of the beach see Figures I.2.3a and I.2.3b).

Dunes already have a use destination according to the Flemish structure plan. But a great part of the beach isn't considered in this plan (mainly the "wet beach") and therefore it is also considered in the present study. This is also the reason why recreation and tourism on the beach is taken into account in this investigation.

Harbours, which also have partly a coastal defense function, are not considered in this use function and are beyond the scope of this study.

In Belgium two types of coastal defense are used: hard coastal defense (through the building of hard structures likes dikes and groins) and soft coastal defense (through beach nourishment).

In 1994, 46 km of beach, about 70 % of the total coast length presented some defense structure. At this time coastal defenses were largely represented by beach fences, long-shore sea walls and groins, which have been used for a long time but whose effectiveness is now questioned. Furthermore, important artificial nourishments have been performed in certain places: more than 10 million m^3 of sand have been put on the beach between Heist and Het Zoute and 2.8 million m^3 between Bredene and De Haan between 1978 and 1994 (Ignacio Ruiz Garcia 1994).

Figure I.2.3a: Illustrative picture of the different beach zones

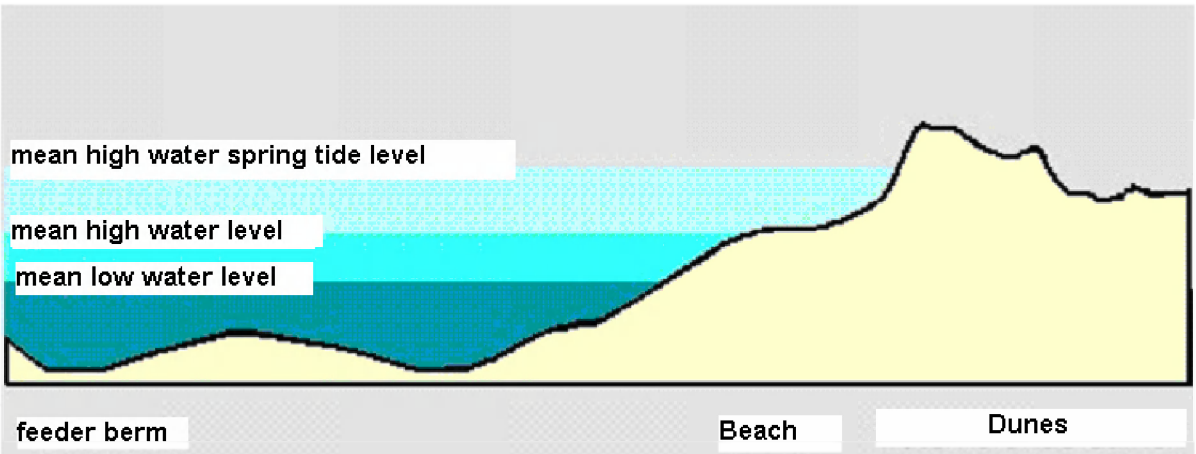
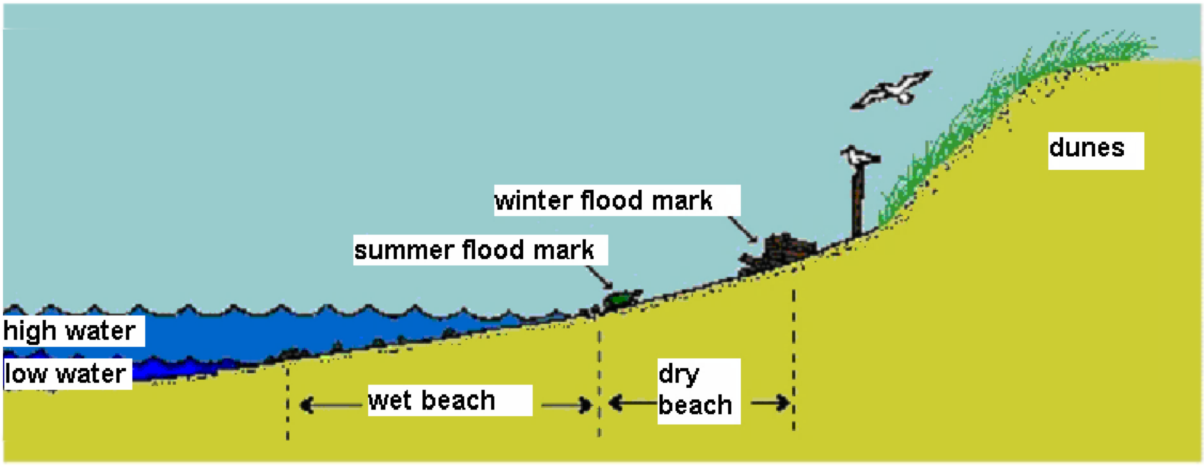


Figure I.2.3b: Illustrative picture of the different beach zones.



3.1 HARD COASTAL DEFENSE

ECOLAS Environmental Consultancy & Assistance
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3.1.1 Description

Along the Belgian coast no natural hard substrates (rocky shores) are found. In the framework of coastal defense several artificial hard substrates have been built. Their most important function is the protection of the hinterland (dikes, groynes), the harbour (piers, moles) or the safeguarding of the shipping (buoys). Furthermore they form a substrate on which specific rocky shore communities can settle.

Along the Belgian coast four main types of hard substrates can be distinguished: groynes, dikes, moles and piers. Groynes, dikes and piers are directly exposed to waves, while moles (except the breakwaters of Zeebrugge) are found within the shelter of the harbour. In contrast to dikes that are orientated practically parallel with the wave activity, groynes are placed perpendicular to the waves. Besides, groynes are on base of their morphology differentiated in a rock-fill on the seaward side, a groyne top and two flanks, all subjected to a different hydrodynamic activity. Piers 'escort' all a harbour gully and consist of a complex construction of differently orientated balk- or pole-structures. These structures are made of wood or concrete.

A further division within the different types can be made on the basis of the following characteristics:

- The degree of exposure in relation to the waves. This is also determined by the degree of inclination (90° or 45°) and the orientation (parallel or perpendicular to the coastline) of the hard construction.
- The building material (concrete, (Belgian) blue stone (Du: Arduin), wood and/ or asphalt) that is determinative for e.g. the fixation of macro-algae.
- The length and height of the groynes that also influences the degree of exposure (in relation to the waves, sun).
- The shape (the presence/absence of a dump of stones, loose/fixed blocks) that is strongly correlated with the present habitat diversity.
- The degree of silting that strongly influences the absence of specific organisms.

Beside these coastal defense elements, also windmills and wrecks make part of the hard substrates along the Belgian coast.

3.1.2 Legislative framework

(updated by Cliquet A.)

3.1.2.1 Spatial delimitation

Competent authority

The competent authority for coastal defense is:

- Flemish Government, the Environment and Infrastructure Department (LIN), the Waterways and Maritime Affairs Administration (AWZ), Coastal Waterways (AWK).

Legislation

(Cliquet et al. 2004 ; Maes and Cliquet 2005)

The construction of coastal defense structures cannot be started before an EIA is executed and environmental permits are granted.

International legislation and Belgian implementation:

- Council Directive 85/337/EEC of 27 June 1985 on the assessment of the effects of certain public and private projects on the environment, *Official Journal L* 175, 5 July 1985, amended by Directive 97/11/EEC of 3 March 1997, *Official Journal L* 73, 14 March 1997:
- EC Directive 97/11/EC makes coastal defense EIA-obliged from 14/03/1999.
    - Implementation in Belgium:
        - Decision of the Flemish Executive of 23 March 1989 on the organization of an environmental impact assessment for certain categories of harmful structures, *BS* 17 mei 1989, as amended: an EIA is needed for the construction of coastal defense structure or the building of a harbour.
        - Law of 20 January 1999 on the protection of the marine environment in the marine areas under Belgian jurisdiction, *BS* 12 March 1999 as amended: an EIA is required for any activity at sea that requires a permit.

National legislation:

- Royal Decree of 4 August 1981 on a Police and Shipping Regulation for the Belgian territorial sea, the ports and beaches of the Belgian coast, BS 1 September 1981: this regulation declares that no works may be executed in the territorial sea, the harbours and on the beaches before a special permit of the valid authority is gained (art. 21).
- Royal Decree of 5 October 1992 concerning the determination of a list of waterways and their associated structures transferred from the State to the Flemish Region, *BS* 6 November 1992: the decree describes coastal defense as the entire public domain with as most important function the protection of the hinterland against the sea.
- Law of 20 January 1999 on the protection of the marine environment in the marine areas under Belgian jurisdiction, *BS* 12 March 1999; as amended: Coastal defense works that are executed at sea should normally be screened against the Law on protection of the marine environment, since

these can be considered as construction works that need a permit before execution (art. 25 §1). But in the same article (§3) an exception is made for activities that are necessary for the execution of the authority of the Flemish Government (according to article 6 §1, X, of the Special Law of 1980 on the state reform). These works still need an environmental impact assessment under the same law.

Flemish legislation:

- Decree of 18 May 1999 on the organization of spatial planning, *BS* 8 June 1999: the execution of coastal defense works can only go through after an urban planning permit is received. Changes of the relief of a terrain, by filling, elevating, excavating, is prohibited, unless an urban planning permit is granted.

- Decree of 14 July 1993 holding measures for the protection of coastal dunes, *BS* 31 August 1993: the Dune Decree establishes a prohibition of all construction works in protected dune areas. Construction works that need to be executed to maintain the nature conservation status of an area or coastal defense works are exceptions to this Decree.

Future perspectives

Not applicable

3.1.2.2 Type and intensity

Intensity per area-unit

There are no juridical restrictions on the number of coastal defense structures per area.

Frequency per unit of time

Not applicable

Future perspectives

Not applicable

3.1.3 Existing situation

3.1.3.1 Spatial delimitation

Artificial hard constructions are practically found along the entire Belgian coast. Near to all Belgian coastal cities promenades are constructed and different lines of dunes (e.g. Westhoek) are separated from the beach by dune base reinforcements (Du: duinvoetverstevigingen). A continuous series of groynes are found between Westende and Bredene and between Wenduine and Knokke. They are absent near to De Panne, Oostduinkerke, De Haan and the mouth of the Zwin. Harbour-related hard constructions (e.g. moles, breakwaters, piers and groynes accompanied by piers) are found in Nieuwpoort, Oostende, Blankenberge and Zeebrugge.

A high diversity of hard substrates are encountered along the Belgian coast:

Moles (Du: havenmuren) and breakwaters (Du: Strekdammen)

Harbour walls (moles) and breakwaters are found in all harbours (Nieuwpoort, Oostende, Blankenberge and Zeebrugge). Breakwaters are coastal defense structures that are mostly built parallel to the coast and that aim for the decrease of wave exposure. The longitudinal embankments in Zeebrugge are currently the only forms of breakwaters along the Belgian coast. The enlargement project of the harbour of Oostende also foresees the construction of extended breakwaters.

Except the seaward side of both the breakwaters of Zeebrugge, all moles are strongly protected against wave exposure. They extend over the entire tidal zone. Moles have an inclination degree of 90° (quay) (e.g. Yacht basin of Oostende) to 45° (e.g. Harbour of Oostende).

The moles are constructed of blocks of concrete or (Belgian) blue stone (Arduin) (e.g. Oostende) or rock-fill, whether or not fixed with asphalt (e.g. parts of Zeebrugge). The blocks used vary strongly in size and form. The breakwaters are built of a core, a filter layer and a coating. The coating can exist of normal dumping stones, furrowed cubes or HARO-blocks, etc.

Dikes (Du: dijken) and dune base reinforcements (Du: duinvoet-versterking)

Dikes are found along practically the whole Belgian coast (e.g. in Oostende). They stretch out from far above the high water level to maximum one or two meters below the high waterline. Dikes are orientated parallel to the coastline which results in a strong exposure to the waves. Their degree of inclination is approximately 45°.

The dike-body exists mostly of a material that is found in the immediate vicinity as for example clay. Concrete blocks, nature stones, dumping stones (possibly impregnated with bitumen), asphalt or other materials protect the core.

Dune-fixations (e.g. De Panne (Nature reserve "De Westhoek")) stretch out to approximately 0.5 m below the high waterline. They can be constructed of gabion (Du: schanskorven), Dutch mattress (Du: zinkstukken) or rock fill and are often buried under a thick sand layer.

Groynes (Du: strandhoofden)

Groynes are relatively long, slender coastal defense elements that are built perpendicular to or under a great angle to the sea. Often they end landwards close to a dune-fixation or dike. Groynes are used to protect beaches against erosion.

Groynes are found along nearly the entire Belgian coast. In general they stretch out from above the high waterline to a few meters under the low waterline. Some groynes (Koksijde) stretch out approximately halfway into the intertidal zone. These are referred to as "beach groynes" (Dutch: strandkribbes). The height of the groynes varies between low (approx. 1 m; e.g. Koksijde) to high (to about 2 m; e.g. Oostende). Some groynes (e.g. Heist) are almost entirely buried under the sand.

In total 127 groynes and 33 beach groynes have been constructed. They show a high ecologically important morphological diversity.

A groyne can be divided in three zones:

- Section A between the dune and the crown of the groyne on the level of mean high water by dead tide (about 4 m T.A.W.).
- Section B: zone starting from section A to the intersection of the basis of the groyne with the mean low waterline by dead tide (about 0.5 – 1 m T.A.W.)
- Section C: zone from the mean low waterline by dead tide.

Groynes consist mostly of dumping material. The general building plan consists of a core of loose granular rubble that in the dry zone is held in place by a protecting coating of bricks, Blue Ashlarstone or concrete blocks. This coat layer is fixed with cement or sometimes covered with asphalt. Between the stones wooden poles can sometimes be found (especially on the east coast). The head and the flanks in the wet part are protected by Dutch mattress in which stones are dumped. Between the blocks silted tide-pools can sometimes be found. Because of the arbitrarily piling up of the blocks, a great diversity of habitats can be found within the rock-fill (e.g. leaning over rocks).

Groynes can also be constructed of wooden poles. These are cheaper, but less efficient.

A further division on the basis of already mentioned selection criteria gives the following types of groynes along the Belgian coast (+ an example) (Table I.2.3a):

Table I.2.3a: Different types of groynes

Type	Type symbol	Characteristics	Example
Groyne	T1	Accompanied by a pier with a rock-fill	Blankenberge (BLSL)
	T2	High and long with a very high rock-fill	Knokke-Zoute (ZSL)
	T3	High and long with a rock-fill	Oostende (OSL)
	T4	Low and long with rock-fill	Koksijde (KSL)
	T3/T4	Middle high with rock-fill	Middelkerke
	T5	Low and long with wooden poles and rock-fill	Duinbergen (DSP)
Beach groyne	K	Low and short without rock-fill	Koksijde (KSK)

The biodiversity, the seasonality and the ecological interactions of the macro-fauna, macro-algae and avifauna of these different types of groynes (except of T3/T4) have been studied and the results can be found in Engledow et al. (2001) and Volckaert et al. (2003a; 2003b). In general, the ecological value on the groynes increases with the length, the height and the number of microhabitats. This explains the low diversity on beach groynes (Type K). Furthermore sand inundation has a negative effect. Finally, also the exposition gradient plays an important role. A greater diversity of algae are found in the more sheltered areas (T1, but especially in harbours (e.g. Zeebrugge), while the macro-fauna prefers a more exposed site.

Pier (Du: staketsel)

All piers "accompany" a harbour gully and are only found in the harbours of Nieuwpoort, Oostende and Blankenberge.

Piers exist of a complex construction of differently orientated balks or poles. These structures, built of wood (e.g. Duinbergen) or concrete (e.g. Blankenberge), stretch out from above the high waterline to some meters below the low waterline.

Others

Beside these four main types some other types have been distinguished e.g. drainpipes in Blankenberge, remnants of bunkers on the Belgian-French border and buoys.

Source

Administratie Waterwegen Zeewezen (AWZ), 2001. Oostende veilig voor overstromingen. Waterspiegel n°1, 4 p.

Belconsulting N.V., 2001. MER Structureel herstel kustverdediging Oostende-centrum. In opdracht van Ministerie Vlaamse Gemeenschap, Departement Leefmilieu en Infrastructuur, Administratie Waterwegen en Zeewezen, Afdeling Waterwegen Kust. 273 p. Web page available on 28/10/2003 http://www.lin.vlaanderen.be/awz/html/download/mer_oostende_centrum.pdf

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Volckaert, A., Engledow, H., Beck, O., Degraer, S., Vincx, M, Coppejans, E. and Hoffmann, M., 2003b. *Onderzoek van de ecologische interacties van macroalgen, macrofauna en vogels geassocieerd met intertidale harde substraten langsheen de Vlaamse Kust.* Eindrapport in opdracht van het Min. Vlaamse Gemeenschap, Dept. Leefmilieu en Infrastructuur, Adm. Waterwegen en Zeewezen, Afd. Waterwegen Kust, 93 p.

Reliability margin

The reports about the biodiversity, seasonality and ecological interactions on artificial hard substrata are based on an intensive quantitative sampling campaign during 2000-2001. The study is very recent and of high quality.

Also the other literature used is of high standards and gives reliable information.

Future perspectives

No new groynes have been built in the last ten years. As a matter of fact, there is a current trend towards the use of soft coastal defense.

The planned enlargement of the harbour of Oostende will however lead to a big expansion of the area of coastal defense structures. The harbour project foresees in the building of two new moles (400 + 200 m) that will exercise a breakwater function. The new westerly dam will be situated near to the Capucijnenstraat and will also function as a promenade. The new easterly dam will be built as the extension of the Hendrik Baelskaai. Furthermore a new dike will be constructed in front of the Zeeheldenplein. This new dike will consist of a number of plateau's that will form a fluent transition from the beach to the dam. Finally a protection dam will be made to ensure the stability of the beach, to prevent the silting of the future harbour gully and to preserve the "Klein Strand".

Beside the construction of hard structures, the following elements will disappear: the eastern pier (Du: het Oosterstaketsel), the promenade (Du: de wandeldijk), the first groyne to the left of the "Klein strand".

Another future project could be the construction of a chaotic groyne in Lombardsijde (beach before the nature reserve "Ijzermonding).

3.1.3.2 Type and intensity

Intensity per surface-unit

Following appendices give an overview of the different coastal defense structures (hard substrates) along the Belgian coast and are digital available (source: data-base "Patrimonium" of AWK):

- Appendix 1: Inventory of the dikes along the Belgian coast (source AWK)
- Appendix 2: Inventory of the groynes along the Belgian coast (source AWK)
- Appendix 3: Inventory of the piers along the Belgian coast (source AWK)

Each appendix is digitally available with Ecolas and contains information about the length, the coating and the location of a specific hard structure. For the groynes also the type is mentioned (see also Table I.2.3b).

Table I.2.3b gives an overview of the number and total length per coastal defense type. Dikes and groynes form the two most important groupes.

Table I.2.3b: Coastal defense along the Belgian coast

Coastal defense	Number	Total length (m)
Moles/ breakwaters (only estimation of breakwaters available)	14	6560
Dike/ dune base reinforcement	163	39908
Groynes	171	45656
Piers	6	2977

A look atthe dispersion of these 4 main types of coastal defenses along the Belgian coast reveals that the east coast (Oostende-East till Knokke-Heist) has the highest number (203). The most important cities are Middelkerke for the west coast (De Panne till Oostende-West) and Knokke-Heist for the east coast with respectively 58 and 72 coastal defense structures (Table I.2.3c).

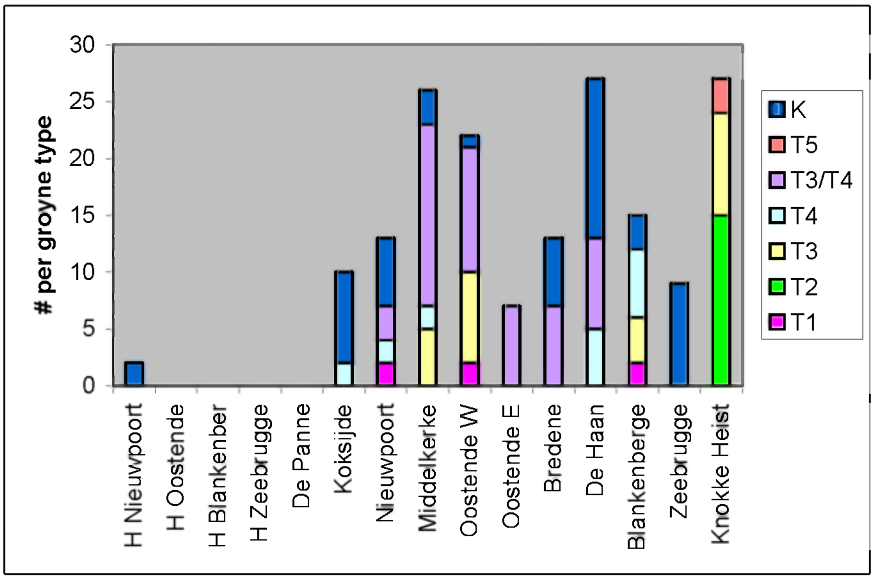
Table I.2.3c: Dispersion of the 4 main types of coastal defense along the Belgian coast

	Breakwater	Dikes	Groyne	Pier	Total
Harbour Nieuwpoort	1	0	2	2	**5**
Harbour Oostende	2	0	0	2	**4**
Harbour Blankenberge	2	0	0	2	**4**
Harbour Zeebrugge	9	2	0	0	**11**
De Panne	0	4	0	0	**4**
Koksijde	0	10	10	0	**20**
Nieuwpoort	0	12	13	0	**25**
Middelkerke	0	32	26	0	**58**
Oostende West	0	13	22	0	**35**
Oostende Oost	0	20	7	0	**27**
Bredene	0	3	13	0	**16**
De Haan	0	16	27	0	**43**
Blankenberge	0	3	15	0	**18**
Zeebrugge	0	3	9	0	**12**
Knokke Heist	0	45	27	0	**72**

As already mentioned, groynes can be divided in different types on the basis of several selection criteria (e.g. length, width, absence/presence rock-fill, etc.). Note: It is not always easy to make a distinction between the type T3, T4 and T3/T4. The distinction is subjective and depends mostly on the degree of sand inundation: the more sand, the less substrate is available for the settlement of species. These groynes give the impression that they are low laying structures.

Figure I.2.3c gives an overview of these types of groynes along the Belgian coast. In the figure the harbours of the coastal cities are indicated with a H (harbour).

Figure I.2.3c: Dispersion of the different types of groynes along the Belgian coast



Groynes are typical coastal defense structures found along the open coast. The beach groynes (K) and the type T3/T4 are the most dominant types. The beach groynes are not being built anymore, because of their weak protection against coastal erosion. As already mentioned, their ecological value is also minimal (Engledow et al. 2001). In Knokke-Heist 2 typical types of groynes are found: T2 and T5. The first are very high groynes of which section C is characterised with a basin-structure that has an ecological importance for specific species like the hydrozoan *Tubularia indivisa.* Also lots of seastars *(A. rubens)* are found here. The other groyne type T5 is rarely found along the Belgian coast, in contrary to the Dutch coast. It consists of wooden poles and a rock-fill. Most of the groyne has disappeared by sand inundation.

Source

Data-base "Patrimonium" of AWK.

The information was provided by AWK (contact person: Dhr. Luc Linskens (Inspection), tel: 059/554 268, mobile: 0476/ 59 03 70, e-mail: luc.linskens@lin.vlaanderen.be).

Reliability margin

High

Future perspectives

For detailed information we refer to the MER Structureel herstel kustverdediging Oostende-centrum: http://www.lin.vlaanderen.be/awz/html/download/mer_oostende_centrum.pdf

Table I.2.3d: Harbour-project Oostende

New hard substrates	Disappearing hard substrates
2 harbour dams (400 m)[1] [2]	Eastern Pier
Promenade on new dams[3]	Promenade
Dike in front of Zeeheldenplein	Groyne n°1
Underwater dam (door TV Herbosch Kiere (Kallo)-Dredging International NV (Zwijndrecht)	

Frequency per time-unit

Not applicable

3.1.4 Interactions

3.1.4.1 Suitability for user

Biological suitability

Not applicable

Geological/physical suitability

Sinking in bottom

Hydrological suitability

Effects of currents, waves and sand movements on the construction has to be checked by use of models (e.g. WAVE, Delft 3D). This can be done in the "Waterbouwkundig Laboratorium" in Borgerhout (Golfgoot).

3.1.4.2 Impact on other users

Spatial conflict

Tourism:

- Positive: hard substrates as a place for mussels- or crab "fishers", educational (new biotope)
- Negative: danger zone for swimming; slippery because of algae; possible nuisance for e.g. beach sailing; disturbance of natural view

Shipping:

- Positive: safer shipping routes because of buoys, moles; the harbour complex itself

[1] First phase: construction western mole with promenade
[2] Second phase: construction eastern protection dam and the broadening and deepening of the harbour gully.
[3] First phase: construction western mole with promenade

- Negative: nuisance of shipping traffic during repair/ construction coastal defense structures or dredging harbour gully.

Recreational fishery:

- Positive: creation of new fishing places on groynes, moles

- Negative: the underestimation of the risks of the hard substrates (e.g. slippery) by fishermen can cause serious accidents.

3.1.4.3 Impact on environment

Biological

- Positive: new habitat for rocky shore fauna (91 invertebrate spp.) and flora (78 macro-algae spp.); feeding-and foraging habitat for birds (gulls, *A.interpres*, *C.maritima*)

- Negative: permanent loss of habitat and biological productivity by the removal of intertidal and near-shore sections of the seabed (NOO 2002); disturbance of benthic communities of soft sediments during construction phase of new infrastructure; unnatural occurring substrates for the Belgian coast (originally sand beach ecosystem).

Geological/physical

- Positive: protection of inner land, deminishing beach/dune erosion

- Negative: former use of anti-fouling paints (toxic); asphalt fixation (leaking to surrounding environment); disturbance natural sand processes

Hydrological

- Positive: breaking of power of currents/ waves

- Negative: formation of eddies around groyne which can lead to depressions, gullies (possible danger)

3.1.4.4 Impact on socio-economy

Economic

Costs:

- The construction, the maintenance and the control of coastal defense structures is the authority of the Ministry of Flanders, the Environment and Infrastructure Department (LIN), the Waterways and Maritime Affairs Administration (AWZ), Coastal Waterways (AWK)
- Last 10 years no new investments in the construction of new groynes, only maintenance
- Cost of maintenance: no data
- Cost of groyne: depending on the length and width of groyne
- Costs totally financed by the State
- Estimation of groyne of 603 m length (source: AWK):
  - Section A (120 m long, about 3 m width): 272683 euro
  - Section B (98 m long, about 3 m width): 156173 euro)
  - Section C (385 m long, up to 20 m width): 1115 million euro

- Total: 1544 million euro

- New harbour project Oostende:
  - cost for the construction of the harbour and the planned coastal defense: 37.2 million euro
  - cost underwater dam: 6.2 million euro

Income:

- Income because of greater touristical value (horeca, fishing, etc.)
- Temporary job creation

Social

- Positive: job creation

- Negative: nuisance during construction (noise, traffic, view etc.)

3.1.5 References

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Inventarisation Coastal defense: dhr. Luc Linskens (tel: 059/ 554 268; gsm: 0476/ 59 03 70; email: luc.linskens@lin.vlaanderen.be): complete database with all hard substrates: "Databank patrimonium" op de site van LIN (internal access): contact person Filip Albregt (tel. 059/554.280, e-mail filip.albregt@lin.vlaanderen.be).

Information on Ports of Ostend and Zeebrugge: constructions situated in the area under responsability of Maritieme Toegang are not inspected or available in the database.

3.1.6 Appendices

Following appendices are based on the data-base "Patrimonium" of AWK and are digitalyl available with Ecolas:

Appendix 1: Inventory of the dikes along the Belgian coast (source AWK)

Appendix 2: Inventory of the groynes along the Belgian coast (source AWK)

Appendix 3: Inventory of the piers along the Belgian coast (source AWK)

Other:

Appendix 4: Specific terminology

Appendix 4: Specific terminology

Source: Translation of terms by Peter De Wolf (AWK)

Avifauna: Vogels

(Belgian) Blue stone: Arduin

Beach groyne: Kribbe

Blue ashlarstone: Blauwe hardsteen

Breakwater: Strekdam

Concrete: Beton

Dyke: Dijk

Dune base reinforcement: Duinvoetversterking

Dutch mattress: Zinkstukken

Gabion: Schanskorven

Groyne: Strandhoofd

Macro-algae: Macro-wieren (vb. blaaswier (*F. vesiculosus*), darmwier (*Enteromorpha* spp.)

Macro-fauna: Macro-fauna (> 1 mm; vb. mossels (*M. edulis*), anemonen (vb. *Sagartia* spp.), wormen (vb. *Polydora* spp.), kreeftachtigen (vb. *Corophium* spp.), krabben (vb. C. maenas), etc.)

Mole: Havenmuur

Pier: Staketsel

Promenade: Wandeldijk

Rock-fill: Steenstort

3.2 SOFT COASTAL DEFENSE

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3.2.1 Description

In Belgium, beach nourishment is a commonly used method in Belgium to fight against coastal erosion and to maintain the basic coastline in a way that the natural coastal processes can proceed safely. Beach nourishment involves placing a large amount of sand on the beach.

Sand nourishment is a natural way to defend the coast that makes the use of hard defense structures (that interfere with the natural dynamics of the coast) pointless. In this way the normal coastal processes can occur and give rise to a more diverse landscape.

3.2.2 Subuses and description

The subuse 'transport of the sand to the beach nourishment area' should also be considered in this use function, but no data is available at the moment.

So, here we only consider the execution of soft coastal defense works. Different subuses can be distinguished within soft coastal defense along the Belgian coast. The descriptions are based on the publication of the Ministry of the Flemish Community (1993).

- **Beach nourishment**: This technique is mostly used along the Belgian coast. Hereby a sand plateau of 10 m broad is placed against the dike (approximately 7 m above the mean low water linewhich slopes gently to the lower part of the beach.
- **Dune foot nourishment**: This technique is used to defend dunes and dikes against natural coastal processes.
- **Feeder berm nourishment**: With this method the beach under the mean low water line is nourished with sand. Since this zone is usually situated below the water surface the method is also called 'underwater nourishment'. This method is used to provide better stabilisation to an eroding beach. This technique is not frequently used in Belgium.
- **Beach reprofiling**: This technique is usually executed in combination with beach nourishment on tourist beaches. Here, the beach sand is redistributed over the beach, without the addition of new sand.
- **Plantation of osiers or marram grass**: Other means for fixation of the dry beaches and dunes are the plantation of osiers (bundles of twig wood, planted vertical in the sand or on the dune) or marram grass. These structures increase the amount of sand, deposited on the dry beach by eolic transport mechanisms. There is little information available on the amounts of such plantations along the coast, so this subuse is not included in the overview.
- **Transport to the working area**: Sand or grind needs to be transported to the working area on the beach. This is usually done directly from the trailing hopper vessel that was used to collect the aggregates at sea. The aggregates are put on the beach through long pipes coming from the vessel. When beach sand is used for the soft coastal defense works, no transport is needed. It is also possible that the aggregates are transported over the land through supply pipes.

Future plans

Studies about the environmental effects of coastal defense works are ongoing and should determine how negative the effects of these works are on the ecology of beaches/dunes. When this is known, boundaries on the amount of coastal defense works can be established. The loss of biodiversity due to coastal defense is less important than safety, but will be compensated where possible. The use of environmental friendly methods is a growing trend (Miguel Berteloot, pers. comm. 2004).

3.2.3 Legislative framework applicable to all subuses

Description and coordinates

There is no legal basis for the Belgian policy concerning coastal defense, but a policy document is made up by AWK. The main priority of coastal defense should be 'the protection of the hinterland against a 1000-year storm'. This is based partly on risk assessments of the chance that heavy storms occur on the Belgian coast and partly on the associated costs for this kind of protection. Also considered, but not as priority, is nature protection (protection of ecologically valuable dune areas). Coastal defense works are not executed to promote or increase tourism, but if possible tourist demands can be considered (for instance in the case of bathing beach elevations). This consideration is only made for beaches that are given in concession to the coastal communities.

The different valid Laws and Decrees do not delimitate special areas for coastal defense works. Works can be executed when the competent authority considers this necessary to maintain/ameliorate the state of the beach/dunes or to defend the land area behind the coast against natural sea processes. There also exists no policy definition on the frequency of execution of coastal defense works. The policy makers (AWK) determine when maintenance nourishments are needed for eroding beaches.

Legislation

International legislation and Belgian implementation:

- Council Directive 85/337/EEC of 27 June 1985 on the assessment of the effects of certain public and private projects on the environment, *Official Journal L* 175, 5 July 1985, amended by Directive 97/11/EEC of 3 March 1997, *Official Journal L* 73, 14 March 1997: EC Directive 97/11/EC makes coastal defense EIA-obliged from 14/03/1999.

    - Implementation in Belgium:

        - Decision of the Flemish Executive of 23 March 1989 on the organization of an environmental impact assessment for certain categories of harmful structures, *BS* 17 May 1989, as amended: an EIA is needed for the construction of coastal defense structure or the building of a harbour.
        - Law of 20 January 1999 on the protection of the marine environment in the marine areas under Belgian jurisdiction, *BS* 12 March 1999; as amended: an EIA is required for any activity that requires a permit.

National Legislation:

- Decree of 14 December 1810 against the erosion of dunes, Rec. Gén., 1487-1814: this decree is still valid as a legal framework to allow the fixation of dunes on private grounds under certain circumstances.
- Royal Decree of 4 August 1981 concerning a Police and Shipping Regulation for the Belgian territorial sea, the ports and beaches of the Belgian coast, BS 1 September 1981; as amended: this regulation declares that no works may be executed in the territorial sea, the harbours and on the beaches before a special permit of the valid authority is gained (art. 21).
- Royal Decree of 5 October 1992 for the determination of a list of waterways and their associated structures transferred from the State to the Flemish Region, *BS* 6 November 1992: this decree describes 'coastal defense works' as the whole of the public property whose function is to defend the land behind it against the natural influences of the sea.

- Law of 20 January 1999 on the protection of the marine environment in the marine areas under Belgian jurisdiction, *BS* 12 March 1999; as amended: Coastal defense works that are executed at sea should normally be screened against the Law on protection of the marine environment, since these can be considered as construction works (in case feeder berm nourishment works are done the level of the seabed is also changed) that need a permit before execution (art. 25 §1). But in the same article (§3) an exception is made for activities that are necessary for the execution of the authority of the Flemish Government (according to article 6 §1, X, of the Special Law of 1980 on the state reform). These works still need an environmental impact assessment under the same law.

Flemish legislation:

- Decree of 18 May 1999 on the organization of spatial planning, *BS* 8 June 1999: the execution of coastal defense works can only go through after an urban planning permit is received. Changes of the relief of a terrain, by filling, elevating, excavating, is prohibited, unless an urban planning permit is granted.
- Decree of 14 July 1993 holding measures for the protection of coastal dunes, *BS* 31 August 1993: the Dune Decree establishes a prohibition of all construction works in protected dune areas. Construction works that need to be executed to maintain the nature conservation status of an area or coastal defense works are exceptions to this Decree.

Municipality legislation:

- Some cities/communities also have municipal rules concerning coastal defense (e.g. Nieuwpoort: the level of the dunes may not be changed/dunes should be defended against sand displacement and erosion (police regulation on the conservation of dunes and prevention of sand displacement); Koksijde: it is prohibited to remove sand from the community properties (chapter 28 of the general police regulation); Oostende: it is prohibited to remove sand from the beach (police regulation on beach and dunes).

3.2.4 Existing situation

3.2.4.1 Spatial delimitation

The first beach nourishment in Belgium was executed in 1968, but no details are available on the location and amount of sand used. Since then a total amount of 18254932 m^3 sand was nourished to different beaches along the Belgian coast (Hanson et al. 2002).

The coordinates of the zones and the intensities of the different nourishment works along the Belgian coast are digitally available (AWK 2003; De Moor 2002; De Wolf 1996; Ministry of the Flemish Community 1993).

Executed coastal defense works (reprofiling of beach and beach nourishments) between 1983 and 2002

- section 99: Raversijde-Oost → reprofiling beach
- sections 103-105: Mariakerke → reprofiling beach
- sections 106-107: Oostende-West → reprofiling beach
- sections 109 and 112: Oostende-Centrum-West → beach nourishment
- sections 124-133: Bredene-West and –Oost → reprofiling beach
- sections 133-172: Hippodroom beach to Wenduine-Rotonde → beach nourishment
- sections 83-88: Middelkerke (1988): 7000 m^3 (Ministry of the Flemish Community 1993)

- sections 29-33: Koksijde (1988): 25000 m³ (Ministry of the Flemish Community 1993)
- sections 148-157: De Haan-Center (1988) 35000 m³ (Ministry of the Flemish Community 1993)
- Sections 173-182: Wenduine (1988): 5500 m³ (Ministry of the Flemish Community 1993)
- Sections 189-192: Blankenberge (1988): 30000 m³ (Ministry of the Flemish Community 1993)
- Sections 215-237: Knokke-Heist (1986): 910000 m³ (De Wolf 1996)

Beach nourishments and re-profilings before 1983

- sections 227-237: between Knokke and Heist (Baai van Heist) (1977-1979): 8.4 million m³ (De Moor 2002)
- section 60-66: Lombardsijde (1981): 40000 m³ (Ministry of the Flemish Community 1993)
- Sections 157-172: De Haan (1980): 1250000 m³ (Ministry of the Flemish Community 1993)
- Sections 132-138: Bredene-Hippodroom (1978): 558000 m³ (De Wolf 1996)

Beach nourishments between 1991 and 2000

- sections 148-157: De Haan-Center (1991-1992)
- sections 131-148: De Haan- West to Bredene-Hippodroom (1993-1995)
- sections 158-169: De Haan-East to Wenduine-Rotonde (1996-1998)
- sections 197-203: Blankenberge (Duinse Polders) (1998-1999)
- sections 233-243: Knokke (1999)
- sections 150-156: De Haan-Center (2000)
- sections 149-158: De Haan-Center (1992)
- sections 132-149: De Haan-West to Bredene Hippodroom (1994-1995)
- sections 157-172: De Haan-East to Wenduine-Rotonde (1996)
- sections 197-203: Blankenberge (Duinse Polders) (1998-1999)
- sections 233-243: Knokke (1999)

Bathing beach elevations and reprofilings between 1998 and 1999

- sections 7-11: De Panne → dune foot nourishment (1998)
- sections 22-25: Sint-Idesbald → beach elevation (1998-1999)
- sections 29-31: Koksijde → beach elevation (1998-1999)
- sections 32-33: Koksijde → beach elevation (1998-1999)
- sections 54-56: Nieuwpoort → beach elevation (1998-1999)
- section 65: Nieuwpoort → dune foot nourishment (1998-1999)
- section 74: Sint-Laureinsstrand → beach elevation (1998-1999)
- section 78: Westende → beach elevation (1998-1999)
- sections 79-80: Krokodille beach → beach elevation (1998-1999)
- sections 81-87: Middelkerke → beach elevation (1998-1999)
- section 99: Raversijde → beach elevation (1998-1999)
- sections 103-107: Mariakerke → beach elevation (1998-1999)
- sections 111-113: Oostende → beach elevation (1998-1999)
- sections 125-130: Bredene → beach elevation (1998-1999)
- sections 168-169: Wenduine-Hippodroom to De Haan-Center → feeder berm nourishment (1997-1999)
- sections 173-175: Wenduine → beach elevation (1998-1999)
- section 176: Wenduine → beach elevation (1998-1999)

- section 182: Wenduine → dune foot nourishment (1998-1999)
- sections 189-192: Blankenberge → beach elevation (1998-1999)
- sections 211-214: Zeebrugge → beach excavation (1999)
- sections 225-226: Duinbergen → beach elevation (1998-1999)

This list of soft coastal defense works is not complete since data of beach works before 1983 are often missing. They were not recorded in full detail, as is the case nowadays.

Future perspectives (Miguel Berteloot, AWK pers. comm. 2004)

A major beach nourishment is planned in Oostende. Approximately 2 million m³ (sections 106-117) will be used to elevate the beach. In Knokke-Heist, 350000 m³ (sections 221 and 237) of sand will be brought on the beach. Here, dredged sand from the shipping lane in front of the coastline of Oostende will be used (250-300 µm).

3.2.4.2 Type and intensity

There are no limitations on the amount of sand used per surface area per beach or per time unit. The median grain size of the sediment is an important criterion when planning soft coastal defense works. The sediment used should be as coarse as possible to give rise to a more stable beach. Every case is considered separately (variables can include such things as natural composition of sediment, currents present and ecological and tourist value of the beach) and normally the nourishment should result in a situation that resembles the original one as close as possible. The beach profile is also kept as natural as possible (as this is ecologically important). The profile is largely dependent on the median grain size of the beach sediment. So to maintain the natural beach profile, the appropriate sediment needs to be available. According to the available sediment the best profile is chosen.

The main goal of soft coastal defense is to maintain the beach stable as long as possible. Some beaches need to be nourished more frequently because they have to endure a high erosion rate (for example the beach of Knokke-Heist). Other beaches (Zeebrugge, De Panne, …) don not erode fast and do not need to be nourished frequently. Different studies concerning the impact of soft coastal defense works (and the periodicity of the works) on the different ecosystem components of the beach are carried out at the moment (AMINAL 2002; 2002-2004). The results of this research could have implications for future nourishments.

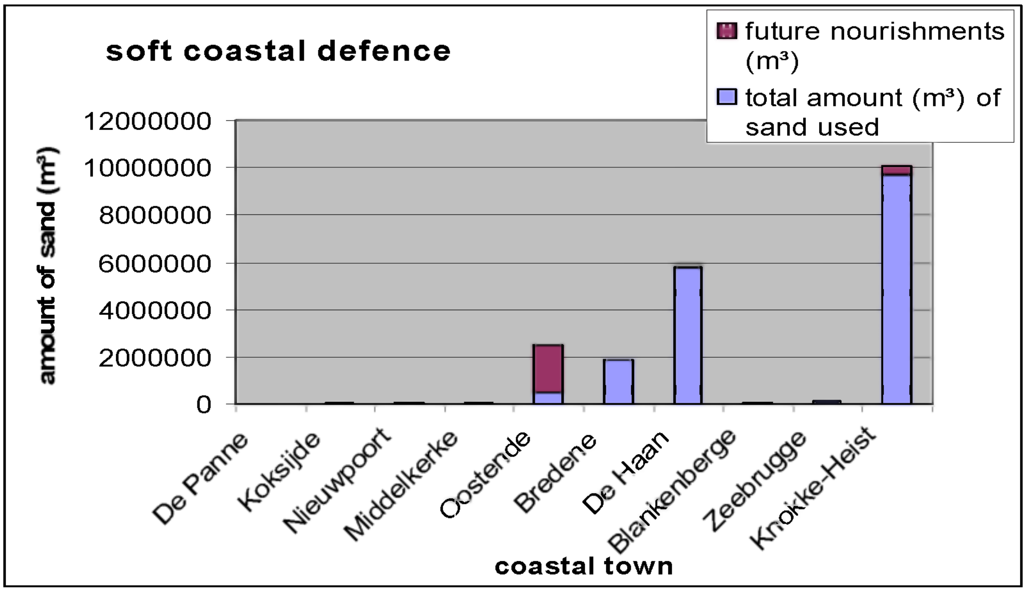
Since the sections of the beaches where soft coastal works are executed are known (see digitally available documents), as is the amount of sand that is used for the works, the amount of sand that is used per surface area can be calculated. The total amount of sand used on the different beaches throughout the years is given in the following table:

Table I.2.3e: Overview of the historic and future beach nourishments along the Belgian coast.

Coastal town	total amount (m³) of sand used	future nourishments (m³)
De Panne	5100	
Koksijde	80200	
Nieuwpoort	56085,8	
Middelkerke	89416,3	
Oostende	472199	2000000
Bredene	1862059,6	

De Haan	5789877,1	
Blankenberge	44260,4	
Zeebrugge	154986,4	
Knokke-Heist	9700747,3	350000
Total	18254931,9	

Figure I.2.3d: Overview of the historic and future beach nourishments along the Belgian coast



Detailed information can be found in the digital documents.

Time series of the different types of soft coastal defense works are provided in the digital documents. This enables the frequency of the works per time unit to be determined.

The works are usually not executed during summer (June-August) to minimise the impact on recreation and tourism, but in the late spring (September – November) so that tourism and recreation can gain profit from the works in the following summer. The winter period is also not suitable to execute works, because heavy storms can occur. Soft coastal defense works in the dunes are postponed during the breeding season (legal basis: Dune Decree → no building from 15th of April until 15th of September). No similar legislation exists for the beaches (except for the beach nature reserve in Heist).

Source

Ir. Miguel Berteloot (AWK, pers. comm. 2004), AWK (2003).

3.2.5 Interactions

3.2.5.1 Suitability for user

Details – if applicable – can be found in the chapter that is specifically dedicated to "Suitability".

3.2.5.2 Impact on other users

Details – if applicable – can be found in the chapter that is specifically dedicated to "Interaction among users".

3.2.5.3 Impact on environment

Details – if applicable – can be found in the chapter that is specifically dedicated to "Interaction between users and the environment" (Harte et al. 2002; AMINAL 2002).

Biological

For more specific details on impacts of soft coastal defense works, see AMINAL (2004).

Impact of transport process of sand to the beaches:

See impacts of shipping or impacts of laying pipelines.

Impact of covering of the original sand:

- death of benthic fauna that is not able to move through the covering sand (with associated effects on species composition, biomass,… of the communities, dependent on the amount of nourishment sand per surface area) → decreasing food availability for birds → decreasing number of birds in that area
- impact of nourishment sand, which can have a different composition than the original sediment → impact on recovery potential of biodiversity of benthos

Disturbance due to the nourishment activities for nesting, breeding, feeding birds

Nourishment sand:

Nourishment sand can also contain (dead) benthos from the extraction/dredging zone. This can constitute an extra food supply for (opportunistic) birds.

Feeder berm nourishment:

- has the same impacts of covering on the benthos. These effects will be more pronounced when the nourishment zone extends further into the sea (because the deeper coastal zone is a more stable environment than the zone near the beach and the benthos is less adapted to changing environmental conditions there)
- impact on fish species foraging on the (covered) benthos → food availability drops

Geological/Physical impact

- change in sedimentological characteristics
- disturbance natural sediment transport (e.g. from the beach to the dunes by sand spraying) on the beach/in coastal area
- change in slope, habitat characteristics of the beach
- less dune erosion

3.2.5.4 Impact on socio-economy

Soft coastal defense works result in an increase of the dry beach, which can be positive for the tourist-recreational sector (attracting more beach visitors). There are no socio-economic details available to underpin this.

Normally soft coastal defense works have a duration of 2 to 6 months.

Very little information is available to make an economic analysis of soft coastal defense.

Between 1994 and 1995 soft coastal defense works were done in the zone De Haan-West – Bredene-Hippodroom, where approximately 1.1 million m^3 sand was used (800000 m^3 for feeder berm). The total cost was 10 million EURO (De Wolf 1995). The soft coastal defense works, executed in 1995 in the zone Bredene used 93000 m^3 sand and the total cost was 875000 EURO (De Wolf, 1996). So, a very rough estimate of the cost of beach nourishment, based on these data, would result in 9 EURO/m^3.

3.2.6 References

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4 RADAR AND WEATHER MASTS

4.1 DESCRIPTION

Masts have been installed throughout the Belgian part of the North Sea. Only one of them is used as radar satellite. Two are situated on the dams of the harbour of Zeebrugge and are therefore not accounted for in this report (since they do not make part of the Belgian part of the North Sea). The other masts are used for weather monitoring and forecast.

4.2 SUBUSES AND DESCRIPTION

This user function can be divided in the actual installation of the masts on the one hand and the presence and maintenance of them on the other hand.

4.3 LEGISLATIVE FRAMEWORK

Competent authority

The competent authority for the installation and maintenance of masts at sea is the Waterways and Maritime Affairs Administration (AWZ) within the Department of the Environment and Infrastructure (LIN) of the Flemish Ministry.

Legislation

(Cliquet et al. 2004 ; Maes and Cliquet 2005)

National legislation:

There is no specific national legislation concerning the setting up of these constructions (Gert Dewilde, AWZ, *pers.comm.*). As is the case with all their construction projects, AWZ communicates its intentions with MUMM (the Management Unit of the North Sea Mathematical Models within the Royal Belgian Institute of Natural Sciences). The construction is subject to article 25 of the Law on the Protection of the Marine Environment in the Marine Areas under Belgian Jursidiction of 20 January 1999. This means that article 28 of this Law demanding a permit and environmental impact assessment does not count for these constructions.

International legislation and Belgian implementation:

- United Nations Convention on the Law of the Sea, Montego Bay, 10 December 1982.
  - Implementation in Belgium:
    - Law of 18 June 1998 on the approval of the Convention on the Law of the Sea of 10 December 1982 and the Agreement relating to the implementation of Part XI of the United Nations Convention on the Law of the Sea of 10 December 1982 of 28 July 1994, *BS* 16 September 1999.

4.4 EXISTING SITUATION

4.4.1 Spatial delimitation

Exact coordinates of masts in the BPNS are indicated in "Overview of positions (WGS84) weather masts and radar mast Oost Dyck on nautical maps" (Table I.2.4a) (7 masts indicated) (AWZ). In Map II.2.4a, both buoys and masts are indicated. Buoys are either linked with shipping routes or with survey and monitoring but are not dealt with in this report. The map indicates 7 instead of 6 weather masts but MOW5 has been dismantled in 2004 (Maps I.2.4a-b).

Source

- Ir. Guido Dumon, head Hydrography and Hydrometeo, AWZ.

4.4.2 Type and intensity

The masts consist of one radar mast on the Oost Dyck sand flat and six weather masts used for a monthly overview of weather (MOW). These all have a specific name and lable as indicated in the matrix (Table I.2.4a) (Maps I.2.4b-c).

Source

- Ir. Guido Dumon, head Hydrography and Hydrometeo, AWZ.

Table I.2.4a: Overview of positions (WGS84) weather masts and radar mast Oost Dyck on nautical maps" (AWZ)

Naam	Positie WGS84 (° ' ")	Positie WGS84 (° ')
MOW 0 (Wandelaar)	51°23'40",21 N 03°02'44",97 E	51°23',67 N 03°02',75 E
MOW 1 (A2)	51°21'37",80 N 03°07'05",33 E	51°21',63 N 03°07',09 E
MOW 2 (Appelzak)	51°21'46",21 N 03°17'23",98 E	51°21',77 N 03°17',40 E
MOW 3 (Bol van Heist)	51°23'22",81 N 03°11'55",18 E	51°23',38 N 03°11',92 E
MOW 4 (Bol van Knokke)	51°25'06",01 N 03°17'54",57 E	51°25',10 N 03°17',91 E
MOW 7 (Westhinder)	51°23'18",57 N 02°26'16",13 E	51°23',31 N 02°26',27 E
Radartoren Oost Dyck	51°16'29",61 N 02°26'50",77 E	51°16',49 N 02°26',85 E

4.5 INTERACTIONS

4.5.1 Suitability for user

Details – if applicable – can be found in the chapter that is specifically dedicated to "Suitability".

4.5.2 Impact on other users

Details – if applicable – can be found in the chapter that is specifically dedicated to "Interaction among users".

4.5.3 Impact on environment

Details – if applicable – can be found in the chapter that is specifically dedicated to "Interaction between users and the environment".

Biological

There is no biological impact.

Geological/Physical

The geological/physical impact is minimal within the entire BPNS scale and can therefore be neglected.

Hydrological

The hydrological impact is minimal within the entire BPNS scale and can therefore be neglected.

4.5.4 Impact on socio-economy

Economic

The economic impact of the presence of masts is negligible.

Social

The social impact of the presence of masts is negligible.

4.6 REFERENCES

AWZ, personal communication Ir. Guido Dumon, head Hydrography and Hydrometeo (22 March 2005).

Cliquet, A., Lambrecht, J., and Maes, F., 2004. Juridische inventarisatie van de kustzone in België, 2^{e} update, Studie in opdracht van de Administratie Waterwegen en Zeewezen, Afdeling Waterwegen Kust, (Departement Leefmilieu en Infrastructuur, Ministerie van de Vlaamse Gemeenschap), Gent, Maritiem Instituut/Vakgroep Internationaal Publiekrecht, 88 p.

Maes, F. and Cliquet, A., 2005. Codex wetgeving kustzone, Brugge, Vanden Broele, vol. 2.

SECTION ONE ANALYSIS

Chapter Three
Users of the Belgian part of the North Sea

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1 WRECKS AND WRECK SALVAGE

1.1 DESCRIPTION

Shipwrecks, other vessel wrecks and sunk loads are spread along the entire BPNS as a consequence of shipping accidents and other disasters at sea.

1.2 SUBUSES AND DESCRIPTION

Shipwrecks, other vessel wrecks and sunk loads generally occur as a result of shipping accidents. It is very probable that shipping accidents will keep on occurring into the future. A shipping accident itself has a purely historical value as a use of the BPNS. This leaves the actual presence on site and/or the destruction of wrecks and sunk loads as a separate use. The latter use is mainly influenced by the characteristics of the wreck or load including its size, the amount of perishing through time, and structural and toxic compositions. Since the southern part of the North Sea is the most intensively used shipping route in the world, it is not surprising that the Belgian part of the North Sea is scattered with a large amount of wrecks.

1.3 LEGISLATIVE FRAMEWORK

(updated by Cliquet A. and Maes F.)

Legislation

(Cliquet et al. 2004 ; Maes and Cliquet 2005)

International legislation:

- European Convention on the Protection of the Archaeological Heritage (Revised), Valetta (Malta), 16 January 1992.

  In the long run, some wrecks are valuable in an ecological and/or cultural way. No legal conservationist measures have been taken until now, but legal frameworks are currently being put into place. The Treaty of Malta (1992) regulates the management of the European archaeological patrimony. It was signed by Belgium in 1992, but is thus far not integrated into Belgian legislation. It is meant to conserve the in situ patrimony in the best way possible and to take measures to achieve this aim. If conservation in situ is not possible, seabed disturbers are asked to finance archaeological research and possible excavations. A distinction between military and civilian wrecks enables differentiation between usual wrecks and graveyards.

- Convention on the Protection of the Underwater Cultural Heritage, UNESCO, Paris, 2 November 2001.

National legislation:

- Law of 20 January 1999 on the protection of the marine environment in the marine areas under Belgian jurisdiction, *BS* 12 March 1999; as amended
- Wreck Law, 11 April 1989, *BS* 6 October 1989

Until recently, wrecks and their cargo were not defined or described under Belgian legislation. The Law on the Protection of the Marine Environment (20 January 1999) does, however, mention permits and licenses in Chapter VI. In that Chapter, article 25 states that wrecks and their cargo can only be left behind or destroyed if the authorised Ministry has granted a previous permit or license. It is therefore not compulsory per se to remove a wreck, or its equipment and cargo as a consequence of a shipping accident, unless the wreck creates or might create environmental pollution. Article 75 of this Law adds to article 13 of the so called "Wreck Law" (Law of 11 April 1989, *BS* 6 October 1989) that if a wreck or its cargo can cause pollution of the marine environment of the Belgian territorial sea or the EEZ, or in case it would jeopardise the safety of shipping in these zones, Belgian authorities have the ability to oblige the owner of that ship to take ameliorative measures. If the owner is unknown or if he does not take such ameliorative actions or in case of emergency, article 14 of the "Wreck Law" authorises the government – at the risk and expenses of the owner or the responsible body – to:

- get afloat, remove, destroy or render harmless, the sunken, the perished, the stranded or the deserted vessel, including everything that is or once was on board
- remove, destroy or render harmless, the load
- clear away the vessel, wreck or load from the territorial sea or the public property, once it is salvaged or removed
- take all necessary measures for the safety, the freedom of shipping, the safeguarding of the shipping route regime or its maintenance
- take all necessary measures to protect the marine environment of the territorial sea and the exclusive economic zone against possible pollution. This last line was added by article 77 of the Law on the Protection of the Marine Environment (20 January 1999) to the "Wreck Law".

- Draft Royal Decree for the installation and allocation of protected areas in the marine areas under Belgian jurisdiction (1999 but never finalised) => ecologically very valuable wrecks:

A draft "Royal Decree for the installation and allocation of protected areas in the marine areas under Belgian jurisdiction" proposes the installation of specific marine reserves as circles with a radius of 500 meters around the wrecks as mentioned below.

- Westhinder 51°22'.928N/002°27'.215E
- Waverley 51°17'.057N/002°41'.344E
- Lies 51°17'.744N/002°49'.701E
- Kilmore 51°23'.780N/002°29'.871E
- Garden City 51°29'.191N/002°18'.402E
- Birkenfels 51°39'.191N/002°32'.350E

1.4 EXISTING SITUATION

1.4.1 Spatial delimitation

A matrix indicates the "Wrecks on the Belgian Continental Shelf adapted up to Baz 2003/07" (3 June 2003). It indicates that there are a total of 209 wrecks, but many more are actually present if smaller parts and small vessels are also taken into account (Map I.3.1a).

Source

- Philippe Formesyn, Flemish Administration of Waterways and Maritime Affairs
- Marnix Pieters, new section of Maritime Patrimony within the Institute of the Archaeological Patrimony

1.4.2 Type and intensity

Names of wrecks – if known - and codes can be found in the matrix. Volume above or below seabed and actual wreck surface above seabed, and details about content and material can be found for 60 of the historically, ecologically and recreationally most valuable wrecks (Termote 1996) (Map I.3.1b).

Source:

- Philippe Formesyn, Flemish Administration of Waterways and Maritime Affairs.
- Marnix Pieters, new section of Maritime Patrimony within the Institute of the Archaeological Patrimony
- Termote, T (1996). Duiken naar 60 wrakken voor de Belgische kust. Geschiedenis, beschrijving en ligging van 60 gezonken schepen. 52 p.

1.5 INTERACTIONS

Interaction in connection with wrecks can only be considered for those that are not removed (compliant with criteria) nor proclaimed as MPAs or as other protected area status.

1.5.1 Suitability for user

Details – if applicable – can be found in the chapter that is specifically dedicated to "Suitability".

1.5.2 Impact on other users

Details – if applicable – can be found in the chapter that is specifically dedicated to "Interaction among users".

1.5.3 Impact on environment

Details – if applicable – can be found in the chapter that is specifically dedicated to "Interaction between users and the environment".

Biological

The impact on the biological environment is mainly due to a change of substrate. On the one hand a hard substrate is introduced which is atypical for the Belgian seabed. This leads to a characteristic fauna. Research on the benthos inhabiting the wreck "Birkenfels" shows a higher biodiversity than elsewhere in the Belgian marine sediment (www.mumm.ac.be/EN/Monitoring/InSitu/Diving/birkenfels.php; Catrijsse and Degraer 2001). On the other hand, it is possible that the soft substrate in the direct vicinity of the wreck is also affected. These effects are supposed to include:

Change of current, erosion and sedimentation:

A change of current, erosion and sedimentation around the wreck will evidently have an impact on the substrate surrounding the wreck and therefore also the community living within or above.

Interaction with the trawling fisheries:

- The attraction of trawling towards wrecks leads to an intensification of trawling tracks in the soft substrate surrounding the wrecks.
- But the area directly surrounding the wreck will be spared from any trawling fisheries at all. This might lead to the conclusion that the areas directly facing the wrecks might belong to the only areas not being impacted by trawling on the Belgian seabed. This hypothesis is recently being investigated by a new BELSPO (Belgian Science Policy) project "BEWREMABI"

Impact on benthos:

- Substrate for sessile fauna such as corals of the family Alcyonae, anemones, organ pipes, and for benthos such as molluscs and echinoderms, with increase of biological diversity
- Positive impact on benthos directly adjacent to wrecks, with increase of biological diversity
- Negative impact on benthos indirectly adjacent to wrecks, with decrease of biological diversity => indirect impact from intensified fishing around wrecks

Impact on nekton:

Positive impact on nekton with an increase of biological diversity:

- Shelter for fishes of the family Gadidae and flatfish in general, crustaceans, and cephalopods
- Habitat areas
- Nursery areas
- Spawning areas
- Feeding areas

Chemical

There is no chemical impact because the decision to extract in the first place takes pollutant criteria already into account.

Geological/Physical

There exists a negative impact on the sediment that is adjacent to wrecks => it is a consequence of an indirect impact from intensified fishing around wrecks.

Hydrological

There is no relevant hydrological impact unless a minor change in currents.

1.5.4 Impact on socio-economy

Economic

Turnover and income for Belgium generated from wrecks => indirectly linked with turnover and income generated from tourism linked with wrecks => very difficult to estimate because very diffuse.

Social

Cultural value:

War graves (Waverley is considered as a War Grave by the British Authorities)

Employment:

Employment in Belgium generated from wrecks => indirectly linked with employment generated from tourism linked with wrecks => very difficult to estimate because very diffuse

1.6 REFERENCES

AWZ, 2003. "Wrecks on the Belgian Continental Shelf adapted up to Baz 2003/07" (3 June 2003)

Catrijsse, A. and Degraer, S., 2001. Macrofauna biodiversity patterns of the Belgian waters. In Biodiversity of the bentjos and the avifauna of the Balgian Coastal waters, p 17-20, Federal Office for Scientific, Technical and Cultural Affairs, Brussels, 48 p.

Cliquet, A., Lambrecht, J. and Maes, F., 2004. *Juridische inventarisatie van de kustzone in België, 2e update*. Studie in opdracht van de Administratie Waterwegen en Zeewezen, Afdeling Waterwegen Kust, (Departement Leefmilieu en Infrastructuur, Ministerie van de Vlaamse Gemeenschap), Gent, Maritiem Instituut/Vakgroep Internationaal Publiekrecht, 88 p.

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Web-sites:

MUMM website www.mumm.ac.be/EN/Monitoring/InSitu/Diving/birkenfels.php

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2 MILITARY AMMUNITION

2.1 DESCRIPTION

After the First World War, the Belgian army disposed of German military ammunition on the sand flat "Paardenmarkt", about 1 km off the Belgian coast near Duinbergen. A major part is now covered with sediment. Since the risks of short-term pollution are minor and the human risks of landing the ammunition are significant, the Belgian authorities decided to leave the ammunition on site. Occasionally, traces of this military ammunition is found by accident on the beach. These trace sites are obviously not indicated on charts and have to be treated with caution.

2.2 SUBUSES AND DESCRIPTION

The disposal of military ammunition was completed under special circumstances directly after the First World War. It is very unlikely that this will ever happen again in the future, since this dumping is prohibited. We therefore can treat the act of disposing of military ammunition as a purely historical use. The presence of the material in the area where it was once disposed of can be described as a separate existing use. This area is influenced by the type of military ammunition, the quantity, the density, the seepage and transformation through time, and by its structural and toxic composition.

2.3 LEGISLATIVE FRAMEWORK

Legislation

(Cliquet et al. 2004 ; Maes and Cliquet 2005)

Delimitation as well as intensity and quantity are not described in the legislation. Neither fishing nor anchoring is allowed on these sites. The disposal took place under special circumstances directly after the First World War. Future dumping into marine areas is prohibited as described by the Law on the Protection of the Marine Environment (20 January 1999).

- Law of 20 January 1999 on the protection of the marine environment in the marine areas under Belgian jurisdiction, *BS* 12 March 1999; as amended.

2.4 EXISTING SITUATION

2.4.1 Spatial delimitation

The "Paardenmarkt" sand flat is near Duinbergen, and about 1 km from the Belgian coast. The site extends over 3 km² and is indicated with a pentagon on hydrographical maps. Fishing and anchoring are prohibited in this area. The surfacing of the ammunition is negligible in this area, as over the years, most of it has been buried by sediment. However, it is possible that surfacing might occur during periods of erosive activity. Official coordinates for the area (UTM/ED50) are (Map I.3.2a):

5690003.8-516676.0	51°21'.60-03°14'.37
5691027.0-517774.9	51°22'.15-03°15'.32
5690475.3-518995.2	51°21'.85-03°16'.37
5689679.7-519381.2	51°21'.42-03°16'.70
5689116.4-517352.1	51°21'.12-03°14'.95

Source

- Missiaen, T. and Henriet, J.-P., 2001. Paardenmarkt site evaluation – Final Report. Federal Office for Scientific, Technical and Cultural Affairs (OSTC), 185 p.

2.4.2 Type and identification

Accurate knowledge of the total volume of dumped material is unknown, but most estimates come close to 35000 tons of which approximately 12000 tons (about one third) consists of toxic ammunitions. The ammunition has been sagging and is largely covered under accumulating fine-grained sediments, mainly due to the construction of the outer port of Zeebrugge. The ammunition is most likely not to be too heavily corroded. The toxic ammunition mainly consists of yperite (60%), (di)phosgene (29%) and clark (11%).

Source

- Missiaen, T. and Henriet, J.-P., 2001. Paardenmarkt site evaluation – Final Report. Federal Office for Scientific, Technical and Cultural Affairs (OSTC), 185 p.

Reliability margin

Estimates concerning the amount of dumped material should be treated with caution. For the time being, however, lacking any further information and for practical reasons, the estimate of 35000 tons is used as the base line.

2.5 INTERACTIONS

2.5.1 Suitability for user

Details – if applicable – can be found in the chapter that is specifically dedicated to "Suitability".

2.5.2 Impact on other users

Details – if applicable – can be found in the chapter that is specifically dedicated to "Interaction among users".

2.5.3 Impact on environment

Details – if applicable – can be found in the chapter that is specifically dedicated to "Interaction between users and the environment".

Biological (see chemical release)

- direct contact of yperite with organisms => water and beach
- impact of arsenic on benthos in long-lasting contaminated sediments.

Chemical

Without mechanical disturbance:

This is non-existing because it will take 100-1000 years before corrosion and if corroded => large dilution and negligible chance for spontaneous detonation.

With mechanical disturbance:

Recovery, trawling fisheries, shipping disaster and anchoring might lead to peak concentrations with:

- lumps of yperite
- release of arsenic to sediment => large radius if erosion of contaminated sediment
- groundwater flux from sea to land with coastal aquifer pollution => risk increases with global warming and sea level rise
- risk for detonation.

With erosion of site:

This might lead to an increased risk because of surfacing.

Geological/Physical

Since this is a historical use, previous geophysical impacts have established a new equilibrium.

Hydrological

Since this is a historical use, previous hydrological impacts have established a new equilibrium.

2.5.4 Impact on socio-economy

Economy

This is non-existing but possibly involves negative costs if removal or positive aspects (costs and employment) if transformation to artificial island and marine protected area.

Social

This is non-existing but possibly involves negative impacts on health if erosion/mechanical disturbance releases heavy metals from the ammunition. They are a potential source of pollution of bathing water.

2.6 REFERENCES

Cliquet, A., Lambrecht, J. and Maes, F., 2004. *Juridische inventarisatie van de kustzone in België, 2e update*. Studie in opdracht van de Administratie Waterwegen en Zeewezen, Afdeling Waterwegen Kust, (Departement Leefmilieu en Infrastructuur, Ministerie van de Vlaamse Gemeenschap), Gent, Maritiem Instituut/Vakgroep Internationaal Publiekrecht, 88 p.

Maes, F. and Cliquet, A., 2005. Codex wetgeving kustzone, Brugge, Vanden Broele, vol. 2.

Missiaen, T. and Henriet, J.-P., 2001. Paardenmarkt site evaluation – Final Report. Federal Office for Scientific, Technical and Cultural Affairs (OSTC), 185 p.

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3 SHIPPING

3.1 DESCRIPTION

Each year, more than 420000 routed ship movements are registered in the North Sea. This number does not include fishing boats or recreational vessels. The majority of the registered movements take place in the southern part of the North Sea. This southern part, therefore, can be seen as one of the busiest shipping areas in the world. It is consequently very vulnerable to accidents and wreckage. The shipping routes along the Belgian coast and on the Belgian part of the North Sea can be divided into three major schemes

- **Category I: West-East bound transit**: Each year, about 150000 ships pass through the Strait of Dover (400 each day) (OSPAR 2000). This does not include crossings (600 each day). The West-East traffic route is used by ships travelling from and to European ports in the southern part of the North Sea and the Baltic Sea, entering or leaving the North Sea via the English Channel. This route is part of the major traffic separation scheme in which counter-current traffic streams are divided by making use of lanes and other regulations. A small part of this major scheme covers the northern strip of the Belgian part of the North Sea.
- **Category II: the Westhinder-separation scheme** is being used by ships travelling from and to ports in Belgium and ports along the Westerscheldt estuary. Those entering the Belgian ports link up with the West-East bound transit in the north. It consists of a western and southern lane and also covers a refuge area in the north. This scheme finds its origin at the end of the Strait of Dover, adjacent to Dunkerk in the French exclusive economic zone, and leads all the way into the Belgian territorial sea.
- **Category III: Other shipping.** Besides these major systems, a variety of other shipping traffic exist with vessels that are not bound to specific routing systems. They are generally under a length of 80 metres except for ferries and other cross channel shipping. An example is the shipping traffic between Belgian ports and the UK, crossing the official traffic separation schemes on a daily basis. Coastal shipping (coasters, whether inland or not, supply vessels, anti pollution vessels, tug boats … etc) also belongs to this category with an area south of the main traffic separation scheme as scope. Recreational and fishing vessels are dealt with under the relevant sections.

3.2 SUBUSES AND DESCRIPTION

Shipping can in fact be subdivided in different sub-uses:

- **The actual transport along the shipping routes**: To limit the number of accidents, collisions and wreckage, a traffic separation scheme called the "Strait of Dover and adjacent waters traffic separation scheme", has been approved by IMO and routes were officially identified on nautical charts, taking into account IMO conventions and regulations, such as COLREG.
- **Places of refuge and anchorage**: Along the Westhinder shipping route, ships are able to anchor at designated areas. This mostly happens while waiting for a pliot or a permission to actually enter a port. Other areas are designated as places of refuge in case of heavy storms at sea or in case of leakage. Yet others can be used for offshore bunkering. Combinations of these

different uses are possible, although no offshore bunkering in the Belgian part of the North Sea (BPNS) takes place at the moment. To start offshore bunkering in the BPNS one needs a permit. In order to receive a permit an environmental impact assessment is required.

- **The ports**: The berthing and anchoring in ports is a sub-use too. Port activities, however, do not make up part of the actual use of the BPNS and are therefore excluded from this study.

3.3 TRANSIT SHIPPING

3.3.1 Description

The West-East traffic route or North Hinder route is made up of ships travelling from and to European ports in the southern part of the North Sea, and entering or leaving the North Sea via the English Channel. A small part of this major scheme covers the northern strip of the Belgian part of the North Sea => coordinates are set under international legislation (see Legislation).

3.3.2 Legislative framework

Legislation

(Cliquet et al. 2004 ; Maes and Cliquet 2005)

International legislation and Belgian implementation:

Traffic separation schemes, shipping routes and traffic regulations were set by international conventions and IMO regulations:

- Convention on the International Regulations for Preventing Collisions at Sea (COLREG), London, 20 October 1972
    - Implementation in Belgium:
        - Law of 24 November 1975 on the approval of the Convention on the International Regulations for Preventing Collisions at Sea, *BS* 12 June 1976.

- International Maritime Organization, Ships' Routeing, London, IMO, 8th Edition, 2002

3.3.3 Existing situation

3.3.3.1 Spatial delimitation

The actual route that is used by West-East bound ships will coincide with the routes as set by the international conventions as mentioned above (Map I.3.3a).

3.3.3.2 Type and intensity

The actual use in frequency and intensity of this transit zone is being studied by other BELSPO projects (ECOSONOS "Emissions of CO2, SO2 and NOx from Ships" and RAMA "Risk Analysis of Marine Activities in the Belgian Part of the North Sea"). This data is not available for the Belgian part of the North Sea. It will need to be collected, making use of transfer data from France or the UK.

3.3.4 Interactions

3.3.4.1 Suitability for user

Details – if applicable – can be found in the chapter that is specifically dedicated to "Suitability".

3.3.4.2 Impact on other users

Details – if applicable – can be found in the chapter that is specifically dedicated to "Interaction among users".

3.3.4.3 Impact on environment

Details – if applicable – can be found in the chapter that is specifically dedicated to "Interaction between users and the environment".

Biological

Ballast water and introduction of harmful aquatic species is a possible impact (mainly in coastal waters and estuaries). Globally, it is estimated that about 10 billion tonnes of ballast water is transferred each year. The water taken on board for ballasting a vessel may contain aquatic organisms, including dormant stages of microscopic toxic aquatic organisms - such as dinoflagellates, which may cause harmful algal blooms after their release. In addition, pathogens such as the bacterium Vibrio cholerae (cholera) have been transported with ballast water. As ships travel faster and faster, the survival rates of species carried in ballast tanks have increased. As a result, many introductions of non-indigenous organisms in new locations have occurred, often with disastrous consequences for the local ecosystem - which may include important fish stocks or rare species.

Regulations concerning harmful aquatic organisms in ballast water:

- The Marine Environment Protection Committee - 44th session (6-13 March 2000) proposed new regulations to address the environmental damage caused by the introduction of harmful aquatic organisms in ballast water, used to stabilise vessels at sea.
- Current options for preventing the spread of harmful aquatic organisms in ballast water are based on IMO Resolution A. 868(20) (Guidelines for the control and management of ships' ballast water to minimize the transfer of harmful aquatic organisms and pathogens) and include:
  - exchanging ballast water in deep ocean, where there is less treath for marine life and where organisms are less likely to survive, if feasible for technical and safety reasons;
  - various (filtration, thermo, chemical, and radiation) treatment of the ballast water en route to kill the living organisms;
  - delivering ballast water to port reception facilities.
- On 13 February 2004, the International Convention for the Control and Management of Ships' Ballast Water and Sediments was approved in IMO. This Convention has not entered into force yet.

Chemical

Oil pollution:

Oil pollution (poly-aromatic carbohydrates or PACs) of which Bap (benzoapyreen 44 mg/kg oil) and Flu (fluorantheen 240 mg/kg oil) for direct disposal and 0.001 mg BaP/kg oil and 0.13 mg Flu/kg oil for indirect pollution via air emissions (Compaan and Laane 1992; Wijffels 1993; Wulffraat and Evers 1993).

- From bilge and sludge (Baan et al. 1998)
  - total of 1500 g/km
  - BaP: 0.025 g/km
  - Flu: 0.15 g/km

The study of movements in the transit zone that is in progress (ECOSONOS and RAMA, see above), and the knowledge of the length of the transit in km, will give the possibility to calculate the exact travelled distance in the transit zone. However, this data is not yet available.

- From ballast water and washing tanks
  - A total of 68500 ton/year is produced for the entire North Sea of which 42% is disposed of (= 28770 tons oil) (Baan et al. 1998). The surface ratio of the Belgian part of the North Sea (3600km^2) against the entire North Sea (750000km^2) = 0.0048 or 0.48% (http://www.mumm.ac.be/EN/NorthSea/facts.php). An extrapolation would therefore add up to about 328.8 tons produced oil for the Belgian part of which 138.1 tons are disposed of.
  - BaP: 1266 tons disposal in the entire North Sea (Baan et al. 1998) and an extrapolation would therefore add up to about 6.08 tons for the Belgian part.
  - Flu: 6905 tons disposal in entire North Sea (Baan et al. 1998) and an extrapolation would therefore add up to about 33.14 tons for the Belgian part.
- From air emission and its atmospheric deposition (Baan et al. 1998) but specific for Wadden Sea => 100% of the PACs end up in sea
  - total of 9 10^{-7} g/km
  - BaP: 9 10^{-10} g/km
  - Flu: 1.17 10^{-7} g/km

The study of movements in the transit zone that is in progress, and the knowledge of the length of the transit in km, will give the possibility to calculate the exact travelled distance in the transit zone. However, this data is not yet available.

As from August 1999, the North Sea, the seas around Ireland and their approaches have been established under the name North West European waters as a Special Area under MARPOL Annex I (oil) (OSPAR 2000).

PCB-153:

PCB-153 from air emission and its atmospheric deposition (Baan et al. 1998) => 100% of PCBs end up in sea of which 7% is PCB-153

- total PCB of 5 10^{-10} g/km
- PCB-153: 3.5 10^{-11} g/km

The study of movements in the transit zone that is in progress, and the knowledge of the length of the transit in km, will give the possibility to calculate the exact travelled distance in the transit zone. However, this data is not yet available.

Heavy metals:

Heavy metals from air emission and atmospheric deposition (Baan et al. 1998) => only vanadium and nickel are supposed to be of significance but no data is available (Wulffraat and Evers 1993).

Antifouling substances:

Anti-fouling paints are used to coat the hulls of ships to prevent sea life such as algae and molluscs attaching themselves to the hull - thereby slowing down the ship and increasing fuel consumption. In the early days of sailing ships, lime and later arsenic were used to coat ships' hulls, until the modern chemicals industry developed effective anti-fouling paints using metallic compounds. These compounds slowly "leach" into the seawater, killing barnacles and other marine life that have attached to the ship. But studies have shown that these compounds persist in the water, killing sea life, harming the environment and possibly entering the food chain. One of the most effective anti-fouling paints, developed in the 1960s, contains the organotin tributylin (TBT), which has been proven to cause deformations in oysters and sex changes in whelks (Evers and Meerendonk 1993; RIZA 1993).

Antifouling substances from vessels (Baan et al. 1998)

- Cu: 1.5 g/km
- TBT: 0.6 g/km

The study of movements in the transit zone that is in progress, and the knowledge of the length of the transit in km, will give the possibility to calculate the exact travelled distance in the transit zone. However, this data is not yet available.

Within the IMO, a general ban on the use of organotin compounds in anti-fouling paints has been agreed. The target is to prohibit the application and to require their removal or at least prevent the leaching of TBT into the water by the year 2008. Within the EC, controls on other TBT applications have been increased with the revision of Directive 76/769/EEC.

Regulations concerning antifouling substances:

- In 1990 IMO's Marine Environment Protection Committee (MEPC) adopted a resolution which recommended that Governments adopt measures to eliminate the use of anti-fouling paint containing TBT on non-aluminium hulled vessels of less than 25 metres in length and eliminate the use of anti-fouling paints with a leaching rate of more than four micrograms of TBT per day.
- In November 1999, IMO adopted an Assembly resolution that called on the MEPC to develop an instrument, legally binding throughout the world, to address the harmful effects of anti-fouling systems used on ships. The resolution called for a global prohibition on the application of organotin compounds that act as biocides in anti-fouling systems on ships by 1 January 2003, and a complete prohibition by 1 January 2008.
- The new International Convention on the Control of Harmful Anti-fouling Systems on Ships (TBT-Convention) adopted on 5 October 2001 (entry into force 12 months after 25 States representing 25% of the world's merchant shipping tonnage have ratified it) defines "*anti-fouling systems*" as "*a coating, paint, surface treatment, surface or device that is used on a ship to control or prevent attachment of unwanted organisms*".
  - Annex I attached to the Convention states that by an effective date of 1 January 2003, all ships shall not apply or re-apply organotin compounds which act as biocides in anti-fouling systems. By 1 January 2008 (effective date), ships either: (a) shall not bear such compounds on their hulls or external parts or surfaces; or (b) shall bear a coating that forms a barrier to such compounds leaching from the underlying non-compliant anti-fouling systems.
- Council Directive 76/769/EEC of 27 July 1976 on the approximation of the laws, regulations and administrative provisions of the Member States relating to restrictions on the marketing and use of

certain dangerous substances and preparations *Official Journal L* 262, 27 September 1976, amended by:

- Council Directive 89/677/EEC of 21 December 1989 amending for the eighth time Directive 76/769/EEC on the approximation of the laws, regulations and administrative provisions of the member states relating to restrictions on the marketing and use of certain dangerous substances and preparations *Official Journal* L 398, 30 December 1989. This Directive introduced a ban on the use of anti-fouling paints with organotin compounds for vessels of less than 25 metres (article 21).
- Commission Directive 1999/51/EC of 26 May 1999 adapting to technical progress for the fifth time Annex I to Council Directive 76/769/EEC on the approximations of the laws, regulations, and administrative provisions of the Member States relating to restrictions on the marketing and use of certain dangerous substances and preparations (tin, PCP and cadmium) (Text with EEA relevance) *Official Journal L* 142, 5 June 1999. This Directive extended the ban for vessels of all lengths especially used on inland waters and lakes.
- Directive 2002/61/EC of the European Parliament and of the Council of 19 July 2002 amending for the nineteenth time Council Directive 76/769/EEC relating to restrictions on the marketing and use of certain dangerous substances and preparations azocolourants) *Official Journal L* 243, 11 September 2002. This Directive extended the ban to vessels of all lengths and used on any water.

- Regulation (EC) No 782/2003 of the European Parliament and of the Council of 14 April 2003 on the prohibition of organotin compounds on ships *Official Journal L* 115, 9 May 2003. This regulation adopts the TBT-Convention of 2001 as mentioned above (as from January 2003 and July 1 2008 off).

Zinc:

Zinc from zinc anodes (Baan et al. 1998)

- Zn: 0.7 g/km

The study of movements in the transit zone that is in progress, and the knowledge of the length of the transit in km, will give the possibility to calculate the exact travelled distance in the transit zone. However, this data is not yet available.

NOx:

NOx from air emission and its atmospheric deposition (Baan et al. 1998) => 40% of the total NOx in the air emission will end up in sea:

- total NOx of 730 g/km
- NOx: 292 g/km to sea

The study of movements in the transit zone that is in progress, and the knowledge of the length of the transit in km, will give the possibility to calculate the exact travelled distance in the transit zone. However, this data is not yet available.

Regulations concerning NOx emissions:

- A Protocol adopted at the Conference of the Parties in September 1997 introduced a new Annex VI, amending MARPOL 73/78. Annex VI is in force since 19 May 2005 and deals with regulations for the prevention of air pollution from ships. Annex VI sets limits on emissions of nitrogen oxides (NOx) from diesel engines. A mandatory NOx Technical Code, developed by IMO, defines how this is to be done.
- European legislation is in the process of being drafted.

Geological/Physical

Oil slicks:

Oil slicks from vessels lead to:

- total oil disposal of 1500 g/km from sludge and bilge, and of 28770 tons from ballast water and washing tanks
- an average oil slick of 0.5m² for 1 kg oil per day (thickness of 0.3mm).

The study of movements in the transit zone that is in progress, and the knowledge of the length of the transit in km, will give the possibility to calculate the exact travelled distance in the transit zone. However, this data is not yet available.

Hydrological

No hydrological impact is significant enough to be mentioned here.

3.3.4.4 Impact on socio-economy

Economic

Figures on turnover and income to Belgium generated from this traffic are not yet available.

Social

Figures on Belgian employment are not available and possibly not relevant.

3.4 PLACES OF REFUGE AND ANCHORING FOR TRANSIT SHIPPING

In the past, offshore bunkering took place on the Belgian part of the North Sea. The Law on the Protection of the Marine Environment (1999) requires a permit for these activities. No offshore bunkering company, however, has been granted a permit to date. One company applied for a permit, based on a mandatory environmental impact assessment (EIS). The EIS did not satisfy the administration (MUMM) who demanded a new EIA. In reaction, the offshore bunkering company moved its activities to British waters. This means that no offshore bunkering sites are in use thus far.

3.5 WESTHINDER SHIPPING

3.5.1 Description

The Westhinder separation scheme is being used by ships travelling from and to ports in Belgium and along the Westerscheldt estuary. It links up with the West-East bound transit in the north. It consists of a western and southern lane and also covers a refuge area in the north. This scheme finds its origin at the end of the Strait of Dover, adjacent to Dunkerk, and leads all the way into the Belgian territorial waters => co-ordinates are set under international legislation. The separation scheme ends at the Westhinder refuge site where ships have to wait until they are piloted (for ships over 80 metres in length) to either the Westerscheldt or the Belgian coastal ports. Buoys also mark certain coordinates along these routes.

3.5.2 Legislative framework

Legislation

(Cliquet et al. 2004 ; Maes and Cliquet 2005)

International legislation and Belgian implementation:

Traffic separation schemes, shipping routes and traffic regulations were set or approved by international conventions and IMO regulations:

- Convention on the International Regulations for Preventing Collisions at Sea (COLREG), London, 20 October 1972
    - Implementation in Belgium:
        - Law of 24 November 1975 on the approval of the Convention on the International Regulations for Preventing Collisions at Sea, *BS* 12 June 1976.

- International Maritime Organization, Ships' Routeing, London, IMO, 8th Edition, 2002.

- United Nations Convention on the Law of the Sea, Montego Bay, 10 December 1982.
    - Implementation in Belgium:
        - Law of 18 June 1998 on the approval of the Convention on the Law of the Sea of 10 December 1982 and the Agreement relating to the implementation of Part XI of the United Nations Convention on the Law of the Sea of 10 December 1982 of 28 July 1994, *BS* 16 September 1999.

3.5.3 Existing situation

3.5.3.1 Spatial delimitation

The actual route that is used by ships over 80 metres in length, going to or coming from the Belgian ports, will coincide with the routes set by the international conventions, as mentioned above (Map I.3.3a).

3.5.3.2 Type and intensity

The identification of the type of shipping was focused on merchant shipping. Location and intensity data of this kind of shipping were collected making use of the IVS SRK database from the Vessel Traffic Services. Data used for the analysis covered the period from April 2003 through to March 2004. In total, 55 351 movements were registered during that period by the VTS in the studied area. For this project, overall shipping density and intensity in the analysed area, and during the analysed period, was registered and set out on a map. Furthermore, a detailed database is presently being finalised that will allow analysis of shipping patterns based on different classes. These classes are based on vessel type (8 classes), route segment and direction (112 classes) and cargo type (15 classes). The distinction between cargo types is based on the IMDG and IMO classes. The database also includes additional data such as cargo, ship characteristics, sailing speed, ETA …etc. These aspects, however, are not within the scope of this project. The number of ships is expressed in units (Map I.3.3b):

- per direction (to or from Belgian coast, possibly to certain harbours)

- per period of one year => data available for the period between April 2003 through to April 2004
- excluding recreational vessels, fishing vessels and all vessels below 80 metres except those that do report their entrance in the area controlled by the VTS (f.e. vessels carrying dangerous goods)

This adds up to a total of 2 921 941.18 travelled km for the studied period.

3.5.4 Interactions

3.5.4.1 Suitability for user

Details – if applicable – can be found in the chapter that is specifically dedicated to "Suitability".

3.5.4.2 Impact on other users

Details – if applicable – can be found in the chapter that is specifically dedicated to "Interaction among users".

3.5.4.3 Impact on environment

Details – if applicable – can be found in the chapter that is specifically dedicated to "Interaction between users and the environment".

Biological

Ballast water and introduction of harmful aquatic species is a possible impact.

See for detailed explanation and legislation under "Transit shipping".

Chemical

Oil pollution:

Oil pollution (PACs) of which Bap (benzoapyreen 44 mg/kg oil) and Flu (fluorantheen 240 mg/kg oil) for direct disposal and 0.001 mg BaP/kg oil and 0.13 mg Flu/kg oil for indirect pollution via air emissions (Compaan and Laane 1992; Wijffels 1993; Wulffraat and Evers 1993):

- From bilge and sludge (Baan et al. 1998)
  - total of 1500 g/km => total of 4382.91 tons for the studied period
  - BaP: 0.025 g/km => total of 73.05 kg for the studied period
  - Flu: 0.15 g/km => total of 438.29 kg for the studied period
- From ballast water and washing tanks
  - A total of 68500 ton/year is produced for the entire North Sea of which 42% is disposed of (= 28770 tons oil) (Baan et al. 1998). The surface ratio of the Belgian part of the North Sea (3600 km²) against the entire North Sea (750000 km²) = 0.0048 or 48% (http://www.mumm.ac.be/EN/NorthSea/facts.php). An extrapolation would therefore add up to about 328.8 tons oil produced for the Belgian part of which 138.1 tons are disposed of.
  - BaP: 1266 tons disposal in entire North Sea (Baan et al. 1998) and an extrapolation would therefore add up to about 6.08 tons for the Belgian part.
  - Flu: 6905 tons disposal in entire North Sea (Baan et al. 1998) and an extrapolation would therefore add up to about 33.14 tons for the Belgian part.

- From air emission and its atmospheric deposition (Baan et al. 1998 but specific for Wadden Sea) => 100% of PACs end up in sea
- total of 9 10^{-7} g/km => total of 2.63 g for the studied period
- BaP: 9 10^{-10} g/km => total of 2.63 mg for the studied period
- Flu: 1.17 10^{-7} g/km => total of 0.34 g for the studied period

See for detailed explanation and legislation under "Transit shipping".

PCB-153:

PCB-153 from air emission and its atmospheric deposition (Baan et al. 1998) => 100% of PCBs end up in sea of which 7% is PCB-153

- total PCB of 5 10^{-10} g/km => total of 1.5 mg for the studied period
- PCB-153: 3.5 10^{-11} g/km => total of 0.1 mg for the studied period

See for detailed explanation and legislation under "Transit shipping".

Heavy metals:

Heavy metals from air emission and its atmospheric deposition (Baan et al. 1998) => only vanadium and nickel are supposed to be of significance but no data is available (Wulffraat and Evers 1993).

See for detailed explanation and legislation under "Transit shipping".

Antifouling substances:

Antifouling substances from vessels (Baan et al. 1998)

- Cu: 1.5 g/km => total of 4.38 tons for the studied period
- TBT: 0.6 g/km => total of 1.75 tons for the studied period

See for detailed explanation and legislation under "Transit shipping".

Zinc:

Zinc from zinc anodes (Baan et al. 1998)

- Zn: 0.7 g/km => total of 2.05 tons for the studied period

See for detailed explanation and legislation under "Transit shipping".

NOx:

NOx from air emission and its atmospheric deposition (Baan et al. 1998) => 40% of the total NOx in the air emission will end up in sea:

- total NOx of 730 g/km => total of 2133.02 tons for the studied period
- NOx: 292 g/km to sea => total of 853.21 tons for the studied period

See for detailed explanation and legislation under "Transit shipping".

<u>Geological/Physical</u>

Oil slicks:

Oil slicks from vessels lead to:

- total oil disposal of 1500 g/km from sludge and bilge, and of 138.1 tons from ballast water and washing tanks => total of 5714 + 138.1 tons for the studied period = 5852.1 tons
- an average oil slick of 0.5 m^2 for 1 kg oil per day (thickness of 0.3 mm)

Hydrological

No hydrological impact is significant enough to be mentioned here.

3.5.4.4 Impact on socio-economy

Economic

Ports:

The economic value (maritime cluster and non-maritime cluster) of the Flemish ports of Ostend, Zeebrugge, Antwerp and Gent (Douvere, in press) can be calculated, but this also includes public service and general service turnover from shipping < 80 metres (see Coastal and cross channel shipping). The added value for the year 2002 is:

- Ostend € 324 million
- Gent € 2942.9 million
- Zeebrugge € 687 million
- Antwerp € 7012.9 million

Shipping itself:

Figures on the level of shipping itself are not available

Social

Ports:

Employment (maritime cluster and non-maritime cluster) in the Flemish ports of Ostend, Zeebrugge, Antwerp and Gent (Douvere, in press) can be calculated, but this also includes public service and general service employment from shipping of <8 0 metres (see Coastal and cross channel shipping) for the year 2002 is:

- Ostend 4095 employees
- Gent 28501 employees
- Zeebrugge 9783 employees
- Antwerp 60563 employees

Shipping itself:

Figures on the level of shipping itself are not available.

3.6 PLACES OF REFUGE AND ANCHORING FOR WESTHINDER SHIPPING

3.6.1 Description

Article 20 of Directive 2002/59/EC asks the member state – amongst other things – to deliver places of refuge to vessels in distress. Because the BPNS is intensively used, the only place of refuge in that part of the North Sea that can be offered is the Westhinder refuge site (Rampenplan Noordzee 2004). The

Westhinder refuge and anchoring site is situated north of the end of the traffic separation scheme. Ships above 80 metres in length are required to wait until vacancy becomes available in the port of arrival or until high tide allows for safe entrance into the port of Antwerp. They are then piloted from the refuge site to the port of arrival.

- Directive 2002/59/EC of the European Parliament and of the Council of 27 June 2002 establishing a Community vessel traffic monitoring and information system and repealing Council Directive 93/75/EEC, *Official Journal L* 208, 5 August 2002.

3.6.2 Legislative framework

Legislation

(Cliquet et al. 2004 ; Maes and Cliquet 2005)

International legislation and Belgian implementation:

The Westhinder refuge and anchorage site is approved by international conventions and IMO regulations.

- Convention on the International Regulations for Preventing Collisions at Sea, London, 20 October 1972.
    - Implementation in Belgium:
        - Law of 24 November 1975 on the approval of the Convention on the International Regulations for Preventing Collisions at Sea, *BS* 12 June 1976.
- International Maritime Organization, Ships' Routeing, London, IMO, 8th Edition, 2002.

3.6.3 Existing situation

3.6.3.1 Spatial delimitation

The actual place of refuge that is used by ships above a certain length (80 metres) going to Belgian ports will coincide with the place of refuge set by the international conventions as mentioned above. An anchorage is established north of the scheme and is bounded by a line connecting the following geographical positions (Map I.3.3a):

- 51°23'.50 N 2°33'.00 E
- 51°26'.00 N 2°35'.00 E
- 51°26'.00 N 2°41'.00 E
- 51°23'.50 N 2°41'.00 E

3.6.3.2 Type and intensity

Using the same IVS SRK database from the Vessel Traffic Services, as was used for shipping intensity and frequency, allows us to get an idea of intensity and frequency of use of the Westhinder place of refuge. Data for the analysis period runs from April 2003 through to March 2004 (Map I.3.3c). Units are expressed as:

- average number of vessels waiting in the area of refuge per day and per year => data available for the period between April 2003 through to April 2004
    - 2.36/day
    - 862.5/year
- average number of waiting hours per vessel in the area of refuge

  - 6.22 hours/vessel
- average number of waited hours per day and per year for all vessels
  - 14.7 hours/day = 0.61 waiting days
  - 5364.75 hours/year = 223.5 waiting days

3.6.4 Interactions

3.6.4.1 Suitability for user

Details – if applicable – can be found in the chapter that is specifically dedicated to "Suitability".

3.6.4.2 Impact on other users

Details – if applicable – can be found in the chapter that is specifically dedicated to "Interaction among users".

3.6.4.3 Impact on environment

Details – if applicable – can be found in the chapter that is specifically dedicated to "Interaction between users and the environment".

Biological

Ballast water and introduction of harmful aquatic species is a possible impact though no ballast water is known to be discharged in this area.

See for detailed explanation and legislation under "Transit shipping".

Chemical

Antifouling substances:

Antifouling from vessels (Baan et al. 1998)

- Cu: 300g/24h per vessel (between 10000 and 30000 tons) => this adds up to a release of 300 x 223.5 days = 67.05 kg Cu in the studied year
- TBT: 50g/24h per vessel (between 10000 and 30000 tons) => this adds up to a release of 50 x 223.5 days = 11.18 kg TBT in the studied year

See for detailed explanation and legislation under "Transit shipping".

Zinc:

Zinc from zinc anodes (Baan et al. 1998)

- Zn: 200g/24h per vessel) => this adds up to a release of 200 x 223.5 days = 44.7 kg Zn in the studied year

See for detailed explanation and legislation under "Transit shipping".

Hydrological

No hydrological impact is significant enough to be mentioned here.

3.6.4.4 Impact on socio-economy

Economic

See under "Westhinder shipping".

Social

See under "Westhinder shipping".

3.7 COASTAL AND CROSS CHANNEL SHIPPING

3.7.1 Description

Ships under a certain tonnage (in general < 80 metres long) are not bound to specific routeing systems. They are free to move anywhere on the condition that they do not strand (therefore taking into account the buoys that delimitate the sand flats) and that they do not disturb the official traffic separation schemes. The "priority to the right" rule counts except for ships using the traffic separation scheme. They always have priority. Shipping linked with fishing and recreation will be dealt with under the relevant chapters. Two sectors can be distinguished:

- The coastal shipping using the area south of the Westhinder traffic separation scheme
- The cross channel shipping linking Belgian ports with UK ports. When ferries are above 80 metres they will need to make use of the traffic separation scheme as mentioned above. Crossing routes are variable and are chosen in terms of weather and traffic.

3.7.2 Legislative framework

(Cliquet et al. 2004 ; Maes and Cliquet 2005)

International legislation and Belgian implementation:

Vessels under 80 metres are not restricted to certain routes but have to take international traffic rules into account (priority of separation scheme, priority of the right, indication of buoys … etc).

- Convention on the International Regulations for Preventing Collisions at Sea, London, 20 October 1972.
    - Implementation in Belgium:
        - Law of 24 November 1975 on the approval of the Convention on the International Regulations for Preventing Collisions at Sea, *BS* 12 June 1976.
- International Maritime Organization, Ships' Routeing, London, IMO, 8th Edition, 2002.

3.7.3 Existing situation

3.7.3.1 Spatial delimitation

The actual route that is used by ships above 80 metres will coincide with the routes as set by the international conventions as mentioned above. The vessels < 80 metres will adapt their routes – either coastal or cross channel – according to the weather and traffic at that moment.

3.7.3.2 Type and identification

No data is available on frequency and intensity of vessels under 80 metres of length that do not make use of the traffic separation scheme or the Westhinder scheme.

3.7.4 Interactions

3.7.4.1 Suitability for user

Details – if applicable – can be found in the chapter that is specifically dedicated to "Suitability".

3.7.4.2 Impact on other users

Details – if applicable – can be found in the chapter that is specifically dedicated to "Interaction among users".

3.7.4.3 Impact on environment

Details – if applicable – can be found in the chapter that is specifically dedicated to "Interaction between users and the environment".

Biological

No biological impact is significant enough to be mentioned here.

Chemical

No chemical impact is significant enough to be mentioned here.

Geological/Physical

No geological/physical impact is significant enough to be mentioned here.

Hydrological

No hydrological impact is significant enough to be mentioned here.

3.7.4.4 Impact on socio-economy

Economic

Figures on turnover and income to Belgium generated by this traffic are not yet available.

Social

Figures on employment in Belgium generated by this traffic are not yet available.

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4 COMMERCIAL FISHERIES

4.1 DESCRIPTION

The Belgian sea fisheries sector consists of recreational fisheries and commercial fisheries. This template deals with the latter (for recreational fisheries: see "Recreation and tourism at sea"). Belgian commercial fisheries can be divided in river Scheldt fisheries and sea fisheries. The river Scheldt, in particular the Western Scheldt, is an estuarine wholly situated on Dutch territory. In 2003, the Scheldt fleet consisted of nine fishing vessels, with a total capacity of 1324 kiloWatt (kW) (Dienst Zeevisserij 2003). The largest part of their captures is landed in Dutch ports (Breskens and Colijnsplaat) (Douvere and Maes 2003). Scheldt fisheries are situated outside the geographical scope of the GAUFRE project. Therefore only commercial fisheries at sea are part of this study.

Commercial fisheries can be separated into: (a) fisheries (harvest); and (b) aquaculture (cultivation). Aquaculture in the Belgian exclusive economic zone (EEZ) and territorial sea (TZ) is in an experimental phase and in terms of social, economic and ecological effects irrelevant at present (Maes et al. 2002; Douvere in press). Aquaculture is part of another chapter (see "Aquaculture").

In 2003, the Belgian fisheries fleet consisted of 120 vessels. This fleet can be divided in a small-scale fleet (< 221 kW: 57 vessels) and a large-scale fleet (> 221 kW: 63 vessels). Half of the small-scale fleet are medium scale vessels (> 70 GT), the rest are small ones (< 70 GT) (Officiële lijst der Belgische vissersvaartuigen, Federale Overheidsdienst Mobiliteit en Vervoer, Maritiem Vervoer, 30p.)

- the small-scale fleet has an average capacity of 52 GT and 200 kW. These vessels stay at sea for a maximum of 24 hours. Usually, 3 persons are on board. In 2003, each vessel had the right to stay 169 days at sea for fishing activities (sailing and fishing together).
- the medium scale fleet has an average capacity of 99 GT and 220 kW. Usually, these vessels are 4 days at sea and have 4 persons on board. In 2003, each vessel had the right to stay 210 days at sea for fishing activities (sailing and fishing together).
- the large-scale fleet has an average capacity of 296 GT and 814 kW. Usually, these vessels are 10 days at sea and have (on average) 6 persons on board. In 2003, each vessel had the right to stay 243 days at sea for fishin activities (sailing and fishing together).

4.2 SUBUSES AND DESCRIPTION

Fishing activities can be divided into:

- sailing towards the fishing ground
- catching fish (or the attempt to catch fish)
- intervals between the catching periods
- returning to the fishery port

4.3 LEGISLATIVE FRAMEWORK

Competent authority

Fisheries at sea are a Flemish competence, with the exception of issuing and controlling technical standards related to the vessels and manning. The latter is a federal competence.

Legislation

International legislation:

Since 1983 the European Common Fisheries Policy (CFP) governs fishing activities of the Member States. The current CFP is based on:

- Council Regulation (EC) No 2369/2002 of 20 December 2002 amending Regulation (EC) No 2792/1999 laying down the detailed rules and arrangements regarding Community structural assistance in the fisheries sector, *Official Journal L* 358, 31 December 2002.
- Council Regulation (EC) No 2370/2002 of 20 December 2002 establishing an emergency Community measure for scrapping fishing vessels, *Official Journal L* 358 , 31 December 2002.
- Council Regulation (EC) No 2371/2002 of 20 December 2002 on the conservation and sustainable exploitation of fisheries resources under the Common Fisheries Policy, *Official Journal L* 358 , 31 December 2002.

Additionally two agreements grant particular fishing rights to fishermen of neigbouring states:

- The Treaty of the BENELUX Economical Union (1958) allowing Dutch fishermen to fish within 3 nautical miles (Verdrag tot instelling van de Benelux Economische Unie, Belgisch Staatsblad, 27 oktober 1960)
- A Belgian-French Agreement (1975) allowing French fishermen to catch herring and sprat in the Belgian territorial sea. This counts for the zone between 3 and 6 nautical miles for vessels that do not exceed a gross tonnage of 60 or that contain engines under 400 horse power. It also counts for the zone within 3 nautical miles of the coastline for vessels whose gross tonnage does not exceed 35 or whose engines do not exceed 250 horse power (Belgisch-Franse overeenkomst over de visvangst op ijle haring en sprot in de Franse en Belgische territoriale wateren, ondertekend per briefwisseling op 30 September 1975 en 23 Oktober 1975)

The central objectives of the European legal framework are:

- access to waters and the exploitation of resources;
- the harmonisation of the conservation policy (Total Allowable Catches (TACs – quota management system);
- restructuring of the community fleet;
- community control system.

The European CFP also contains a market and price policy and an external fisheries policy.

National legislation on spatial delimitation:

Spatial delimitation of fisheries in the Belgian EEZ is governed by (Map I.3.4a):

- Law of 19 August 1891 concerning the regulation of fisheries in the Belgian territorial sea, *BS*, 29 August 1891, amended by the Law of 22 April 1999 on the Belgian exclusive economic zone in the North Sea, *BS* 10 July 1999.

- Law of 10 October 1978 concerning the establishment of a Belgian fisheries zone, *BS*, 28 December 1978,amended by the Law of 22 April 1999 on the Belgian exclusive economic zone in the North Sea, *BS* 10 July 1999.
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Based on the CFP, some EU Members States have access to the Belgian territorial sea. The access is limited as follows:

- 3 to 12 nautical miles: unlimited fishing right for Dutch fishing vessels;
- 3 to 12 nautical miles: fishing right for Herring for French fishing vessels
- EEZ: free access for all Member States – unlimited (except Spain, Portugal and Finland for whom access is only allowed for unlimited and non-assigned fish species).

Based on the Benelux agreement:

- 0 to 3 nautical miles: unlimited fishing right for Dutch fishing vessels

In the Belgian territorial sea between 0 and 12 nautical miles, the allowed fishing vessels as mentioned above, may not exceed the limit of 221 kW. In the Belgian territorial sea between 0 and 3 nautical miles, the allowed fishing vessels as mentioned above, may not exceed the limit of < 70 GT.

Additional to the fishing rights for foreign vessels in the Belgian part of the North Sea, Belgian fishing vessels have fishing rights outside the Belgian part of the North Sea.

Table I.3.4a: Belgian historic fishing rights according to Council Regulation (EC) 2371/2002 on the conservation and sustainable exploitation of fisheries resources under the Common Fisheries Policy, December 2002, PB. L. 358

Geographical area	species	Particular characteristics
United Kingdom coast (6 to 12 nautical miles)		
Berwick upon Tweed east	Herring	Unlimited
Coquer Island east		
Cromer north		
North Foreland east	Demersal	Unlimited
North Foreland east		
Dungeness new lighthouse south	Demersal	Unlimited
Dungeness new lighthouse south, Selsey Bill south	Demersal	Unlimited
Straight Point south-east, South Bishop north-west	Demersal	Unlimited
Irish coast (6 to 12 nautical miles)		
Cork south		
Carnsore Point south	Demersal	Unlimited
Wicklow Head east		
Carlingford Lough south-east	Demersal	Unlimited
Coastal waters of Denmark		
Blavands Huk to Bovbjerg	Cod	Unlimited only during June and July
Thyboron to Hanstholm	Whiting	Unlimited only during June and July
	Plaice	

Skagerrak (Hanstholm to Skagen) (4 to 12 nautical miles)	Plaice	Unlimited only during June and July Unlimited only during June and July
Coastal waters of France Belgian/French frontier to east of Departement Manche (Vire-Grandcamp les Bains estuary 49°23'30" N-1° 2'WNNE)	Demersal Scallops	Unlimited Unlimited
Coastal waters of the Netherlands (3 to 12 nautical miles) Whole coast	All species	Unlimited
Shetland box	Demersal species other than Norway pout and blue whiting	2 vessels (length between perpendiculars of not less than 26 metres)

Based on the Benelux Agreement, Belgian fishing vessels have an unlimited fishing right in the Dutch territorial sea from 0 to 3 nautical miles.

Legislation on effort limitation:

Belgian fishing effort is limited as follows (figures for 2003):

- the total effort capacity of the Belgian beam trawler fleet may not exceed 23260 GT and 65600 kW;
- the total effort capacity of the Belgian demersale trawler fleet may not exceed 1016 GT and 2174 kW;
- between 1 January 2004 and 31 December 2004, the total amount of sailing days is limited to 255 days;
- in the Belgian territorial sea from 0 to 3 nautical miles only fishing vessels under 70 GT are allowed to fish;
- in the Belgian territorial sea from 0 to 12 nautical miles only fishing vessels under 221 kW are allowed to fish.

Legislation on extract limitations:

The exploitation of fish resources is limited by the TAC/quota system of the CFP[1]. The Belgian quota for 2003 are (Dienst Zeevisserij 2003):

Table I.3.4b: The TAC/quota system applied to Belgium

Species	Geographical area	Effective quotum (after exchange) - tonnes[2]
Cod	IIIa Skagerrak IIa (EG-zone); IV	0 1502

[1] A revision of the CFP (incl. Historic rights concept – relative stability) is expected in 2012

[2] The assigned quota can be subject of exchanges between EU Member States. Usually Belgian quota for mackerel, herring and sprot are exchanged with the Netherlands for cod, plaice, sole and haddock

	Vb (EG-zone) ; VI ; XII ;XIV	162
	VII excl. VIIa ;VIII ;IX ;X ;34.1.1 (EG-zone)	162
	VIIa	201
Haddock	IIIa; IIIb, c, d (EG-zone)	0
	IIa (EG-zone); IV	560
	Vb (EG-zone) ; VI ; XII ; XIV	7
	VII excl. VIIa ; VIII ; IX ; X ;34.1.1 (EG-zone)	131
Pollack	Vb (Färöer)	0
Ling	IIIa Skagerrak	0
	IV (EG-zone); int. waters	40
	VI; VII; VIII; IX; X; XIV; int. waters	46
Whiting	IIa (EG-zone); IV	275
	VIIa	13
	VII excl. VIIa	369
	VIII; IX; X; 34.1.1 (EG-zone)	10
Plaice	IIIa Skagerrak	0
	IIa (EG-zone); IV	5149
	VIIa	636
	VIId, e	919
	VIIf, g	212
	VIIh, j, k	116
	VIII; IX; X; 34.1.1 (EG-zone)	15
Sole	II; IV	1588
	VIIa	688
	VIId	1607
	VIIe	4
	VIIf, g	729
	VIIh, j, k	136
	VIIIa, b	308
Turbot and brill	IIa (EG-zone); IV (EG-zone)	426
Ray	IIa (EG-zone); IV (EG-zone)	494
Dab and flounder	IIa (EG-zone); IV (EG-zone)	634
Lemon sole	IIa (EG-zone); IV (EG-zone)	469
Picked dogfish	IIa (EG-zone); IV (EG-zone)	102
Mackerel	IIa (EG-zone); IIIa; IIIb, c, d (EG-zone); IV	18

Sprat	IIa (EG-zone); IV (EG-zone)	761
Hake	IIa (EG-zone); IV (EG-zone) Vb (EG-zone) ; VI ; VII ; XII ; XIV VIIIa, b, d, e	55 62 15
Anglerfish	IIa (EG-zone); IV (EG-zone) Vb (EG-zone) ; VI ; XII ; XIV VII VIIIa, b, d, e	252 0 934 116
Megrim	VII VIIIa, b, d, e	164 17
Norway lobster	IIa (EG-zone); IV (EG-zone) VII VIIIa, b, d, e	344 34 5
Herring	I, II Ivc (uitgez. Blackwater-bestand); VIId	4 9
Bleu whiting	Vb (EG-zone); VI; VII; XII; XIV	600
Other species	IV (Noorse zone) bezuiden 62° NB	370

4.4 EXISTING SITUATION

The fishing activities of the Belgian fleet take place in both the Belgian territorial sea, EEZ and outside this area (see Legislation on Spatial delimitation) (Maps I.3.4b-c). Estimates of fishing activities in the Belgian part of the North Sea reveal 2 problems:

- Currently, there are no accurate scientific data to assess fishing activities in the Belgian part of the North Sea, for Belgian or foreign vessels. Related to this, all figures concerning effort and extraction used below are indications for the entire fishing fleet, including (but not specifying) fishing activities in the Belgian part of the North Sea and outside.
- The reliability of the available data is uncertain. The composition of the official figures, as used below, is based on log books, which are filled in on board by the fishermen. Various sources (including ICES) show that officially gathered information is often underestimating the actual situation. The size of the bias is uncertain.

4.5 INTERACTIONS

4.5.1 Suitability for user

Details – if applicable – can be found in the chapter that is specifically dedicated to “Suitability”.

4.5.2 Impact on other users

Details – if applicable – can be found in the chapter that is specifically dedicated to "Interaction among users".

4.5.3 Impact on environment

Details – if applicable – can be found in the chapter that is specifically dedicated to "Interaction between users and the environment".

Biological

Extraction of living organisms:

In 2003, 23637 tons of fish were landed by Belgian fishing vessels (in 1980 this was 43000 tons). The fish landings included (Dienst Zeevisserij 2003):

- 89 % demersale fish
- 5.8 % mollucs
- 5 % crustaceans
- 0.1 % pelagic fish

The Belgian fish catch is highly concentrated on cod, plaice and sole, which are ca. 60 % of the total landings. More than 90% of the Belgian fishing fleet uses beam trawls.

Trawling:

- severe impact on benthos (displacement, entanglement, abrasion)
- severe impact on fish population (displacement)
- positive (increased food availability), negative (noise, entanglement) impact on sea birds

Pelagic fishing:

- low impact on zooplankton (disturbance)
- low impact on benthos (displacement, entanglement)
- severe impact on fish population (displacement)
- eutrofication (discarding)
- positive impact (increased food availability) or negative impact (entanglement in nets, noise) on seabirds
- medium impact on sea mammals (entanglement, displacement, noise)

Chemical

Trawling:

- CO_2 emissions
- oil pollution
- solid waste pollution
- tributyltin (TBT) (anti-regenerating paintings)
- copper (anti-regenerating paintings)
- zinc (corrosion protection treatments)
- change in nutrient cycling due to displacement of species: medium severity

Pelagic fishing:

- CO_2 emissions
- oil pollution
- solid waste pollution
- tributyltin (TBT) (anti-regenerating paintings)
- copper (anti-regenerating paintings)
- zinc (corrosion protection treatments)

Geological/Physical

Trawling:

- impact on substrate: physical disturbance of seabed (stirring, moving and removal of stones): severe impact
- turbidity increase: medium severity
- loss of fishing nets or disposal of fishing nets generally close to ship wrecks: medium severity

Pelagic fishing:

- turbidity increase: medium severity

4.5.4 Impact on socio-economy

Economic

The annual turnover strongly depends on the price and volume of catch. In 2003, the turnover of Belgian fish caught was estimated to be 90.3 million euro (Dienst Zeevisserij 2003).

Social

The direct employment of fishing activities at sea is estimated at 577 people. This estimate is based on the fishermen on board.

Fishermen on board:

- small scale vessels: 3 fishermen*29 vessels = 87 fishermen
- medium scale vessels: 4 fishermen*28 vessels = 112 fishermen
- large scale vessels: 6 fishermen*63 vessels = 378 fishermen

4.6 REFERENCES

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5 MILITARY EXERCISES

5.1 DESCRIPTION

Military use of the Belgian part of the North Sea comprises different types of exercises that are executed both on land (on the beach) and at sea. These exercises are all assigned to specific zones. Although these zones cover a large part of the BPNS, the intensity of the exercises is rather small in comparison to the other use functions.

5.2 SUBUSES AND DESCRIPTION

Military exercises can be categorised into different sub-uses according to the zone in which they are executed and to the military component that is responsible for them.

Mixed land/sea

Responsibility: Army (land component):

Conducted by Army, Air Force and Navy → **Shooting exercises directed seawards from the land**. These exercises are held off the beach area located in Nieuwpoort – Lombardsijde. The purposes of the exercises are to test new ammunition or weapons and to train the staff (simulation of defense against sudden air attacks). During the shooting exercises two types of targets can be used:

- balloons filled with Helium (can only be used when the wind direction is Northeast)
- Ultima 2 (little plane that is controlled from safety tower): the wings of the plane contain microphones that register the ammunition that passes in a certain range around them (this target cannot be used when it rains, because the rain drops give false signals).

The exercise area is divided into three shooting sectors, namely K, M and G. K stands for small ('klein'), M for medium ('middelgroot') and G for great sector ('groot'). Depending on the calibre of the ammunition used (and the associated distance they travel), the sector is chosen.

The sectors where these shooting exercises are held are mentioned on hydrographical charts of the Belgian coast. During the exercises all ships are advised to avoid the sector. The periods in which the exercises are held are announced to ships (Messages to Seafarers - 'Berichten aan Zeevarenden: BaZ') and airplanes (military bases send messages to the airports of Oostende and Koksijde who send them to the relevant airports).

Ammunition remainders are not cleaned (or captured by bullet catchers) from the seabed after termination of the exercises. The metal casings of the bullets that fall on land are cleaned afterwards.

Sporadically also 'chaff and flare' exercises with A109 helicopters are executed in this training area. These exercises are defense/decoy exercises (Adj. Debreyer pers. comm. 2003).

Responsibility: Army/Navy/Air Force → Amphibian exercises:

These are exercises to train the survival performance of Air Force pilots. They are dropped in sea and their survival capacities are tested. These exercises are only sporadically executed (not more than 5 times a year, mean of 3 exercises a year). Since impacts coming from airspace traffic are not considered in the project, this sub-use will not be considered further. The impact of the pilots in the water can be ignored (comparable to very low intensity of recreational bathing) (Cmdt. Morris pers. comm. 2003).

At sea

Responsibility: Navy → Shooting exercises at floating targets:

These exercises are held in a training area which forms a five-sided polygon. The naval ships are situated at the southern limit of the polygon and the shooting exercises are directed toward the north. The shots are aimed at a floating target that is dragged by another ship or anchored. The exercises can be executed during day or night time. The exercises are announced in BaZ and on NAVTEX ('Urgent Messages' from DVZ). During the exercises all ships are advised to avoid the sector. The exercises are performed from naval frigates employing canons with 100 mm ammunitions. The amount of ammunitions that is fired is classified information (Cmdt. Morris pers. comm. 2003).

Responsibility: Navy → Exercises in which experience is gained in the detonation of war ammunitions and training mines:

These exercises are held north of the anchor area Westhinder (hereafter called **mining exercises**). As the destruction of explosives at sea is forbidden the detonation of mines during mining exercises is also prohibited. Instead training mines are used. These are tape recorders simulating mines. The training mines are always cleared from the seabed after exercises. When real war ammunitions, that need to be swept due to safety reasons, are encountered by naval ships or fishermen/dredging vessels the mines can be detonated in this area (announced through 'Urgent Messages' – Dringende Berichten – which are broadcasted with NAVTEX (telex system of ships). When the location of discovery is not suited for explosion, the ammunition will first be brought to one of the training areas in the vicinity. War ammunitions are only seldom found in the study area. These exercises are held in a circular training area, which has only been in use since 2001. Different types of ships of the Belgian Navy can use this area. The exercises that are organised can be of two types:

- Defensive mining: many mines are put in groups in front of a harbour (simulated by other target in the exercise) and a secret entrance route is provided. This exercise simulates a war situation in which a strategic place needs to be defended against enemies. At the end of the exercise the training mines are swept.

- Offensive mining: in this kind of mining the enemy tries to put mines in front of the harbour (or target) of their enemy. The mines that are used can be much more sophisticated than the ones used for defensive mining. Sometimes they are adjusted in such a way that they are sensitive for one type of ship (all ships show different pressure waves or acoustics when they pass the water). The mine explodes when the specific ship moves over it. The mines can also be dropped by aircraft or by little fishing boats. This is all simulated during the exercises and afterwards the mines are swept (Cmdt. Morris pers. comm. 2003).

Responsibility: Navy → Exercises for putting, hunting and sweeping bottom mines: In the framework of training areas for mine sweeping in the North Sea, the Channel and the waters around the British Isles, two zones are situated on the BPNS.

The first zone (NB-01) is situated around the Westhinder sandbank and can be used by different types of ships of the Belgian Navy for individual or group exercises. The area is also used as a 'deep water zone' by the mine hunting ships to practice the use of sonar, underwater vehicles and divers. Most ship movements can extend into the training area of exercise (4).

The other training zone (NBH-10) is situated around the Wenduine sandbank and can be used by mine hunting ships of the Navy from Belgium or other nations. This area is a 'shallow water zone' and can be used to gain experience in the use of sonar, underwater vehicles and divers in mining operations. Additionally the training area can be used to test and evaluate mine hunting systems. Due to manoeuvre characteristics of the mine hunting ships and weather conditions the ship movements can extend beyond the limits of the designated training area into a zone situated between the harbour of Oostende and the Wenduine sandbank. This training area is only very seldom used (Cmdt. Morris pers. comm. 2003).

The frigates of the Navy are equipped with anti-submarine warfare sonar. These produce 4000 – 5000 kHz to detect submarines and could have a negative effect on sea mammals and fishes.

Responsibility: Navy → Navigation:

The Navy is directly responsible for the exercise areas at sea. The Navy uses the existing navigation routes that are used by commercial vessels to get to their training areas at sea. No records are held of these tracks by the Navy, but should be included in the data (amount of passages through harbours by naval ships) provided by the use function 'Shipping'. The amount of passages can also be derived by checking the amount of military exercises at sea. In times of war secret war routes (Q routes) can be used. These can obviously not be documented in this report. The impact of shipping by naval ships will be minor since the speed of these ships (frigates: 16 knots cross speed; mine hunting ships: up to 15 knots) is much lower than that of commercial ships. (Cmdt. Morris pers. comm. 2003) This sub-use will not be investigated further, since it is dealt with in the description of the use function 'Shipping'.

Responsibility: Air Force → Search and rescue exercises:

The Air Force, located in Koksijde, performs training flights and rescue operations in the study area. These exercises are performed with Sea King helicopters. Maximum speed: 226 km/h. The helicopters must fly at 200 feet (~60.96 m) above the water level. In application of the Convention of Chicago (also known as ICAO: Convention on International Civil Aviation) the Air force (and more specifically the Sea King helicopters) is obliged to secure the rescue of victims of airplane crashes within Belgian's territorial boundaries. The helicopters can also be used to rescue people at sea. All these operations need to be rehearsed to gain experience. Since impacts coming from airspace traffic are not considered in the project, this sub-use will not be considered further. On average 100 search and rescue operations occur each year. At least one exercise is held per day and these exercises have an average duration of one and a half hours (40ste Smaldeel Koksijde pers. comm. 2003).

Responsibility: Air Force → Passage flights to training area outside study area (North Sea – territory of UK):

The Air force base at Kleine Brogel is responsible for test flights with F16 jets. But no exercises with F16-jets are done in the air space of the study area. The aircraft do fly above the BPNS, however, to get to their training area (above North Sea - territory of UK). The aeroplanes do not use fixed flying routes above the North Sea. All flight passages above the BPNS are restricted in breeding or migration times of birds (Cmdt. Morris 40ste smaldeel Koksijde pers. comm. 2003). Since the impacts of airspace traffic are not considered in this project, this sub-use will not be considered further.

Responsibility: cooperation of different NATO countries → Extensive naval exercises on mine defense:

Extensive international (NATO) large-scale naval exercises are held within the BPNS once every two years. The maritime squadron of NATO that is responsible for these exercises is the Mine

Countermeasures Force Northern Europe. During exercises it is usually composed of seven mine hunting ships and one commando ship. The exercises are permanently held in all European waters. Different countries participate in these mining exercises. The program consists of two phases: first a zone is delineated in which several training mines are placed (As discussed above, no explosive devices are detonated during training). Then the members of the different countries need to cooperate to locate and sweep the "mines". The mining exercises can be of the defensive or offensive type (see above).

Notes

- No exercises with depth bombs are organised in the study area since the water is not sufficiently deep to perform these exercises.
- Also no exercises with rocket launchers can be executed in the study area. These armaments are tested in the Caribbean waters.
- According to the different spokesmen of the military forces no plans exist for the designation/closure of (new) training areas (Cmdt. Morris and Adj. Debreyer pers. comm. 2003).

5.3 LEGISLATIVE FRAMEWORK APPLICABLE TO ALL SUBUSES

(updated by Cliquet A.)

(Cliquet et al. 2004 ; Maes and Cliquet 2005)

International legislation and Belgian implementation:

- United Nations Convention on the Law of the Sea, Montego Bay, 10 December 1982.
    - Implementation in Belgium:
        - Law of 18 June 1998 on the approval of the Convention on the Law of the Sea of 10 December 1982 and the Agreement relating to the implementation of Part XI of the United Nations Convention on the Law of the Sea of 10 December 1982 of 28 July 1994, *BS* 16 September 1999.

The United Nations Convention on the Law of the Sea of 10 December 1982 assigns the authority for military activities in the territorial sea to the coastal state. This is in accordance with the sovereignty of the coastal state over the territorial sea. This allows the coastal state to execute fleet exercises, shooting exercises … etc in the territorial sea. The right of innocent passage by foreign ships can be temporary cancelled by the coastal state in case the cancelling is indispensable to the protection of their safety, including military exercises. Such cancelling is only legal when it is announced in a suitable way (art. 25, § 3). The coastal state can also take measures to avoid the non-innocent passage of foreign ships through the territorial waters (art. 25, §1). Activities that are not included within the term 'innocent passage' are: exercises with weapons and the launching, landing or boarding of military equipment (art. 19, §2, b and f). Coastal states can voluntary make exceptions to these articles with the aim of organising international NATO exercises in the territorial sea.

The principle of 'freedom of shipping' provides for the free movement of vessels on the high seas. Although this is not explicitly described in the Convention on the Law of the Sea, this freedom could also include the execution of military exercises. In any case its provision for the freedom of shipping includes the passage of war ships. The freedom of shipping is also valid in de EEZ. However, the coastal state has the right to take measures to protect the marine environment of the EEZ.

Several conventions limit the execution of certain military activities at sea.

- Convention concerning the banning of nuclear weapon tests in the atmosphere, in outer space and under water (Partial Test Ban Treaty - PTBT), Moscow, 5 August 1963.

  In this convention the different parties agreed to stop the tests of nuclear weapons under water, including both the territorial sea and open sea.

  - Implementation in Belgium:

    - Law of 26 January 1966 on the approval of the Convention concerning the banning of nuclear weapon tests in the atmosphere, in outer space and under water, *BS* 20 April 1966

- Convention on the prohibition of the emplacement of nuclear weapons and other weapons of mass destruction on the seabed and the ocean floor and in the subsoil thereof, London, Moscow and Washington, 11 February 1971.

  This Convention states that no strategic or nuclear weapons may be placed outside a sea area of 12 nautical miles from the coastline.

  - Implementation in Belgium:

    - Law of 18 August 1972 on the approval of the Convention on the prohibition of the emplacement of nuclear weapons and other weapons of mass destruction on the seabed and the ocean floor and in the subsoil thereof, *BS* 13 September 1973

National legislation:

- Law of 20 January 1999 on the protection of the marine environment in the marine areas under Belgian jurisdiction, *BS* 12 March 1999; as amended.

  The limitations concerning the marine protected areas, described in the Law of 20 January 1999 on the protection of the marine environment in the marine areas under Belgian jurisdiction, are not valid for military activities (art. 7, § 4). The military authority, in accordance with the Minister of Environmental Affairs, will take all the necessary measures to prevent damage and environmental disturbance, without compromising the effective work of the defense units. There are also exceptions on the prohibition statements concerning the marine nature reserves made for military activities (art. 8, vi). Exceptions for military activities were also made on the limitations for shipping in marine protected areas (art. 20): the special routing system does not hold for war ships and marine assistance ships (art. 20, § 6). The report duty for captains involved in a shipping accident also doesn't hold for these ships (art. 21, § 3). In the sea areas certain activities are subject to a preceding license or authorization (art. 25), but military activities can only be subject to such license or authorization after a joint recommendation by the Minister, with authority on the protection of the marine environment, and Minister of Defense (art. 27). Furthermore, article 30 (§ 2) exempts military activities from compliance with environmental effects reporting and the environmental impact assessment.

- The legal coordinates of the zones for execution of the different sub-uses are given in Messages to Seafarers (Messages to Seafarers (Berichten aan Zeevarenden – BaZ), published by the Department of the Environment and Infrastructure, Administration Waterways and Maritime Affairs, Ministry of the Flemish Community). These coordinates are updated every year and announced before the beginning of a new year. The coordinates for 2003 are given below.

5.3.1 Legislative framework for shooting exercises directed seawards from the land

Description

There are three shooting sectors available:

- K-sector (small sector): the dangerous zone is comprised in a sector with a radius of 2.5 NM and with the lighthouse of Nieuwpoort as centre. The zone is confined by the 114° mark of the lighthouse of Nieuwpoort and the 191° mark of the old water tower of Westende (position: 51°10.14'N – 2°46.62'E).

- M-sector (medium sector): the dangerous zone is comprised in a sector with a radius of 7.5 NM and with position 51°08.62'N – 2°46.15'E as centre (confined by the same marks as the K-sector).

- G-sector (great sector): the dangerous zone is comprised in a sector with a radius of 12 NM and with the same centre and marks as the M-sector.

There are no limitations on the number of shooting exercises per year in this zone, but since these exercises cannot take place during the summer school holiday (extended to 15th of June until first week of September) and during weekends, the maximum number of shooting days is 175 days.

Legislation

Messages to Seafarers (Berichten aan Zeevarenden – BaZ), published by the Department of the Environment and Infrastructure, Administration Waterways and Maritime Affairs, Ministry of the Flemish Community 2001; 2002; 2003, www.lin.vlaanderen.be/awz/baz, consulted on 10 October 2003.

5.3.2 Legislative framework for shooting exercises at floating targets

Description

Shooting exercises, executed by the ships of the Navy, can be executed in the zone, confined by the following points:

- Point A: 51° 39,95'N - 2° 37,92'E
- Point B: 51° 36,95'N - 2° 37,92'E
- Point C: 51° 32,95'N - 2° 54,92'E
- Point D: 51° 38,95'N - 2° 56,92'E
- Point E: 51° 39,95'N - 2° 54,92'E

The shooting is executed from the southern limit (line A-B-C) in northern direction. The shooting area is not guarded. The surface exercises can be executed during night and day on a towed or anchored floating target.

There are no limitations on the number of shooting exercises per year in this zone. The zone can be used the whole year through.

Legislation

Messages to Seafarers (Berichten aan Zeevarenden – BaZ), published by the Department of the Environment and Infrastructure, Administration Waterways and Maritime Affairs, Ministry of the Flemish Community 2001; 2002; 2003, www.lin.vlaanderen.be/awz/baz, consulted on 10 October 2003.

5.3.3 Legislative framework for mining exercises

Description

Since 2001 an area has been delineated for the detonation of war ammunitions and training mines. This area is situated northeast of the anchorage area Westhinder. The zone has a radius of 4 NM and the centre is situated at position 51°29.07'N – 2°49.92'E. The zone is mostly used to detonate old war ammunitions that are found by navy ships or by fishing vessels or dredging boats. If necessary also other zones can be used for detonation. Special procedures need to be respected in such cases (BaZ no. 1, 1/13 – 2003).

There are no limitations on the number of detonations per year in this zone. The zone can be used the whole year through.

Flexibility:

Mining exercises can also be conducted in areas other than the one designated in BaZ, but only when emergency situations (accidental discovery of unexploded war ammunitions) evoke the immediate detonation of the mine. But the safety measures that need to be taken in such cases are also outlined in BaZ.

Legislation

Messages to Seafarers (Berichten aan Zeevarenden – BaZ), published by the Department of the Environment and Infrastructure, Administration Waterways and Maritime Affairs, Ministry of the Flemish Community 2001; 2002; 2003, www.lin.vlaanderen.be/awz/baz, consulted on 10 October 2003.

5.3.4 Legislative framework for putting, hunting and sweeping bottom mines

Description

Two training areas for the putting, hunting and sweeping of bottom mines are situated on the BPNS.

Zone NB-01 (Westhinder):

This zone is confined by the following points:

- Point A: 51° 28,85'N - 2° 44,92'E
- Point B: 51° 26,75'N - 2° 44,92'E
- Point C: 51° 26,75'N - 2° 35,52'E
- Point D: 51° 28,85'N - 2° 35,52'E

Zone NBH-10 (Wenduine) :

This zone is confined by the following points:

- Point A: 51° 20,55'N - 2° 55,42'E
- Point B: 51° 18,55'N - 2° 55,12'E
- Point C: 51° 18,65'N - 2° 53,52'E
- Point D: 51° 20,65'N - 2° 53,82'E

There are no limitations on the number of mining exercises per year in these zones. The zones can be used the whole year through.

Flexibility:

Movements of ships, executing mining exercises in zone NB-01, can extend into the training area of exercise (4) ('mining exercises').

Due to manoeuvre characteristics of the mine hunting ships in zone NBH-10 and weather conditions the ship movements can extend beyond the limits of the designated training area into a zone situated between the harbour of Oostende and the Wenduine sandbank.

Legislation

Messages to Seafarers (Berichten aan Zeevarenden – BaZ), published by the Department of the Environment and Infrastructure, Administration Waterways and Maritime Affairs, Ministry of the Flemish Community 2001; 2002; 2003, www.lin.vlaanderen.be/awz/baz, consulted on 10 October 2003.

5.3.5 Legislative framework for extensive naval exercises on mine defense

Description

The zones where these exercises are held are not predefined, but are announced by NATO before the exercises are held. One of the zones that can be used for mining exercises by NATO countries is the zone NBH-10 (Wenduine) described above.

Legislation

If NATO exercises are held in the Belgian part of the North Sea this is announced in Messages to Seafarers (Messages to Seafarers (Berichten aan Zeevarenden – BaZ), published by the Department of the Environment and Infrastructure, Administration Waterways and Maritime Affairs, Ministry of the Flemish Community 2001; 2002; 2003, www.lin.vlaanderen.be/awz/baz, consulted on 10 October 2003.).

5.4 EXISTING SITUATION

5.4.1 Existing situation of shooting exercises directed seawards from the land

5.4.1.1 Spatial delimitation

See legal coordinates (Map I.3.5a)

5.4.1.2 Intensity and frequency

The shooting sectors are reserved in advance from 8.00 AM until 17.00 PM, but usually the exercises do not comprise the whole time period. The reservation of such large time period is only done to make sure that no ships/aircraft pass through the sectors during the exercises. They can be cancelled when weather conditions are bad (too much wind or rain) or when the training staff is late. (Map I.3.5b)

Sector K and M are most intensely used; the G sector is only used 3 times a year on average.

In accordance to the frequency/intensity mentioned in jurisdiction (see above) the maximum number of shooting days is 175. The spokesman of the Army stated that on average 120-150 of this type of exercise are executed per year.

It is announced in BaZ when a certain shooting sector is reserved for exercises. The following overview (Table I.3.5a) gives the number of reserved days for 2001-2003 (these are the legally permitted amounts of shooting exercises for these years):

Table I.3.5a: Overview of the number of reserved days for shooting exercises directed seawards from the land.

	No exercises	K-sector	M-sector	G-sector	Total number of shooting days
2001	202	5	148	10	163
2002	196	33	118	18	169
2003	193	31	128	13	172

The actual amount of shooting days was given by the spokesman of the Army. Only data for 2001 were available (Table I.3.5b).

Table I.3.5b: Actual amount of shooting days (for shooting exercises directed seawards from the land) for 2001.

	No exercises	K-sector	M-sector	G-sector	Total number of shooting days
2001	278	0	78	9	87

This table shows that the actual amount of shooting days is much lower than the amount of days reserved in BaZ (only 53.37 %).

The next tables give an overview of the spreading of these exercises throughout the year.

Table I.3.5c: Amount of reserved days for 2001

2001	BaZ			
	0	K	M	G
January	13	0	18	0
February	11	0	17	0
March	11	0	20	0
April	20	0	10	0
May	12	0	19	0
June	16	0	14	0
July	31	0	0	0
August	31	0	0	0
September	15	0	5	10
October	11	0	20	0
November	15	5	10	0
December	16	0	15	0
Total	202	5	148	10

Table I.3.5d: Actual shooting days during 2001

2001	**actually executed**			
	0	**K**	**M**	**G**
January	**20**	**0**	**11**	**0**
February	**22**	**0**	**6**	**0**
March	**16**	**0**	**15**	**0**
April	**30**	**0**	**0**	**0**
May	**19**	**0**	**12**	**0**
June	**19**	**0**	**11**	**0**
July	**31**	**0**	**0**	**0**
August	**31**	**0**	**0**	**0**
September	**16**	**0**	**5**	**9**
October	**21**	**0**	**10**	**0**
November	**29**	**0**	**1**	**0**
December	**24**	**0**	**7**	**0**
Total	**278**	**0**	**78**	**9**

Table I.3.5e: Reserved shooting days for 2002

2002	BaZ			
	0	K	M	G
January	12	0	19	0
February	13	0	15	0
March	10	5	16	0
April	18	7	0	5
May	11	7	13	0
June	16	4	0	10
July	31	0	0	0
August	31	0	0	0
September	14	0	16	0
October	12	0	19	0
November	12	0	15	3
December	16	10	5	0
Total	196	33	118	18

Table I.3.5f: Reserved shooting days for 2003

2003	BaZ			
	0	K	M	G
January	11	10	10	0
February	8	0	20	0
March	15	0	16	0
April	18	5	7	0
May	13	3	10	5
June	17	0	13	0
July	31	0	0	0
August	31	0	0	0
September	13	0	12	5
October	8	5	15	3
November	12	3	15	0
December	16	5	10	0
Total	193	31	128	13

These tables show that the intensity of shooting exercises is highest in January, March, May and October.

Type of exercise:

Testing of new ammunition/weapons: 1 time in 2001

Training staff (shooting exercises): 87 times in 2001

No heat or infrared searching missiles can be used. There are no other limitations on the calibre of the ammunition. There is no information available on the constitution of the ammunition. On average 50000 pieces of ammunition are shot in one week (5 working days). For 2001, with a total of 88 shooting days this gives an approximate number of 880000 pieces of ammunition.

Ammunition:

For an overview of the weapons used in each shooting sector, see Table I.3.5g:

- Machine guns: calibre ammunition from 5.56 up to 30 mm
- Cannons: mortars up to 155 mm
- Rocket launchers (during "chaff and flare" exercises): missiles
- No bombs are used during the exercises

Table I.3.5g: Overview of the different weapons and their characteristics used in the different shooting sectors

Sector	Weapon	Maximum travel distance of ammunition	Ammunition calibre	Fire speed
K	- Collective infantry weapon (MAG) - Anti-tank weapon (MILAN) - Collective automatic weapon (MINIMI) - Collective infantry weapon (Mortier 60 mm) - Collective infantry weapon (Mortier 81 mm)	0.6 km 0.075-2 km 2.72 km 1.8 km 3 km	7.62 mm 122 mm 5.56 mm 60 mm 81 mm	600-900/min - 400/min 18/min 18/min
M	- Collective weapon for air defense (Mi 50) - Air target weapon – missile (MISTRAL) - Collective infantry weapon (Mortier 120 RT) - Collective infantry weapon (Mortier 4"2)	7.4 km 5.4 km 8.17 km (up to 13 km with long-distance ammunition) 6 km	12.7 mm 90 mm 120 mm 4"2	450-500/min - 10/min during 3 min 5/min
G	Artillery (Houwitzer GIAT LG 1 MkII)	14985 km	105 mm	12/min

No information is available on the frequency of the use of a certain weapon or ammunition, but this can roughly be extrapolated from the frequency of the sector used.

The intensity/frequency of the exercises is largely dependent on the supply of ammunition and on the subsidies assigned to a certain military unit.

The safety level during the shooting exercises is very high:

- Radar control to detect ships in sector
- Air control through images from airport of Oostende/Koksijde
- Target aircraft with GPS system to determine if it is not moving out of the used sector
- Radio connection with relevant airports/ships/pilotage

Source

Adj. Debreyer (pers. comm. 2003) and www.mil.be/def/index.asp?LAN=nl

5.4.2 Existing situation of shooting exercises at floating targets

5.4.2.1 Spatial delimitation

The exercises only take place in the assigned zones, described in BaZ. However, these zones change every year (Map I.3.5a).

5.4.2.2 Intensity and frequency

These exercises are infrequently executed. The training area is only used for military exercises (Map I.3.5b).

For the years 2001, 2002 and 2003 no data were reserved in BaZ. The spokesman of the Navy stated that in other years on average 3 exercises are held per year (with a maximum of 5 exercises per year) (Cmdt Morris pers. comm. 2003).

The exercises are held from frigates. These cause, when loaded, a water displacement of 2200 tons. The cruising speed is 16 knots (~ 30 km/h).

Ammunition:

Automatic cannon: calibre ammunition 100 mm.

Source

Cmdt. Morris (pers. comm. 2003)

5.4.3 Existing situation of mining exercises

5.4.3.1 Spatial delimitation

The exercises only take place in the assigned zones, described in BaZ. However, these zones change every year (Map I.3.5a).

5.4.3.2 Intensity and frequency

According to BaZ 15-20 explosions are executed per year. According to the Navy spokesman (Cmdt. Morris pers. comm. 2003) the number of exercise days is less than 10 per year. In 2001 there was a total of 10 training days. Next to these exercises detonations of recovered war mines can also take place. No data on the number of these explosions is available (Map I.3.5b).

The exercises are executed with frigates or tripartite mine hunting ships. The latter cause a water displacement of 560 tons when loaded. The maximum speed is 15 knots (~ 28 km/h).

Ammunition:

Machine guns: calibre ammunition 12.7 mm.

Source

Cmdt. Morris (pers. comm. 2003) and www.mil.be/def/index.asp?LAN=nl

5.4.4 Existing situation of putting, hunting and sweeping bottom mines

5.4.4.1 Spatial delimitation

The exercises only take place in the assigned zones, described in BaZ. However, these zones change every year (Map I.3.5a).

5.4.4.2 Intensity and frequency

This training area is only used on very limited occasions for military exercises. According to the Navy spokesman the maximum number of this type of exercises is 10 per year (on average 7 exercises a year). For the years 2001, 2002 and 2003 no data were reserved in BaZ (Map I.3.5b).

The exercises are also executed with tripartite mine hunting ships. These cause a water displacement of 560 tons when loaded. The maximum speed is 15 knots (~ 28 km/h).

Ammunition:

Machine guns: calibre ammunition 12.7 mm.

Source

Cmdt. Morris (pers. comm. 2003) and www.mil.be/def/index.asp?LAN=nl

5.4.5 Existing situation of extensive naval exercises on mine defense

5.4.5.1 Spatial delimitation

The zones where these exercises are held are not predefined, but are announced by the NATO before the exercises are held (Map I.3.5a).

5.4.5.2 Intensity and frequency

These exercises are held once in two years on the BPNS. The exercises have the purpose of training the staff in mine hunting and sweeping, with simulation of real war situations. No data is available on the duration of these exercises (Map I.3.5b).

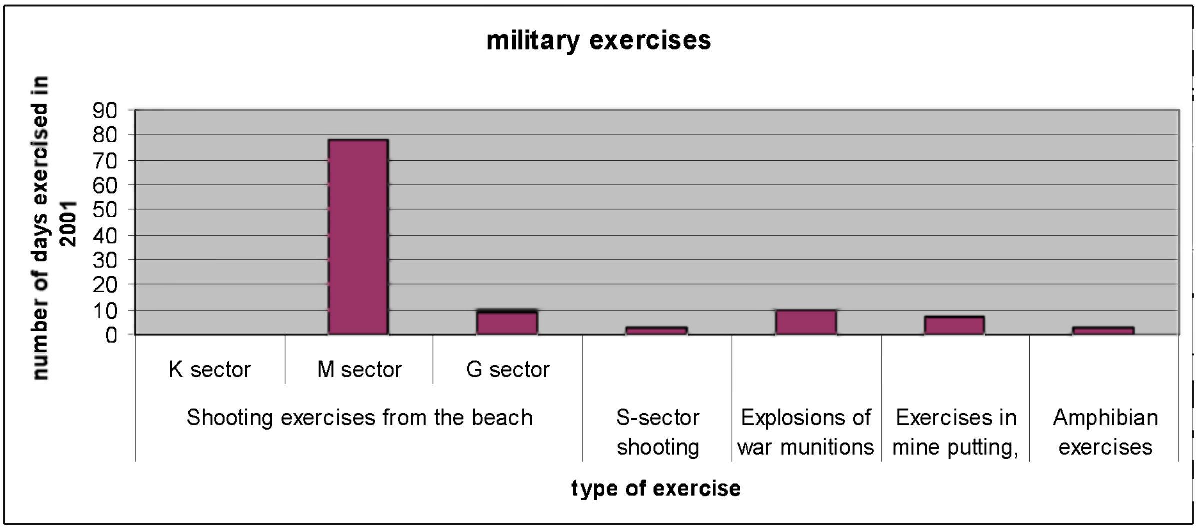
5.4.5.3 Summary of intensities of all sub-uses (where data are available) for the year 2001

The following table and graph give an overview of the number of exercises of each type for 2001 (where no data is available, the average number per year is used):

Table I.3.5h: Number of exercise days in 2001 of each sub-use within military exercises.

Type of exercise		number of days in 2001
Shooting exercises from the beach	K sector	0
	M sector	78
	G sector	9
S-sector shooting exercises with floating targets		3
Explosions of war ammunitions and training mines		10
Exercises in mine putting, hunting and sweeping		7
Amphibian exercises		3

Figure I.3.5a: Overview of the number of exercise days in 2001 of each sub-use within military exercises.



5.5 INTERACTIONS

5.5.1 Suitability for user

Details – if applicable – can be found in the chapter that is specifically dedicated to "Suitability".

5.5.2 Impact on other users

Details – if applicable – can be found in the chapter that is specifically dedicated to "Interaction among users".

5.5.3 Impact on environment

Details – if applicable – can be found in the chapter that is specifically dedicated to "Interaction between users and the environment".

Biological

Mine explosions:

Mine explosions have a negative impact on the benthos, fish and sea mammals occurring in the mining zones (Baan et al. 1998). However, during exercises only training mines (not producing an explosion) are used, so impact can only occur when real war ammunitions are found and detonated on the BPNS.

Dropped ammunition:

There is a potential Impact of dropped ammunition on benthos, fishes… etc due to a change of substrate, danger of unexploded ammunition on the seabed, mechanical disturbance (abrasion, smothering) and pollution effects (Baan et al. 1998).

Acoustical disturbance:

Acoustical disturbance (Larkin 1996; Baan et al. 1998): influence of noise (due to shooting, ships and helicopters) on wildlife (birds… etc) is possible. The nature reserve 'De Ijzermonding' is situated near the shooting area of Lombardsijde. This kind of impact is unavoidable as the Belgian defense capacities need to be maintained, but can be partly diminished by good timing (exclusion of exercises in breeding times). Only a limited amount of the noise production will be transmitted in the water phase (mostly the lower frequencies). No information is available on the extent of disturbance by this kind of noise in the water, but it is generally assumed that the effects are minimal.

Chemical

Dropped ammunition:

Impact of dropped ammunitions on the chemical composition of the seabed: ammunition usually consists of heavy metals, but the constitution is different for the different types of ammunition. The heavy metals, present in ammunition, are mostly copper and lead, next to steel, aluminium, magnesium, chrome, molybdenum, potassium and vanadium. The 7.62 mm ammunition consists of 2 g copper and 7 g lead per bullet. Of other types of ammunition the constitution is not known. However, it is unknown how many 7.62 mm bullets are shot per year, so it is not possible to calculate the amount of copper and lead that enters the marine environment through military shooting exercises. It is known that copper leaches continuously out of the ammunition when entering the salty marine environment (2% leaching in one year). The total amount of copper entering the system this way will probably be much lower than the amount coming from other sources, but can still have a local impact on the ecosystem. The leaching velocity of lead is much lower (0.0001 % per year), so this impact will be negligible. It is possible that the ammunition sinks in the sea bottom, without leaching, which could reduce the local impact. Ammunition that drops on the sea bottom can cause mechanical disturbance. This effect will be very small and negligible in case of single shooting exercises. The effect could be significant in places where ammunition used to be dumped (Baan et al. 1998).

Impact from associated shipping to exercise areas:

Since military ships are not obliged to follow the OSPAR Convention and the Marpol Convention (on prevention of pollution by dumping and discharges from ships at sea) pollution could be possible.

Geological/Physical

Solid waste pollution:

From dropped ammunition (Baan et al. 1998).

Real mine explosions:

Impact of real mine explosions on sediment (Baan et al. 1998).

Hydrological

Real mine explosions:

Temporary impact of real mine explosions on hydrology (Baan et al. 1998).

Impact from associated shipping to exercise areas:

The speed of the naval ships is low when compared to commercial ships (Cmdt. Morris pers. comm. 2003) so the impact on hydrology will be negligible.

5.5.4 Impact on socio-economy

Economic

Not available

Social

Employment:

No data on employment can be given for this use function, since the military exercises are only part of the training programme of the staff.

5.6 REFERENCES

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6 SAND AND GRAVEL EXTRACTION

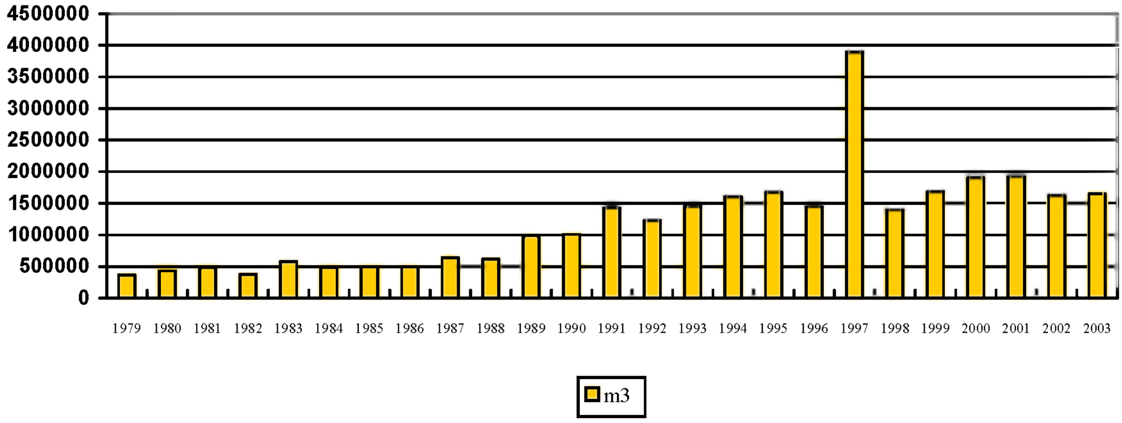
6.1 DESCRIPTION

Today there is a growing demand for sand and gravel. Aggregate extraction of sand from the seabed provides an alternative source to existing sand quarries on land. While permits have been issued for sand extraction to date no permits have been issued for gravel extraction. This is because the extent of the gravel quantities on the BPNS (BPNS) is very poorly known. Moreover, the gravel source areas that have been located lie towards the north of the BPNS implying higher transport costs.

The permits for exploiting sand and possibly in the future gravel are issued by the Federal Public Service Economy, SMEs, Self-employed and Energy. They gather the necessary background information from the Ministry of the Environment (through its Management Unit of the Mathematical Models of the North Sea (MUMM) and from the Ministry of Agriculture (through its Fisheries Department (DVZ)).

The first sand extractions from the Belgian part of the North Sea date from as far as 1979. This extraction was rather constant during the first 10 years. It conspicuously increased as from the 90s off. The following figure (I.3.6a) gives an overview of the evolution of sand extraction on the BPNS druing the period 1979-2000. In 1997, an unusual high volume of sand was extracted (almost 3.9 million m³). This volume was used for the installation of the new gas pipelines Interconnector and Norfra in the BPNS. (Maes et al. 2002)

Figure I.3.6a: Evolution of sand extraction in m³ on the BPNS from 1979 to 2000 (Federal Public Service Economy, SMEs, Self-employed and Energy)



Since 1976 various concessions for offshore sand exploitation have been granted. At the moment there are **12 active concessions** for exploitation of specific areas, depending on the license (Table I.3.6a).

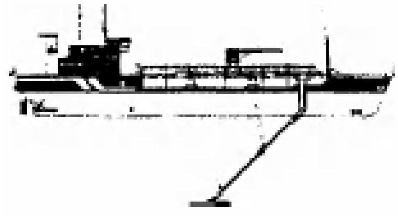
Table I.3.6a: Aggregate extraction license holders on the BPNS (source: MAGIS www.sandandgravel.com 2005)

License Holder	Period from	Period to	Licensed Quantity/year
Cambel Agregates NV	6/8/1993	6/8/2006	500000m^3
Insagra NV	6/8/1993	31/4/2013	500000m^3
Dranaco NV	19/2/1996	1/3/2005	300000m^3
Satic NV	8/9/1995	18/9/2005	300000m^3
Temporary Union Zeezand Exploitation NV of Baggerwerken Decloedt en Zoon NV, Dredging International NV and Ondernemingen Jan De Nul NV	21/5/2002	31/12/2006	650000m^3
Alzagri NV	18/7/2002	31/12/2009	300000m^3
Temporary Union of Nieuwpoortse Handelsmaatschappij NV and C.E.I. Construct NV	18/7/2002	31/12/2009	1000000m^3
Ghent Dredging NV	7/5/1997	31/12/2009	300000m^3
NV Belmagri	18/1/2000	1/1/2010	800000m^3
De Hoop Handel B.V.	9/1/2002	1/1/2012	300000m^3
Hanson Aggregates Belgium NV	4/6/2002	31/12/2011	1000000m^3
DBEM (DEME Building Materials)	13/5/2003	30/4/2013	500000m^3
Charles Kesteleyn NV	6/8/1993	6/8/2006	500000m^3

The license authority is the Federal Public Service Economy, SMEs, Self-employed and Energy, Gen. Dir. Quality and Safety. Each license holder's exploitation vessel must be equipped with an automatic recording system, a **black box**. The MUMM is responsible for the management and processing of data from the black box, on behalf of the Federal Public Service Economy, SMEs, Self-employed and Energy. The recording device of the black box automatically registers the following parameters: vessel identification, trajectory, date, time, position, speed, status of dredging pumps, exploitation status, journey number, license holder code, etc. (MUMM 2003).

There are 19 exploitation vessels on the BPNS, with a bin content between 760 m^3 (Delta) and 13700 m^3 (Uilenspiegel). Generally sand extraction takes place with a trailing suction hopper dredger (Figure I.3.6b).

Figure I.3.6b: A trailing suction hopper dredger (source: Donze 1990)



When going to the extraction zone, the hold is filled with seawater for stability reasons. At the extraction zone, the suction pipe extracts the sediment and fills up the cargo. Upon return to the harbour, the material is discharged with a conveyer or a crane.

The extracted sand is used for three specific purposes: for **construction** purposes (concrete), as **beach supplements** to suppress erosion of the Belgian coast due to waves and currents and for **land reclamation** (Rzonzef 1993). Sand for extraction should be of a constant quality, untreated and with a grain-size between fine and medium (between 125 and 500 μm). Ideally, sand for concrete purposes should have a grain-size between 300 and 500 μm and a content of calcium less than 30% (Rzonzef 1993; Desaever 2003).

Each sandbank has its own specific sandqualities. The sand of the Oostdijck sandbank is finer and more yellow and is useful for bricklaying and pointing. The sand of the Buitenratel is mostly used for the construction of roads. According to the aggregate industry, the Kwinte Bank has the coarsest sand and until recently, about 95% of the exploitation took place on this bank. Moreover, most of the extraction took place in a very small area in the northwestern and central part of the Kwinte Bank, because of the homogeneity and quality of the sand. However, this intensive extraction has led to a depression of up to 5 m deep. The Federal Public Service Economy, SMEs, Self-employed and Energy decided to close this most exploited part of the Kwinte Bank for three years, starting on February 15, 2003. During this period the eventual recovery of the bank is studied in terms of infilling, large dune regeneration, lithology and biology throughout the projects Marebasse (Belgian Science Policy, Van Lancker et al. 2004), Eumarsand (EU-FP5 RTN) and Speek (Belgian Science Policy) and in close cooperation with the Federal Public Service Economy, SMEs, Self-employed and Energy. These studies aim at providing a scientific basis for the estimation of environmental impacts following extraction. Until recently, extraction was only permitted in two large zones (zone 1 and zone 2), but the regulation was changed and new zones have since been appointed (art. 2–6, Royal Decree of 7 October 2004).

Only recently, starting from 01/07/2004, the amount of the fee ranges changed to € 0.35/m^3 for low quality sand from control zone 3, € 0.54/m^3 for normal sand and € 1.14/m^3 for gravel. This fee is divided between (i) the Federal Public Service Economy, SMEs, Self employed and Energy, Marine Sand Fund (5/7) and (ii) the MUMM (2/7) and is used for continuous research on the impact of the exploitation on the sediments and the marine environment. The maximum quota of exploitation is 15000000 m^3 during 5 year (art. 25, Royal Decree of 7 October 2004). In terms of sustainable development, the conditions for exploitation have become more limited. The zones are now considered as "control zones" (3) and an "exploration zone" (1) (Maps I.3.6a-b).

Control zone 1

This zone consists of two sectors: 1a (on the Thorntonbank) and 1b (on the Gootebank). Sector 1b may not be exploited in March, April and May because of the breeding of fishes and the impact on the environment.

Control zone 2

This zone is divided in three sectors: 2a and 2b (on the Kwinte Bank) and 2c (on the Buiten Ratel and Oostdijck). These zones are subject to a rotation system. The exploitation will always take place on two of the three sectors, to allow the natural recovery of the sand banks. The third sector is then closed for three years. Sector 2b contains the most intensively exploited depression and is the first zone to be closed.

Control zone 3

This zone is located near a former dumping zone of dredged material (S1). This zone is a "recycling zone", nearby the coast. As such, the exploitation on the natural banks will be reduced. However, the quality of the sand will be low as control zone 3 covers a large range in grain-sizes (up to mud and even clay).

Exploration zone 4

There is also a fourth zone: the **exploration zone (zone 4)**. The government and the concession holders will carry out exploration in this zone. The results of this exploration will lead to the delineation of a new (possibly gravel) exploitation zone.

6.2 SUBUSES AND DESCRIPTION

Not applicable

6.3 LEGISLATIVE FRAMEWORK

The Law of June 13 1969 on the exploration and exploitation of non-living resources of the continental shelf, as amended by the Law of 20 January 1999 on the protection of the marine environment in the marine areas under Belgian jurisdiction and the Law of 22 April 1999 on the Belgian exclusive economic zone in the North Sea, regulates inter alia the exploration and exploitation of sand and gravel. The implementing orders further to these laws are: a Royal Decree of 1 September 2004 concerning the conditions, the geographical delimitation and the procedure for granting concessions for the exploration and exploitation of mineral resources and other non-living resources in the territorial sea and on the continental shelf (BS 7 October 2004) and a Royal Decree of 1 September 2004 concerning environmental impact assessment rules in application of the law of June 13 1969 related to the exploration and exploitation of non-living resources in the territorial sea and on the continental shelf (BS 7 October 2004).

Legislation

(Cliquet et al. 2004 ; Maes and Cliquet 2005)

National legislation:

- Law of 13 June 1969 on the exploration and exploitation of non-living resources of the territorial sea and the continental shelf, BS 8 October 1969; as amended by the Law of 20 January 1999 on the protection of the marine environment in the marine areas under Belgian jurisdiction, *BS* 12 March 1999; Law of 22 April 1999 on the Belgian exclusive economic zone in the North Sea, *BS* 10 July 1999.

- Law of 20 January 1999 on the protection of the marine environment in the marine areas under Belgian jurisdiction, *BS* 12 March 1999; as amended.

- Royal Decree of 1 September 2004 concerning the conditions, the geographical delimitation and the procedure for granting concessions for the exploration and exploitation of mineral resources and other non-living resources in the territorial sea and on the continental shelf (BS 7 October 2004) .

- Royal Decree of 1 September 2004 concerning environmental impact assessment rules in application of the law of 13 June 1969 related to the exploration and exploitation of non-living resources in the territorial sea and on the continental shelf (BS 7 October 2004).

- Royal Decree of 30 October 1997 on granting exclusive permits for the exploration and exploitation of hydrocarbons of the continental shelf and in the territorial sea, *BS* 6 December 1997.

- Royal Decree of 12 August 2000 on the establishment of an advisory council concerned with the coordination of the administrations involved in the management of the exploration and exploitation of the continental shelf and the territorial sea and on the establishment of the working modalities and expenses, *BS* 27 September 2000.

6.4 INTERACTION

6.4.1 Suitability for user

Details – if applicable – can be found in the chapter that is specifically dedicated to "Suitability".

6.4.2 Impact on other users

Details – if applicable – can be found in the chapter that is specifically dedicated to "Interaction among users".

Spatial conflict

There is a spatial conflict between sand and gravel extraction and:

- cables and pipelines
- military exercise areas
- fisheries
- anchorage area
- navigation
- future electricity cable
- future windmill parks

6.4.3 Impact on environment

Biological

Impact on benthos:

Gent University has carried out several benthic research projects looking at the effect of aggregate extraction on the BPNS and tried to find a relationship between sand extraction and benthic communities. Bonne (2003) studied the effect on benthic copepod communities of the Kwinte Bank and on macrobenthos (the latter only presented as preliminary analysis), whilst Vanaverbeke et al. (2003) investigated the impact on nematodes.

The extraction on the Kwinte Bank was very intense and patchy until the closing of the site. The northern tip and the centre of the sandbank are strongly impacted. In the central zone, there is a depression, due to sand extraction.

In the seventies, before intensive sand extraction took place, the Kwinte Bank was split up into two communities of harpacticoid copepods (N: highly variable, S: high similarity), while in the nineties Bonne (2003) observed four communities (N: 3 different entities, S: stable in time). In the most intensively exploited area (centre of the bank), the community structure changed completely and the copepod density and diversity decreased dramatically. Within the heavily exploited site, local infauna might be replaced by large numbers of mobile opportunistic species that were able to colonise sediments following episodic disturbances (Newell et al. 2004). According to Campbell (1993), the benthic infaunal and epifaunal assemblages can also be altered as a consequence of seabed alteration and disturbance. Generally, the biological impact is especially related to the intensively dredged zones; outside these zones there seems to be no large alteration (Newell et al. 2004). Turbid plumes of suspended sand and silt can cause substratum removal and alteration of the bottom topography, resulting in the destruction of infaunal and epifaunal biota (De Groot 1996). However, this impact is difficult to demonstrate in areas where the currents have high sediment transport capacities.

Impact on fishes/birds/flora:

Because of the disturbance of the benthic assemblages, there are consequent effects upon food supply for higher organisms including commercial fish and shellfish species (Campbell 1993).

When dredging activities take place in fish spawning grounds, a deposition of fine material from the plumes (which can extend in a larger area than the actual dredging area) can smother eggs laid on the bottom (De Groot 1996).

An increased turbulence of vessel movements and dumping can have an impact on bank stability (e.g. erosion of banks), dislodge macro-invertebrates and disturb fish eggs and larvae in the edges of a waterway (Hopkins and White 1998).

Geological/physical

Aggregate extraction has a physical impact on the marine environment. The sediment topography and type will change through removal of material and resettlement of fine particles (Campbell 1993). In the central zone of the Kwinte Bank, there is a depression, due to sand extraction. If the human-induced physical disturbances continue, this could lead to continuous erosion and impoverishment. The Federal Public Service Economy, SMEs, Self-employed and Energy decided to close the most exploited part of the Kwinte Bank for three years, starting on 15 February 2003.

Interactions between hydrography, hydrodynamics and sedimentology need better investigation in the extraction zones of the exploitation areas. This leaves questions as to the sustainability of extracting these mineral resources, and the measures that may need to be taken to guarantee sustainability. A turbid plume of suspended material (sand and silt) is formed when the displaced water of the hopper flows back into the sea. Removal of substratum, alteration of the bottom topography, the formation of temporary plumes in the water column and re-deposition of material are the most common physical impacts of dredging (De Groot 1996).

The geological/physical impact is presently (2002-2006) being studied in the framework of the Belgian Science Policy project Marebasse in cooperation with the EU-FP5 RTN project Eumarsand and the Federal Public Service Economy, SMEs, Self-employed and Energy. First results are discussed in Van Lancker et al. (2004).

Impact on socio-economy

Economic:

The total turnover of 19 of the 22 producers and importers of dredged marine granulates in Belgium are estimated at 264931000 euros for 2002. This amount increase with 45.5% over the period 1998-2002. About 65% of the companies of which we have figures of turnover for the year 2002, realise a turnover of minimal 10000000 euros/year (Zeegra 2004).

The gross profit is calculated as the turnover subtracted by costs for salaries and wages, loans, indirect taxes but not including subsidies. In 2002, this gross profit was 31245000 euros for 22 companies This is an increase of about 74.4% as compared with the year 1998.

Social:

The total employment of the 22 producers and importers of dredged marine granulates in Belgium in the year 2002 can be estimated at about 295 employees. This is an increase of about 18.5% as compared with the year 1998 (Zeegra 2004).

6.5 REFERENCES

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7 DREDGING AND DISPOSAL OF DREDGED MATERIAL

7.1 DESCRIPTION

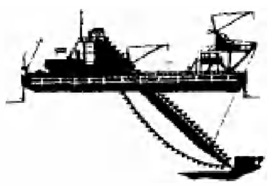
7.1.1 Dredging

In order to maintain access to Belgian seaports, dredging is required along the Belgian coast, in the estuary of the Western Scheldt and in the seaports (Zeebrugge, Oostende, Nieuwpoort and Blankenberge).

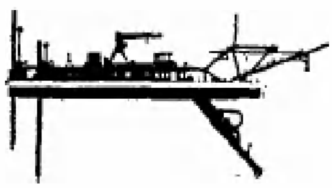
There are two types of dredging activities: dredging required for the initial construction, deepening and broadening of ports and shipping channels; and maintenance dredging to maintain the required depth of existing infrastructure (Maes et al. 2000). Maintenance dredging on the BPNS is the most important activity that takes places the whole year round. The deepening of the fairways also takes place during certain periods of the year.

To dredge the navigation channels and harbours the following techniques are being used in Belgium (De Brauwer 2003) (definitions and figures from Donze (1990):

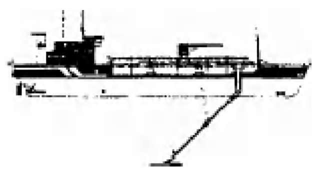
- **bucket dredger**: stationary dredger, with an endless chain of buckets that scrape material from the bottom. The dredged material is loaded in barges.



- **cutter suction dredger**: stationary dredger with a cutter head to loosen the material on the bottom to be dredged. The dredged material is pumped via a pipeline ashore or into barges.



- **trailing suction hopper dredger**: self-propelled ship which fills its hold or a hopper during dredging, while following a pre-set track. The hopper can be emptied by opening the bottom doors or valves (dumping) or by pumping its load ashore. This kind of dredging is mainly used in open water. It is this kind of dredger that is mainly used in the harbour of Zeebrugge.



7.1.2 Dredge disposal

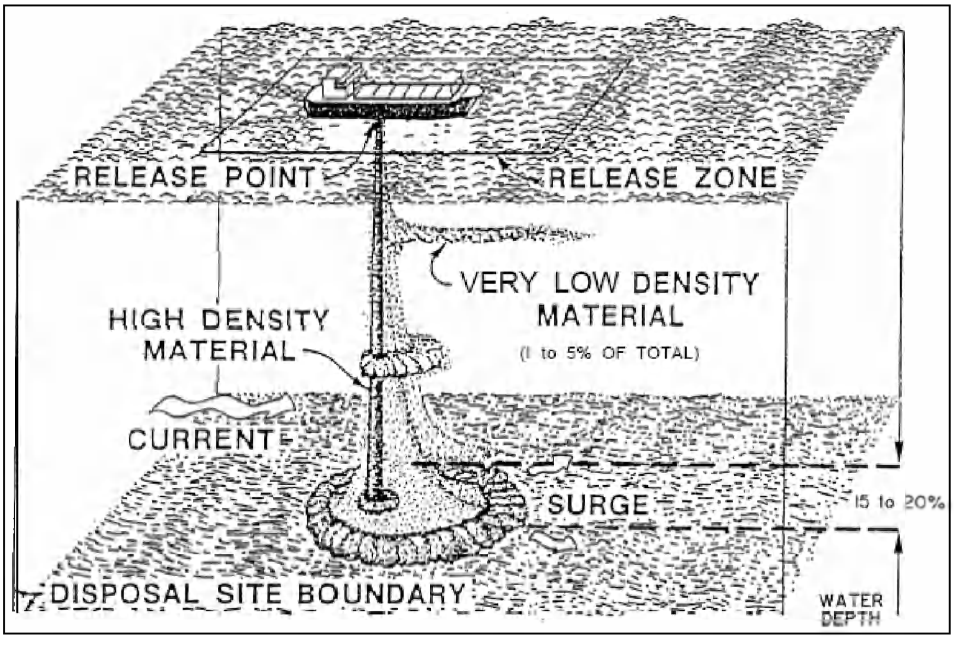
Most of the dredged material is dumped back into the sea or in the Westerscheldt. It is difficult to choose the best place for disposal. The cheapest way is to dump the material in a dumping site close to the place where dredging takes place (e.g. Bruggen en Wegen Zeebrugge Oost is close to the harbour of Zeebrugge). But the closer to the location of dredging, the more chance on re-circulation of the material.

The dredged material from maintenance dredging consists of fine sediments that are deposited from sedimentation. The material originating from deepening works contains a higher sand fraction (Fettweis et al. 2003).

The quality of dredged material is assessed every 10 years as part of a large-scale monitoring programme, executed by the Flemish region (Lauwaert 2002). The results show that the dredged material from the harbours is contaminated to a higher extent than the material that is dredged from the navigation channels. This is due to the higher content of fine fraction and organic matter in the harbour sediments. However, the concentrations measured in 2000 were not higher than the sediment quality criteria, except for tributyltin (Seys 2002).

The dumping of the dredged material generally occurs underneath the transport vessel (Figure I.3.7a). During dumping the majority of the material is caught within a vertical density current. Near the seabed this current transforms into a horizontal one, influenced by the direction of the tidal current and the seabed slope (Malherbe 1991; Van Parijs et al. 2002; The Scottish Office Agriculture 1996).

Figure I.3.7a: Transport processes during open water disposal (from The Scottish Office Agriculture (1996) after Collins (1990), Truitt (1988) and earlier authors)



7.2 SUBUSES AND DESCRIPTION

Monitoring

The monitoring of dredging activities is necessary and can be executed from both a survey vessel or onboard the dredging vessel. Those monitoring activities include several measurements from the sea bottom and the water column.

Depth measurements

Depth measurements are necessary before and after the dredging. This can be done with several techniques. In the past a *lead line* was used, whilst nowadays echo-sounding techniques like *singlebeam* and *multibeam* are used.

Density measurements

(Van Craenenbroeck et al. 1998).

The presence of fluid mud layers in maritime access channels and ports results in unpredictable changes in the registered depth, which is mainly caused by hydrometeorological conditions and seasonal variations. Deep-draughted vessels can navigate through this fluid mud, if the density of the mud remains below a certain level. Therefore, the concept of **navigable depth** in muddy areas has been developed. This corresponds with a physical level within the fluid-mud layer indicating a safe navigation limit for deep-draughted vessels. Each port has to determine this density level, because the physical properties of the mud are different. The port of Zeebrugge considers the **1.15 t/m^3 density level** a safe limit for navigation. In Zeebrugge, the Navitracker system is daily used to measure this density level: a towed density probe that automatically tracks a pre-determined density level within the fluid mud in order to allow the production of navigable depth charts. An H-shaped inclinometer-equipped Vertical Density Profiler was added to the basic system to allow the collection of data throughout the mud column.

7.3 LEGISLATIVE FRAMEWORK

(updated by Cliquet A.)

7.3.1 Spatial delimitation

Competent authority

The Flemish Region (Ministry of the Flemish Community - Maritime Access Division) is responsible for the dredging activities in the Belgian coastal zone. The Water- and Seaways Administration of the Ministry of the Flemish Community commission dredging activities. The material dredged from the harbours and fairways is dumped back into the sea in large quantities. This material can be polluted in varying degrees. The federal government is responsible for the monitoring of the effects of dumped dredged material. The management of the dredging activities and the dredged material to be dumped is a shared responsibility. The Belgian State and the Flemish Region signed a **cooperation agreement** on 12 June 1990, as modified by a co-operation agreement signed on 6 September 2000.

Legislation

(Cliquet et al. 2004; Maes and Cliquet 2005)

The management of the dredged material in Belgium follows international obligations under the **OSPAR Convention** (regional) and the **London Convention** (world). The London Convention is the worldwide equivalent of the OSPAR Convention. Belgium follows the 'Waste-specific Guidelines for Dredged Material' of the London Convention. International dumping of dredged material is regulated by the OSPAR '**1998 Guidelines for the Management of Dredged Material**'. In the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR, Paris, 1992), dumping of waste is prohibited in principle, except for certain categories such as dredged material. No such material can be dumped without a permit or regulation by the competent authorities (Maes et al. 2000).

In accordance with the Law of **20 January 1999** on the Protection of the Marine Environment in the Marine Areas under Belgian Jurisdiction (*BS* 12 March 1999), the dumping of dredged material into the sea requires an authorization. The Flemish Region must obtain such an authorization from the Belgian State, pursuant to the Royal Decree of 12 March 2000.

International legislation and Belgian implementation on dredge disposal:

- Convention for the Protection of the Marine Environment of the North-East Atlantic ("OSPAR Convention"), Paris, 22 September 1992.
- OSPAR Guidelines for the Management of Dredged Material (OSPAR 98/14/1-E, Annex 43).
  - <u>Implementation in Belgium:</u>
    - Law of 11 May 1995 on the approval of the Convention for the Protection of the Marine Environment of the North-East Atlantic, *BS* 31 January 1998.
    - Law of 20 January 1999 on the Protection of the Marine Environment in the Marine Areas under Belgian Jurisdiction, *BS* 12 March 1999.
    - Cooperation Agreement of 12 June 1990 between the Belgian State and the Flemish Region on Preventing Adverse Environmental Effects on the Marine Environment due to Dumping of Dredged Material, *BS* 22 August 1990.
    - Royal Decree of 12 March 2000 for defining the procedure for the authorization of dumping certain substances and materials in the North Sea, *BS* 4 April 2000.
    - By four Ministerial Orders of 29 March 2000, the Ministry of the Flemish Community (Department of Infrastructure and Environment, Waterways and Maritime Affairs Administration, Ports, Waterways and Maritime Affairs Policy Division) has the authority to dump dredged material into the sea, *BS* 26 May 2000.

National legislation on dredging:

- Special Law of 8 August 1980 on the state reform, *BS* 15 August 1980, as amended.
- Royal Decree of 4 August 1981 on a Police and Shipping regulation for the Belgian territorial sea, the ports and beaches of the Belgian coast, *BS* 1 September 1981; as amended.

7.4 EXISTING SITUATION

7.4.1 Spatial delimitation

7.4.1.1 Dredging

In order to maintain accessibility to the Belgian seaports, dredging is required along the Belgian coast, in the estuary of the Western Scheldt and in the seaports themselves (Zeebrugge, Oostende, Nieuwpoort and Blankenberge) (Map I.3.7a).

7.4.1.2 Dredge disposal

Most of the dredged material is dumped back into the sea or in the Westerscheldt. It is difficult to choose the best place for disposal. The cheapest way is to dump the material in a dumping site close to the place where dredging takes place (e.g. Bruggen en Wegen Zeebrugge Oost is close to the harbour of Zeebrugge). But the closer the dumpsite is to the location of dredging, the more chance there is of re-circulation of the material (Map I.3.7a).

There are seven official **dumping zones** on the BPNS:

- Bruggen en Wegen Zeebrugge Oost
- Bruggen en Wegen Oostende
- S1
- S2
- S3
- R4
- Nieuwpoort disposal

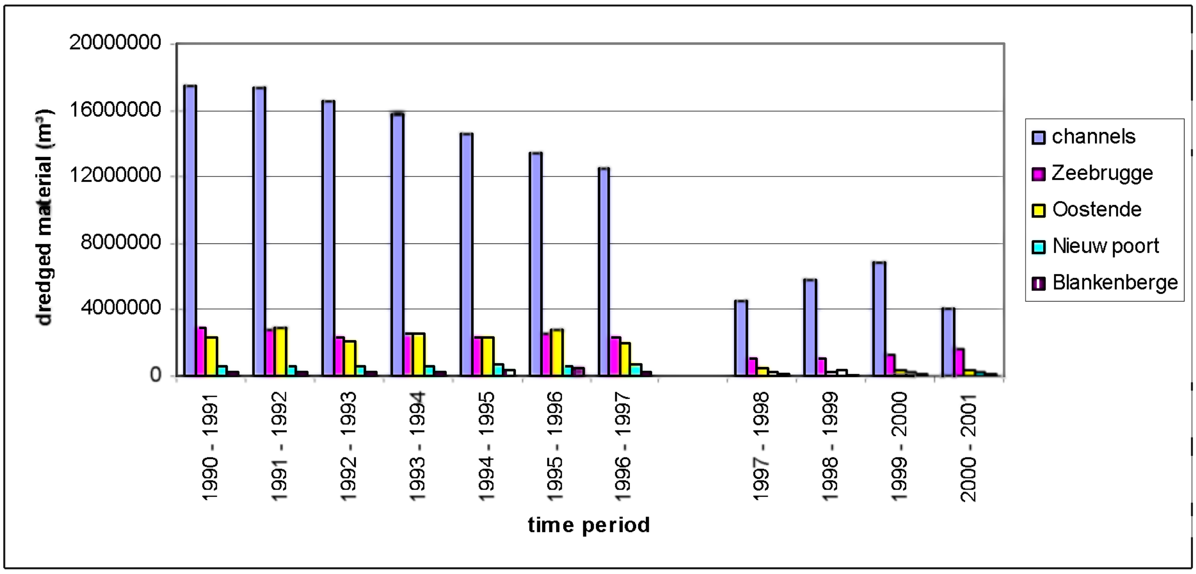
It is envisaged there will be two new zones for dumping dredged sand (zone 3a and 3b). These zones will probably be recognized as sand extraction zones, as the sand that is dumped could be recycled (Communication press, December 30, 2003). Scientific aspects related to this are discussed in Du Four (2004).

7.4.2 Type and intensity

7.4.2.1 Dredging

Dredging activities are of two types: dredging required for the initial construction, deepening and broadening of ports and shipping channels; and maintenance dredging to maintain the required depth of existing infrastructures (Maes et al. 2000). Maintenance dredging on the BPNS is the most important activity and takes places the whole year round. The deepening of the fairways also takes place during certain periods of the year. Annually about 9 to 10 million tonnes of dry material (TDM) has to be dredged from the Belgian coastal zone (De Brauwer 2003). On average 75% originates from the harbour of Zeebrugge, its access channel (Pas van 't Zand) and the access channel to the Westerscheldt (Scheur). This high amount is likely due to the presence of a turbidity maximum in front of Zeebrugge (Fettweis et al. 2003). The other dredged material comes from the harbours and access channels of Oostende, Blankenberge and Nieuwpoort (Figure I.3.7b) (Map I.3.7b).

Figure I.3.7b: Quantities of dredged material from the Belgian harbours and their access channels in (m^3) from 1990 to 2001. Quantities before 1997 were measured on wet material, whilst from 1997 onwards the material was measured as tonnes of dry matter. Due to this different methodology, both measurements cannot be compared directly (source: Ministry of the Flemish Community (Maritime Access Division)

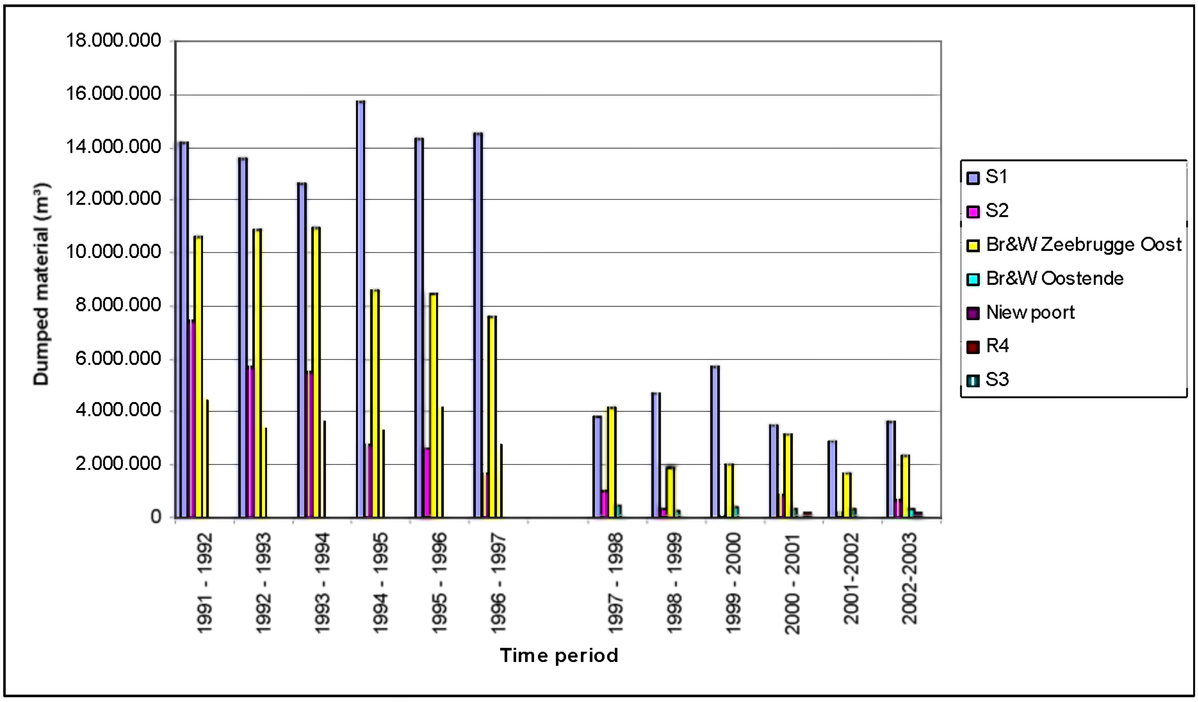


7.4.2.2 Dredge disposal

The most important dumpsites are S1 and Br&W Zeebrugge Oost ('Bruggen en Wegen'). The dredged material of maintenance dredging consists of fine sediments that are deposited from sedimentation. The material originating from deepening works contains a higher sand fraction (Fettweis et al. 2003) (Map I.3.7c).

The quality of dredged material is assessed every 10 years as part of a large-scale monitoring programme, executed by the Flemish region (Lauwaert 2002). The results show that the dredged material from the harbours is contaminated to a higher extent than material dredged from the navigation channels. This is due to the higher content of fine fraction and organic matter in the harbour sediments. However, the concentrations measured in 2000 were not higher than the sediment quality criteria, except for tributyltin (Seys 2002).

Figure I.3.7c: Quantities of dredged material dumped at sea (m³) from 1991 to 2003. Quantities before 1997 were measured when the material was still wet, while from 1997 onwards the material was measured as tonnes dry matter. So due to this difference in measurement methods we cannot compare both. (source: MUMM)



Dredged material is generally dumped under the transport vessel (Figure I.3.7a). During dumping the majority of the material is caught within a vertical density current. Near the seabed this current transforms into a horizontal one, influenced by the direction of the tidal current and the sea-bed slope (Malherbe 1991; Van Parijs et al. 2002; The Scottish Office Agriculture 1996).

7.5 INTERACTION

7.5.1 Suitability for user

Details – if applicable – can be found in the chapter that is specifically dedicated to "Suitability".

7.5.2 Impact on other users

Details – if applicable – can be found in the chapter that is specifically dedicated to "Interaction among users".

Beneficial use of dredged material

(Paipai 2003)

Biological uses:

- habitat restoration, enhancement and/or creation
- aquaculture
- agriculture
- horticulture

- forestry

Geological/physical uses:

- relocation within the natural ecosystem
- beach nourishment
- sediment cell maintenance
- construction and other engineered uses
- construction material
- replacement fill
- shoreline stabilization
- erosion control

Spatial conflict

There is a spatial conflict between dredging and dredge disposal on the BPNS and:

- cables and pipelines
- military exercise areas
- future electricity cable
- fisheries
- nature protection

7.5.3 Impact on environment

Biological

Impact on benthos:

The impacts of sediment disposal on benthic communities vary depending on many factors including the amount, frequency and nature of the disposed sediment, water depth, hydrography, time of year, the types of organisms inhabiting the disposal area and the similarity of the dredged sediment to that of the disposal area (Harvey et al. 1998).

Turbid plumes of suspended sand and silt can cause substratum removal and alteration of the bottom topography, resulting in the destruction of infaunal and epifaunal biota (De Groot 1996).

Harvey et al. (1998) came to the conclusion that the benthic community structure changes drastically shortly after the open-sea deposition of dredged materials. Less opportunistic families had a decreasing density and the most opportunistic families tended to have an increasing density. Both the burial with dredged sediments and the enhanced food-supply are responsible for the changing densities. However, studies carried out by the Sea Fisheries Department (DvZ) from 2001 till 2004 showed that there was no long-term change in the amount, density or diversity of species between the dumping sites on the BPNS and the reference sites. The only parameter that changed from station to station was the species composition, which is strongly dependent of the soil composition (Lauwaert et al. 2004).

The Scottish Office Agriculture (1996) gives an overview of responses of benthic communities to different waste types. Their conclusions were the following: '*Most dredged material, irrespective of its nature, will be rapidly re-colonised by benthic species following disposal. The rate of recolonisation will clearly depend on the frequency of disposal, and the nature of the receiving area. The timing of disposal in* *relation to seasonal peaks of recruitment of juveniles from the plankton will also affect recolonisation rates. However, adults may arrive immediately, either through vertical migration if undamaged and only lightly buried, or horizontally (passively or actively) from unaffected areas nearby. Factors influencing time-scales for "recovery" on cessation of disposal include the dispersive properties of the receiving environment, the degree of similarity of the deposited substrate with that naturally prevailing in the area and the age composition of "key" species in unaffected populations'.*

Impact on fish/birds/flora:

Dredging activities can have beneficial impacts on fish and fish habitats (e.g. increased water column oxygen content, re-oxygenation of sediments, re-suspension of nutrients, removal of polluted sediments) (Hopkins and White 1998).

In the Mobag 2000 project, initiated by the Flemish Government, the physical, chemical and ecotoxicological impact of dredging and relocation in the harbour of Nieuwpoort was investigated. The maintenance dredging and relocation operations only cause a visual effect near the relocation area, but have no adverse environmental effect and do not impact the local ecosystem as such (De Groote et al. 1998). Also the results of DvZ studies showed no important changes in the demersal fish stocks due to dumping activities (Lauwaert et al. 2004).

When dredging activities take place in spawning grounds, a deposition of fine material from the plumes (which can extend in a larger area than the actual dredging area) can smother eggs laid on the bottom (De Groot 1996).

Geological/physical

A turbid plume of suspended material (sand and silt) is formed when the displaced water of the hopper flows back into the sea. Removal of substratum, alteration of the bottom topography, the formation of temporary plumes in the water column and re-deposition of material are the most common physical impacts of dredging (De Groot 1996; Burt and Hayes 2005). However dredging activity is not the only factor that affects the turbidity. Other causes are storm and tides. Therefore the relative contribution of dredging should be quantified in order to assess the surplus impact of dredging (Van Parys et al. 2002).

Dumping of dredged material will change the bathymetry and the nature of the bed sediments, if it is of a different particle size. It also influences a larger area due to the formation of a turbid plume during the dumping process. If bedforms are present they will likely disappear during the period of dumping. However, if the sediment composition is restored after the dumping has ceased the chances of recovery are high (Knaapen and Hulscher 2002). Bedforms have reappeared in the old dumping site of the Sierra Ventana area (S1) after the site was closed for dumping. This has been well demonstrated by Du Four (2004).

Hydrological

Increased turbulence due to vessel movements and dumping may re-suspend sediments, which can have an impact on bank stability (e.g. erosion of banks), dislodge macro-invertebrates and disturb fish eggs and larvae in the edges of a waterway (Hopkins and White 1998).

Chemical

De Groote et al. (1998) did not find a change in the quality of seawater owing to the relocation of dredged sediments in the near shore zone near the harbour of Nieuwpoort. Pieters et al. (2002) concluded that the mobility of contaminants in dredged material changed during dredging. This change is different for every examined contaminant. For some contaminants the mobility decreases; for others it increases. However it is important to note that the change in mobility is very low for all the considered contaminants and for both dredging techniques. There are indications that arsenic is liberated to the surrounding seawater at the disposal area. However, the concentrations remain very low and in the laboratory no negative effects could be detected for the organisms tested.

The Belgian Sea Fisheries Department investigated the impact of dumping activities on the concentrations of organic and inorganic contaminants in the fine sediment fraction. However the fluctuating concentrations could not be brought in correlation with the dumping activities (Lauwaert et al. 2004).

7.5.4 Impact of on socio-economy

Economic

An estimate of the turnover of dredging in the Belgian part of the North Sea (and its coastal ports) can be given by extrapolating the budgets invested. In 2000-2001 this was an amount of 57 million euros. There seemed to be a gradual increase of turnover over the last 10 years mainly due to investment in dredging works during the period 1998-2001 (Maes et al. 2002).

Social

Making use of information from the "Temporary Union" of dredgers, an estimate of about 240 employees for the year 2000 could be given. More than 65% of these people worked on the vessels whereas the others worked in the office, on the berth or in the work places (Maes et al. 2002).

It is extremely difficult however to give an estimate since most companies have huge activities abroad. In the past 5 years for example, De Nul alone already invested 580 million euro. The employment increased from 1600 to 2400 persons. There is an ongoing recruitment of engineers, technical people and vessel staff. De Nul's activities however go beyond the Belgian part of the North Sea.

The number of employees of the Ministry of the Flemish Community authorized for dredging works should also be taken into account:

- 29 staff monitoring dredging activities
- 2 engineers
- 1 civil engineer

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8 RECREATION AND TOURISM ON THE BEACH

8.1 DESCRIPTION

The Belgian beaches attract many tourists and offer a lot of possibilities for recreational activities (playing, sun bathing, swimming, dynamic water sports … etc). This can be explained by the typical characteristics of the Belgian beaches:

- composed of mainly fine-grained sand
- usually interrupted by groins
- beaches are rather broad compared to other North Sea coasts
- softly sloping transition from shallow to deep water
- presence of rather large waves

The West coast (De Panne, Koksijde and Oostduinkerke) is characterized by very broad beaches, which are not interrupted by groins. Due to this characteristics and the permanent wind, the intensity of land yachting and speed sailing is much higher than on other beaches.

Tourists especially appreciate the fact that the different beaches are connected to each other, as this makes long walks possible (Westtoer 2002).

The coastal area is already one of the most famous and important tourist locations in Belgium, and the tourist-recreational use of this area is continuously getting more intense (PSEP 2003).

8.2 SUBUSES AND DESCRIPTION

Different sub-uses can be distinguished under the use of ‘tourism and recreation on the beach’.

- **Tourism:** this sub-use tries to give an idea of the global tourist pressure on the different Belgian beaches
- **Recreational fisheries on/from the beach:** next to angling at sea (see ‘recreation and tourism at sea’), other forms of fisheries take place along the shoreline, namely beach fisheries (with standing nets), shrimp fisheries and beach angling (from dikes, groins ... etc).
- **Land yachting:** for this recreational activity a small vehicle is driven on the beach with the aid of wind, captured by a sail attached to it.
- **Sport animation:** sport animation events are recreational activities that are organised on the beach
- **Horseback riding:** occasionally horseback riding is executed on some beaches or dunes.
- **Other (unorganised) beach recreation:** in this category all unorganised beach activities are gathered: sunbathing, playing, walking … etc.

8.3 TOURISM ON THE BEACH

8.3.1 Legislative framework

(update by Cliquet A.)

Description

Tourism and recreation can be undertaken on Belgian beaches. The delimitation of Belgian beaches is described in the Royal Decree of 5 October 1992. However, organizations or clubs that want to undertake activities on beaches, dikes or associated structures need a license granted by the Flemish Government.

Different spatial design plans (Flemish Regional plans, general and exceptional municipal design plans) determine the planning uses for land within the coastal zone (e.g. habitation, industrial, recreational, nature … etc area). These plans are not available for the marine part of the coastal zone. Spatial plans for the coastal zone can require licences to be obtained for certain activities (e.g. building, changing the relief of the bottom …).

No actual legislation exists concerning the maximum intensity or frequency of tourism that can take place on beaches, dikes or in the dunes. The only legislation applicable to tourism concerns tourist infrastructure and employment in the tourist sector.

National and Regional Legislation:

(Maes and Cliquet 2005)

Delimitation of beaches:

- Special Law of 8 August 1980 on the state reform, *BS* 15 August 1980, as amended: Article 2 describes the provincial boundary of West-Vlaanderen as the zero line of the coast or the low water line of the mean low water spring (MLLWS). This is also the boundary of the Flemish Region.
- Royal Decree of 5 October 1992 concerning the determination of a list of waterways and their associated structures authority transferred from the State to the Flemish Region, *BS* 6 November 1992: All beaches and sea defense structures that are passed onto the Flemish Region are delineated.

Legal status of beaches:

- Civil Law: Beaches and associated structures are described as public domain (art. 538).
- Law of 30 April 1958 concerning the granting of beach concessions, *BS* 30 May 1958: Beach concessions for the installation of infrastructure for sea and sun bathing, sports and animation should be granted in favour to the coastal towns.
- Decree of 18 December 1992 concerning the accompanying of the State Budget of 1993, *BS* 29 December 1992: The Flemish Government is vested with authority to grant beach concessions for the private use of public domain pursuant to the Royal Decree of 5 October 1992.
- Decision of the Flemish Executive of 26 April 1995 concerning beach concessions, *BS* 29 August 1995: This Decision sets out the conditions for the granting of concessions, the duties of concession holders and the beach management measures that have to be taken into account.

Infrastructure on beaches:

- Decree of 18 May 1999 on the organization of spatial planning, *BS* 8 June 1999, as amended: This decree orders the making of spatial structure plans, describing the desired spatial structure of a region. This decree also requires a building permit for building constructions.

8.3.2 Existing situation

8.3.2.1 Spatial delimitation

Tourism occurs on all Belgian beaches and associated dikes and dunes.

8.3.2.2 Type and intensity

The Provincial Spatial Execution Plan (PSEP 2003) Beach and Dike (2003) made an inventory of **tourist pressure** on the different Belgian beaches. Tourist pressure was expressed by means of qualitative (descriptive) pressure classes. These pressure classes can also be translated into **pressure indices** which makes their representation easier.

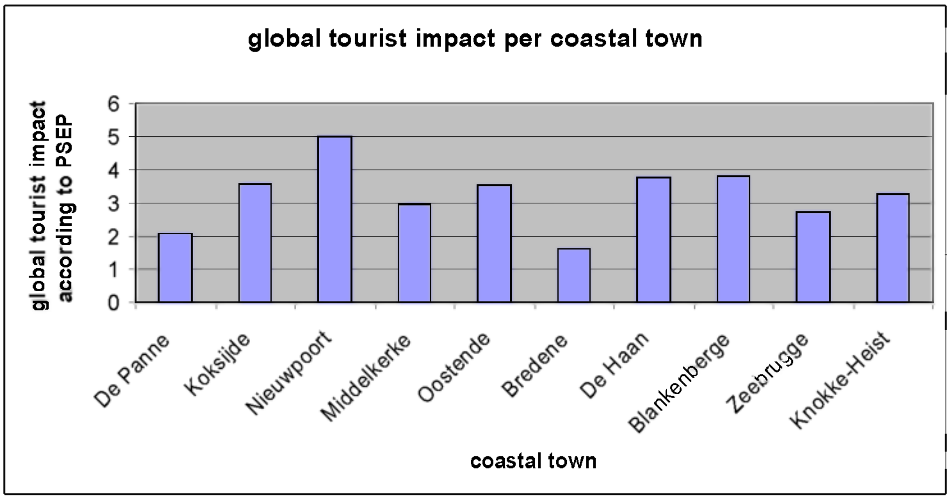
Qualitative pressure classes	Pressure index
Low pressure	1
Medium pressure	3
High pressure	5

The beaches were divided into small sections that give a more detailed picture of the tourist impact along the coastline (see digital document 'Tourist pressure PSEP' for details). The tourist impact of each sector was multiplied by a fraction, representing the estimated relative length of the sector in relation to the whole beach length of a coastal town. The sum of the multiplications of all sectors of a coastal town gives an idea of the global qualitative tourist impact in that coastal town (Table I.3.8a, Figure I.3.8a).

Table I.3.8a: Global tourist impact on the beaches of the different coastal towns (PSEP 2003)

Coastal town	Global tourist impact
De Panne	2.1
Koksijde	3.6
Nieuwpoort	5.0
Middelkerke	2.9
Oostende	3.5
Bredene	1.6
De Haan	3.8
Blankenberge	3.8
Zeebrugge	2.7
Knokke-Heist	3,3

Figure I.3.8a: Global tourist impact per coastal town (PSEP 2003).



PSEP (2003) also made an inventory of **all constructions on the beaches and dikes**. An increased range of water and beach sports, and commercial events, has consequently increased the demand for temporary and permanent structures on the beach, in the dunes and on the dikes. The major part of beaches lies outside the boundaries of the Flemish region's spatial plans, which classifies such areas as 'undefined territory'. The fact that the Flemish region has not defined these territories means that constructions and activities on certain parts of the beach, linked to tourism and recreation, are indeterminate both at law and in terms of planning.

The aim of the PSEP is to plan for tourist-recreational activities that require either permanent or temporary structures on beaches, dikes or accompanying constructions (irrespective of whether a building permit is required). Individual activities like sunbathing, walking, horseback riding and beach fisheries are not dealt with under the plan.

Table I.3.8b and Figure I.3.8b give an overview of all types of constructions on the beach. These can be separated into beach constructions (constructions for restaurants, bars, sports, public services and surfing clubs) and beach cabins. The total number of constructions on the beach could also give an idea of the tourist/recreational pressure on different beaches. Since the major part of beach constructions are tourist structures (restaurants, bars …etc), the total number of beach constructions can be correlated to tourist pressure. Beach cabins are mostly used to store tourist beach and recreational equipment. Accordingly, beach cabins can also be correlated to recreational pressure on beaches (see below).

Table I.3.8b: Overview of the numbers of the different types of constructions on the beach (PSEP 2003).

	Number of constructions for restaurants/bar/sports/public services	Number of surf clubs	Total number of beach constructions	Number of beach cabins	Total number of beach constructions + cabins
De Panne	42	1	43	527	570
Koksijde	65	3	68	648	716
Nieuwpoort	74	0	74	240	314
Middelkerke	46	1	47	735	782
Oostende	67	1	68	890	958
Bredene	11	1	12	172	184
De Haan	51	1	52	1022	1074
Blankenberge	58	1	59	1243	1302
Zeebrugge	21	1	22	482	504
Knokke	139	5	144	2974	3118
Total	574	15	589	8933	9522

Figure I.3.8b: Total number of beach constructions and beach cabins (PSEP 2003).

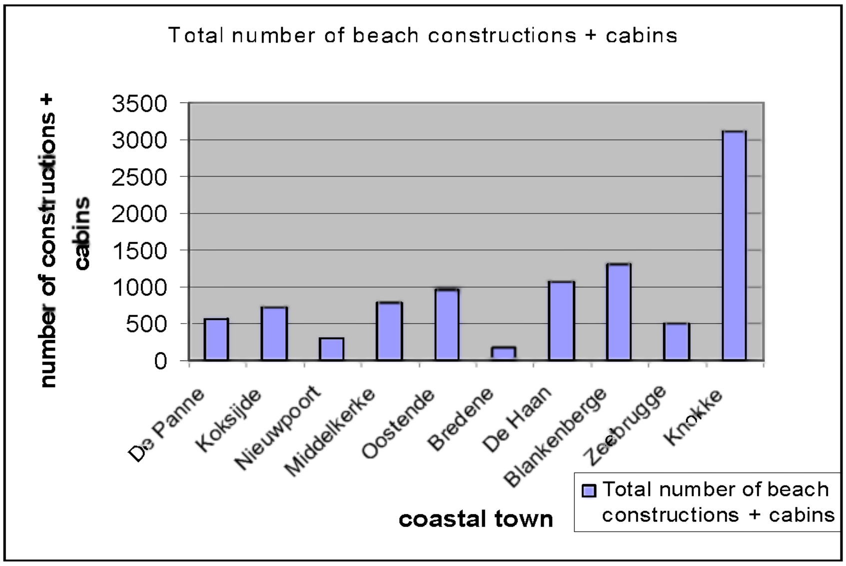


Table I.3.8c gives an overview of the total number of constructions on beaches and dikes in different coastal towns. This is represented graphically in Figure I.3.8c and Figure I.3.8d (division into temporary and permanent constructions).

Table I.3.8c: Constructions on beaches, dunes and dikes in the different coastal towns. A division is made between the number of temporary (mostly during the summer season) and permanent constructions (PSEP 2003).

	Number of constructions	Number of temporary constructions (summer season)	Number of permanent constructions
De Panne	43	33	10
Koksijde	68	42	26
Nieuwpoort	74	42	32
Middelkerke	47	36	11
Oostende	68	50	18
Bredene	12	3	9
De Haan	52	39	13
Blankenberge	59	42	17
Zeebrugge	22	17	5
Knokke	144	106	38
Total	589	410	179

Figure I.3.8c: Number of beach constructions per coastal town (PSEP 2003).

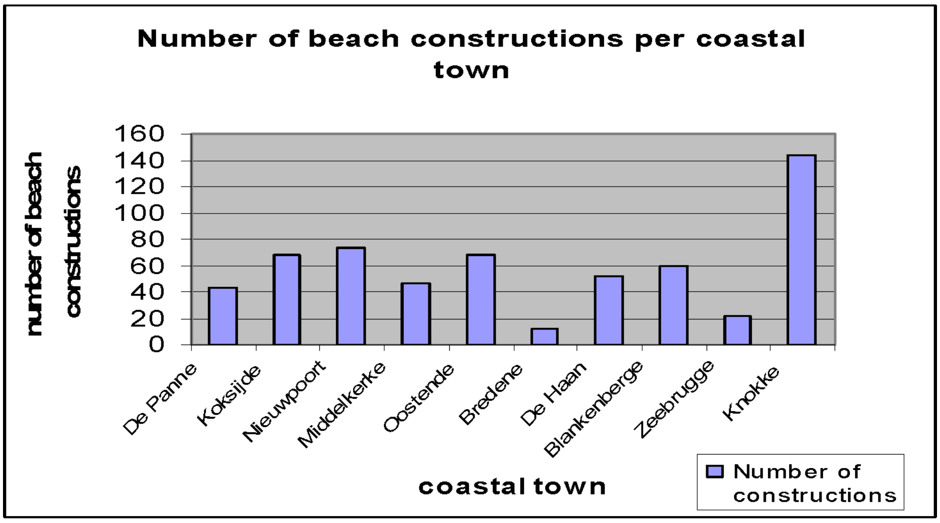
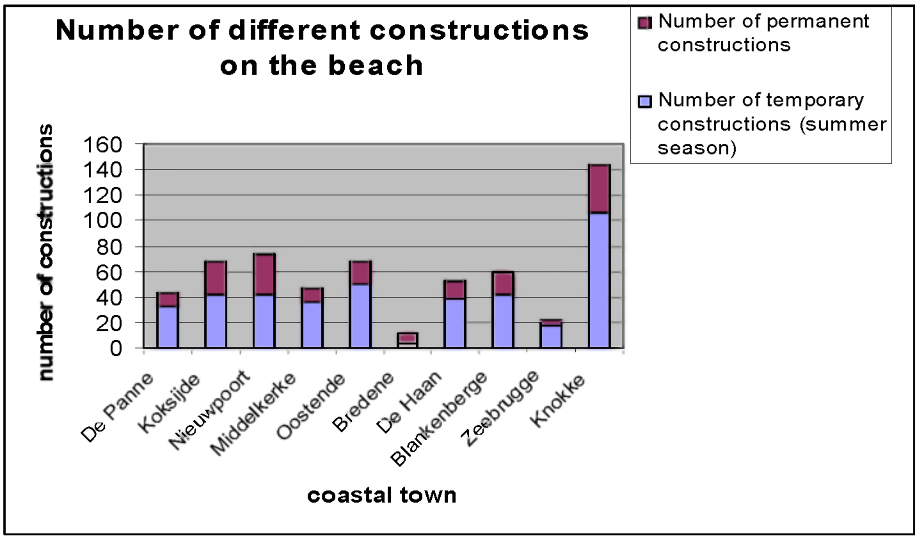


Figure I.3.8d: Visualization of the permanent and temporary constructions in the different coastal towns (PSEP 2003).



The recently finished **MAREDASM project** (Maes et al. 2002) produced an overall assessment of the marine degradation of the North Sea and made some proposals for sustainable management. One chapter dealt with degradation due to tourism. Some socio-economical issues of tourism are reproduced in the following section.

One of the results of the project was the estimation of the tourist pressure in the different coastal towns. This was done by correlating 4 parameters to tourist pressure:

- The number of overnight stays in commercial accommodations (intensity 1)
- The number of individual holiday rental homes and second residencies (intensity 2)
- The number of one day tourists (intensity 3)
- The number of sold train tickets to the different coastal towns (intensity 4)

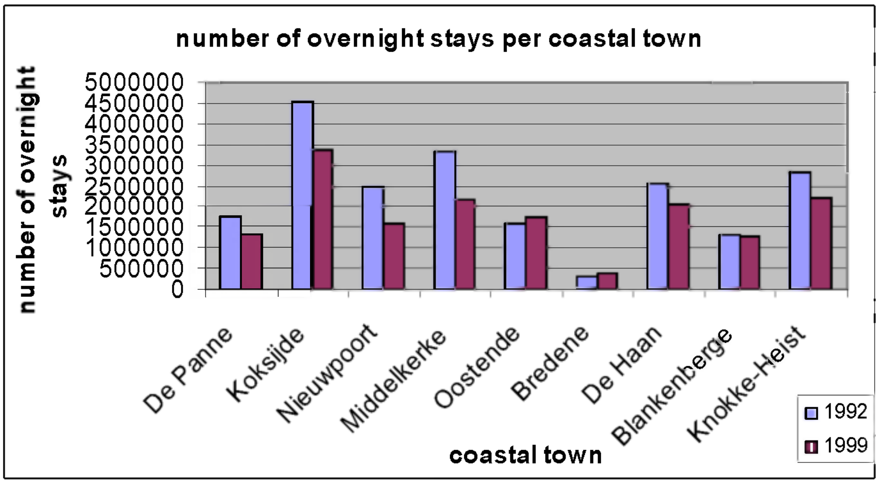
Intensity 1

Table I.3.8d gives an overview of the estimated number of overnight stays in commercial accommodations per coastal town. Comparison between the years 1992 and 1999 gives an idea of the temporal changes in tourist pressure (Figure I.3.8e) (Westtoer 2002).

Table I.3.8d: Number of overnight stays in commercial accommodations (Westtoer 2002).

	1992	1999
De Panne	1732000	1312000
Koksijde	4548000	3385000
Nieuwpoort	2486000	1589000
Middelkerke	3319000	2187000
Oostende	1587000	1744000
Bredene	315000	393000
De Haan	2541000	2049000
Blankenberge	1309000	1272000
Knokke-Heist	2841000	2227000

Figure I.3.8e: Evolution of the number of overnight stays in commercial accommodations (Westtoer 2002).

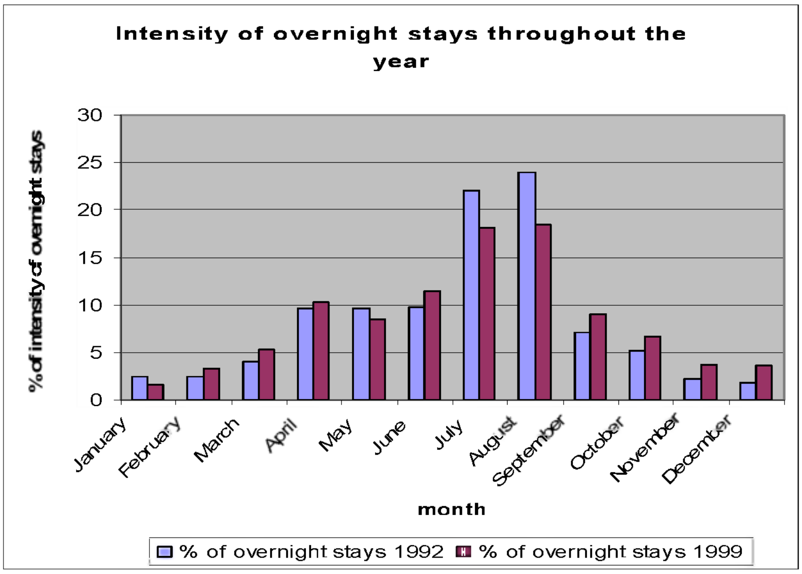


The **frequency** of overnight stays was not evenly spread over the year. The highest were in July and August (ca. 40 %) and lowest were in November and December (ca. 5 %) (Table I.3.8e, Figure I.3.8f).

Table I.3.8e: The evolution of the percentage of overnight stays in commercial accommodations throughout the year (Westtoer 2002).

	% of overnight stays	
	1992	**1999**
January	2.4	1.6
February	2.4	3.3
March	4	5.3
April	9.6	10.3
May	9.6	8.5
June	9.8	11.4
July	22	18.1
August	24	18.4
September	7.1	9
October	5.2	6.7
November	2.2	3.7
December	1.8	3.6

Figure I.3.8f: The evolution of the percentage of overnight stays in commercial accommodations throughout the year (Westtoer 2002).



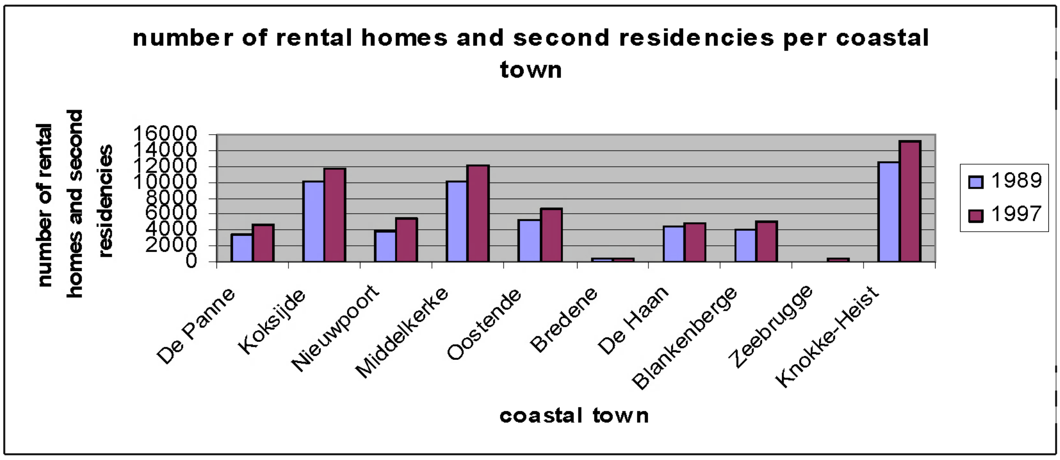
Intensity 2

Second residencies are not included in the above-mentioned 'number of overnight stays in commercial accommodations'. However, they are a substantial aspect of coastal tourism in Belgium. This form of tourism has significantly increased over the last years (Table I.3.8f, Figure I.3.8g).

Table I.3.8f: Estimated number of individual holiday rental homes and second residencies (De Keyser and Handsaeme 1998).

	1989	1997
De Panne	3457	4751
Koksijde	10062	11746
Nieuwpoort	3920	5397
Middelkerke	10061	12081
Oostende	5219	6613
Bredene	327	457
De Haan	4439	4898
Blankenberge	3980	5143
Zeebrugge		333
Knokke-Heist	12559	15224

Figure I.3.8g: Estimated number of individual holiday rental homes and second residencies (De Keyser and Handsaeme 1998).



The average occupation of these homes is rather low (**25 %** of the year) and the coastal towns can be separated in three groups when considering the occupation of rental homes and second residencies:

- occupation is <u>lower than the average</u>: De Haan, Nieuwpoort, De Panne
- occupation equals <u>average</u>: Koksijde, Middelkerke, Blankenberge, Zeebrugge
- occupation is <u>higher than the average</u>: Bredene, Oostende, Knokke-Heist

On average 38 % of the individual holiday rental homes and second residencies are offered for rent by the owners. Since the occupation percentage only considers occupation by the owner, the actual occupation percentage could be much higher and could also give another spreading pattern over the different coastal towns.

<u>Intensity 3</u>

One-day tourism can be defined as follows:

'Trips with a duration of one day that do not include an overnight stay. Lunch is taken outside the home, the stay has a recreational goal (no family visits) and is usually situated more than 20 km from the home'

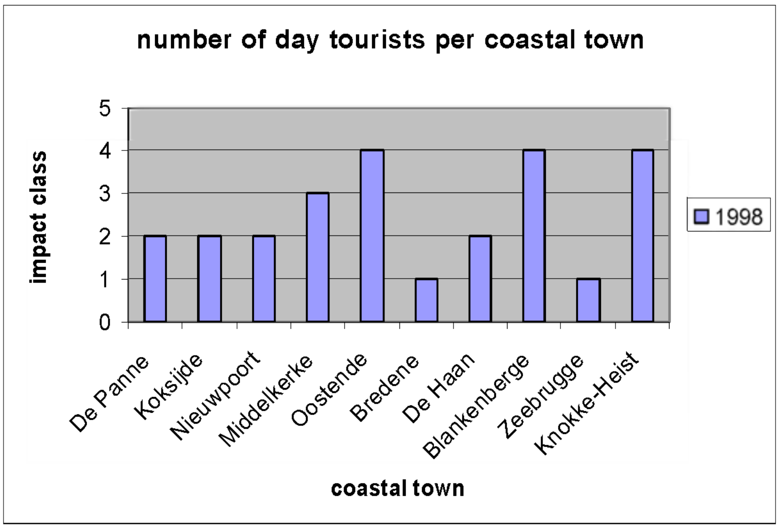
This type of tourism is very important in the Belgian coastal zone, but until recently no accurate system existed to measure the intensity of the activity. Therefore the conclusions on one-day tourism are mainly based on rough assessments of the number of day tourists coming to the coast. Westtoer has developed a methodology for a permanent measurement system for one-day tourism (considering number of tourists coming to the coast by car and by train/bus), but this tool has just become operative and only preliminary results are available (which do not give measurements for the different coastal towns) (Westtoer 2003). A recent declaration of the Flemish Ministry of Employment and Tourism (2004) stated that, according to the permanent measurement system, 19.4 million tourists visited the coastal area in 2003. The statement also indicates that this represents an increase of 13 % in comparison to 2002 (14.9 million day tourists). Earlier Westtoer estimates on the number of day tourists were 28.3 million in 1992 and 30.6 million in 2000.

WES estimated the number of day tourists to the coastal area in 1998 at 17.2 million, which is considerably lower than the estimates made by Westtoer (Verhaeghe 2000). Table I.3.8g gives the WES-estimated number of day tourists to each coastal town for the year 1998 (represented graphically in Figure I.3.8h).

Table I.3.8g: Number of day tourists to the different coastal towns (Verhaeghe 2000).

	1998
De Panne	1200000
Koksijde	1500000
Nieuwpoort	1500000
Middelkerke	2000000
Oostende	3000000
Bredene	600000
De Haan	1100000
Blankenberge	3000000
Zeebrugge	700000
Knokke-Heist	3300000

Figure I.3.8h: Number of day tourists to the different coastal towns (Verhaeghe 2000).



Intensity 4

The number of sold train tickets to the coast can also be used as a parameter for determining the **extent of one-day tourism that comes to the coast by train**. This parameter certainly has its limitations since not all train passengers to and from coastal towns are day tourists. People who can use the train for free are also not included in this way.

Table I.3.8h: Number of sold train tickets to coastal towns in 1998, 1999 and 2000 (Westtoer 2002).

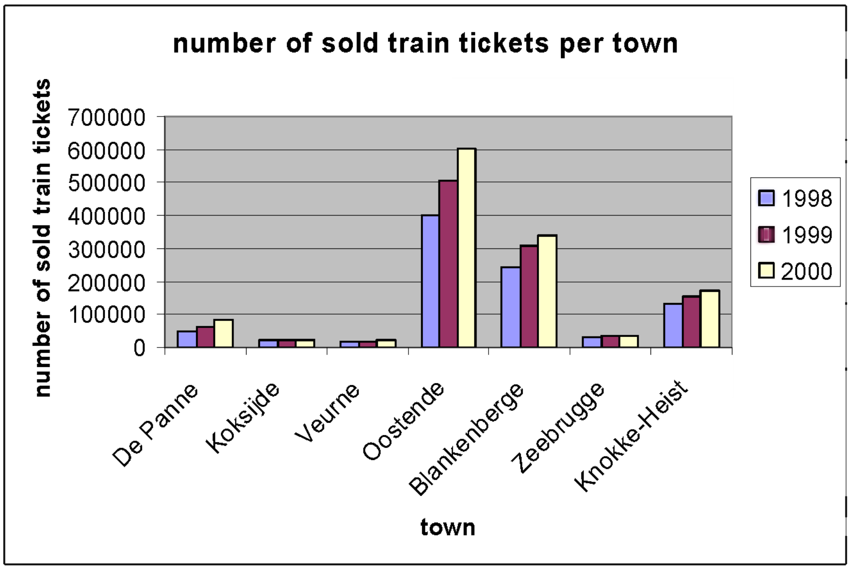
	1998	1999	2000
Total number of sold train tickets	890036	1105880	1277265

The numbers in table I.3.8h show that, although the number of 'day tourists' arriving by train is increasing every year, the **greatest part** of the total number of day tourists (17200000 in 1998) reach coastal towns **by car**. Table I.3.8i and Figure I.3.8i give a detailed overview of the number of sold train tickets to the different coastal towns.

Table I.3.8i: Number of sold train tickets to the different coastal towns (Westtoer 2002).

	1998	1999	2000
De Panne	48291	61164	85777
Koksijde	20431	21662	22698
Veurne	16914	18045	19858
Oostende	400574	508079	604362
Blankenberge	241630	308559	338397
Zeebrugge	28705	35573	34800
Knokke-Heist	133491	152798	171373
total	890036	1105880	1277265

Figure I.3.8i: Number of sold train tickets to the different coastal towns (Westtoer 2002).



Middelkerke, Bredene and De Haan do not have a train station, but can be reached by train (and subsequent buses or trams).

Combined estimate of tourist pressure in the different coastal towns

The number of sold train tickets is not very representative as an expression of tourist pressure because there are coastal towns that haven't got a train station.

Another parameter that can be correlated with tourist pressure is the number of registered compensated employers in the tourist/recreational sector (intensity 4').

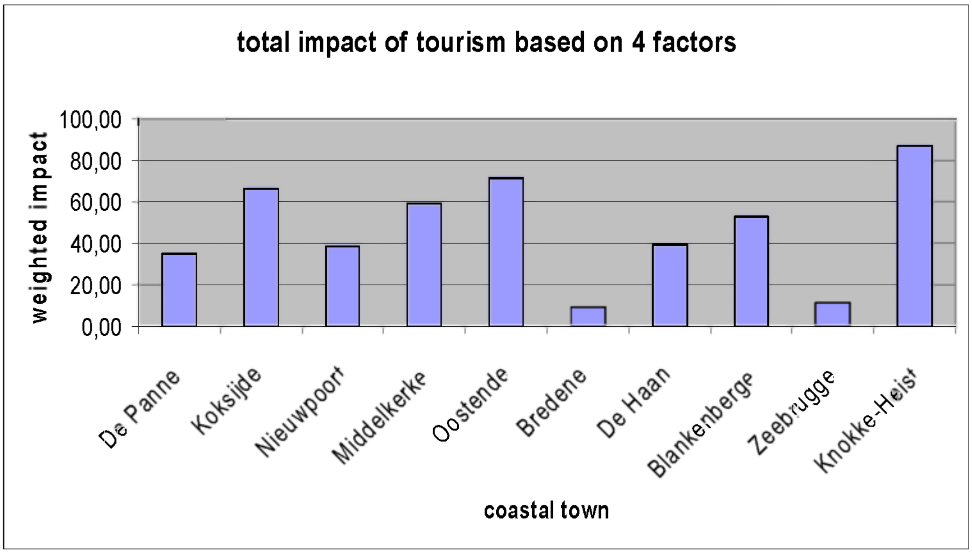
To combine these parameters in order to get an overall picture of tourist pressure in the different coastal towns, first the maximum number of each intensity parameter should be highlighted, and then, all numbers of an intensity parameter should be divided by the corresponding maximum number to get fractions. A weighting factor can be assigned to every intensity parameter (e.g. same weighting factor of 25 for each parameter – sum of weighting factor should be 100).

This gives for the period 1997-1999:

Table I.3.8j: Overview of the combination of tourist intensity parameters into a global tourist impact factor.

	intensity 1			intensity 2			intensity 3			intensity 4'			SUM
	1999	Fractions	weight	1997	fractions	weight	1998	fractions	weight	1997	fractions	weight	impact
De Panne	1312000	0.3876	9.69	4751	0.3121	7,80	1200000	0.3636	9.09	677	0.3267	8.17	34.75
Koksijde	3385000	1	25	11746	0.7715	19,29	1500000	0.4545	11.36	868	0.4189	10.47	66.13
Nieuwpoort	1589000	0.4694	11.74	5397	0.3545	8,86	1500000	0.4545	11.36	520	0.2510	6.27	38.24
Middelkerke	2187000	0.6461	16.15	12081	0.7935	19,84	2000000	0.6061	1515	689	0.3325	8,31	59.46
Oostende	1744000	0.5152	12.88	6613	0.4344	10,86	3000000	0.9091	22.73	2072	1	25	71.47
Bredene	393000	0.1161	2.90	457	0.0300	0.75	600000	0.1818	4.55	93	0.0449	1.12	9.32
De Haan	2049000	0.6053	15.13	4898	0.3217	8.04	1100000	0.3333	8.33	623	0.3007	7.52	39.03
Blankenberge	1272000	0.3758	9.39	5143	0.3378	8.45	3000000	0.9091	22.73	1028	0.4961	12.40	52.97
Zeebrugge				333	0.0219	0.55	700000	0.2121	5.30				11.70
Knokke-Heist	2227000	0.6579	16.45	15224	1	25	3300000	1	25	1699	0.82	20.50	86.95

Figure I.3.8j: Global tourist impact in the different coastal towns, based on 4 different, weighted tourist intensity factors.



8.4 RECREATIONAL FISHERIES ON OR FROM THE BEACH

8.4.1 Legislative framework

(updated by Cliquet A.)

Description

Recreational fishing is a leisure activity whereby the catches can only be used for personal use. There are three categories of recreational fisheries: beach fisheries, shrimp fisheries and beach angling.

Beach fishing is a kind of fishing that is done when it's low tide. The nets (bottom set gill nets) are placed on the beach or just below the low water line (maximum 150 m at sea). The nets are anchored with concrete blocks, anchors, and rims of car wheels or with heavy metal posts.

During shrimp fishing a net is towed or pushed over the seafloor during low water.

Between Koksijde and Nieuwpoort (but especially in Oostduinkerke) the shrimp nets are towed by horses (traditional way). There are only a few fishermen that perform this activity (from March until December). Therefore this way of shrimp fishing is economically not profitable, but it is maintained for tourist and traditional reasons.

Next to angling from boats, this recreational activity can also be executed from the beach or from groins and seawalls. Local inhabitants and tourists execute the activity.

Recreational fishing from the beach is very poorly regulated in the current legislation. The Law on river fishing (1st of July 1954) only covers the fresh water basins and the authority for the coast is divided between the Belgian State and the Flemish Community. This has led to fragmented legislation and a lack of coherence in the management of the coastal area. The only regulation concerning certain activities both on land and at sea is the Belgian Coastal Regulation. In several coastal municipalities such as Koksijde, Bredene and Oostende regulations concerning beach fisheries also exist. These regulations deal with beach-fishing areas and comprise rules concerning the permitted period and maximum number of nets per fishermen.

A regulation for beach fishing that is valid for the whole coastal area doesn't exist and a fishing permit (obliged for freshwater fishing) is not needed.

Specific for recreational angling at sea (V.V.H.V. 2003):

- Beach and sea angling: catches have to have minimum measures
- Sea angling: limited for catches of cod (maximum 15 kg/person.day) and sea bass (maximum 5 kg/person.day).

Legislation

(Maes and Cliquet 2005)

International legislation:

- Council Regulation (EC) No 850/98 of 30 March 1998 for the conservation of fishery resources through technical measures for the protection of juveniles of marine organisms, *Official Journal L* 125, 27 April 1998: ➔ It is for instance forbidden to keep any undersized fish that are caught (art. 19).

National legislation:

- Law of 22 January 1901, changing article 13 of the Decree of 16 December 1811 concerning the catch of mussels, *BS* 23 August 1901: It is prohibited to catch mussels, mussel seed, snails or other sea products from the coastal defense works without a permit.
- Royal Decree of 25 January 1951 concerning the search and catch of mussels, mussel seed, snails and other sea products on coastal and harbour works, *BS* 14 February 1951: A permit is needed to perform these activities (art. 1). The Ministry of the Flemish Community brought attention on the danger of damaging coastal defense structures (like groins) when collecting mussels and/or mussel seed. To prevent this, the Flemish government can exclude these activities on the coastal defense works.
- Royal Decree of 4 August 1981 concerning the Police and Shipping Regulations for the Belgian territorial sea, the harbours and the beaches of the Belgian coast, *BS* 1 September 1981, as amended (also known as Belgian coastal regulation): It is prohibited to fish in the channels of harbours from coastal works, except with cross nets or lines and provided shipping is not hindered (art. 10, § 11). Beach fisheries are regulated under article 40. Beach nets and fishing lines with hooks can only be placed outside the bathing areas on the beach and nets must be marked with yellow markings (art. 33, § 1, 1).
- Royal Decree of 14 August 1989 concerning the determination of additional national measures for the maintenance and conservation of the fish stocks and for control on the fishery activities, *BS* 2 September 1989, as amended: This decree sets additional measures for the implementation of the EU regulations concerning the maintenance and conservation of fish stocks. The Amendment of 11 March 1996 significantly limits the extent of recreational fisheries, with the aim of protecting commercial fisheries.
- Law of 20 January 1999 on the protection of the marine environment in the marine areas under Belgian jurisdiction, *BS* 12 March 1999; as amended: The King can, when recommended by the Ministers for protection of the marine environment and for Agriculture, take measures to limit the extent of recreational fisheries at sea (art. 12, § 2).

Municipal regulations concerning beach fisheries/shrimp fisheries (with horses) /beach angling:

- Police Regulation of Bredene of 20 September 1999 concerning beach fisheries: This inludes zones for beach fishing, period, materials and methods.
- General Police Regulation of De Panne, Chapter X on beach fisheries: This includes zones, period, materials , and methods.
- General Police Regulation of Koksijde ,Chapter 32 on beach fisheries: zones for beach, shrimp fisheries and beach angling, placing of posts, anchors and other material for beach fisheries.
- General Police Regulation of Middelkerke, art. 93.1-93.12 on beach fisheries: This includes zones for beach fishing, period, materials and methods.
- Police Regulation of Oostende concerning beach fisheries: This includes placing of posts, anchors and other material for beach fisheries.

8.4.2 Existing situation

8.4.2.1 Spatial delimitation

Very little information is available on the delimitation of zones where beach fisheries, beach angling and shrimp fishing are actually conducted.

8.4.2.2 Type and intensity

Beach fisheries

Beach fisheries are most intensively conducted on the West coast. This kind of recreational fishing is done the whole year through, at low tide. Fishing nets are 50 to 200 meters long. During spring sole is mostly caught, while in autumn the target species are young cod and whiting. Problems with this kind of fishing are:

- Catch: small, undersized, and protected species are caught.
- Because of the combined length of the many nets the beach gets closed off in certain areas of the coast. Seals, porpoises and different water bird species can get caught in these nets and suffocate.
- The nets are usually not emptied quickly enough, which causes rotting of the catch, pollution of the beach and health risks.
- The metal posts on the beach can be dangerous for swimmers and other recreational users of the beach, such as surfers. There are also conflicts with other recreational fishing activities, such as angling and shrimp fishing.
- The nets are frequently dumped illegally at sea. The propellers of fishing or recreational boats can become entangled in the nets causing considerable damage. The floating nets also continue to catch fish and other sea mammals ("ghost fishing").

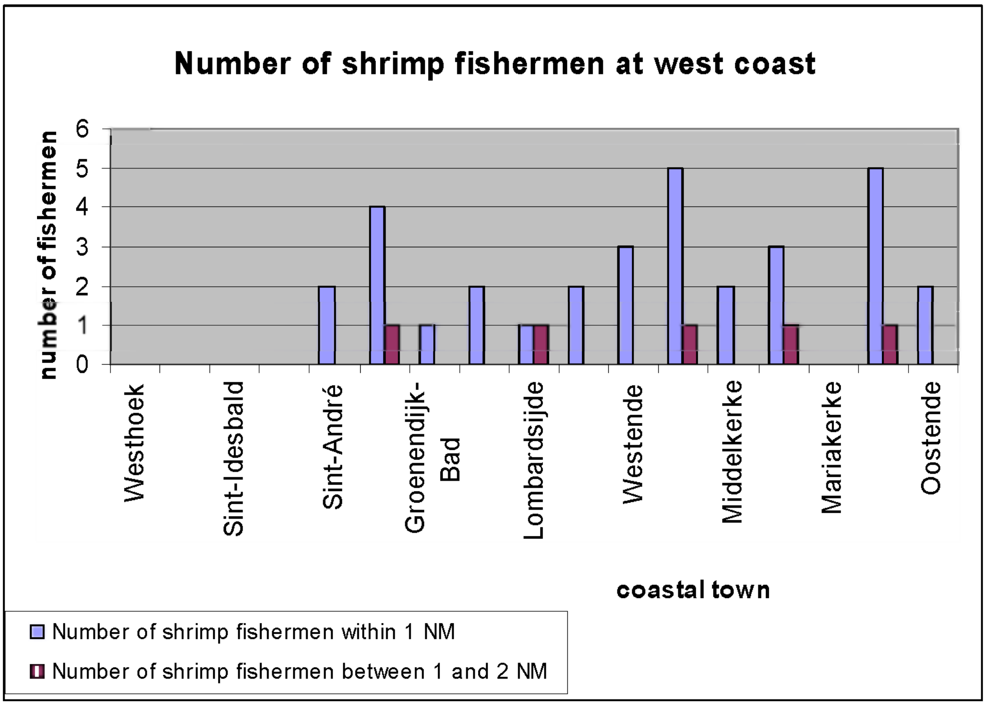
The intensity of shrimp fishing is only known for one day (13 October 1999), and only for the beaches from De Panne to Oostende (Table I.3.8k, Figure I.3.8k) (BMM 2000). The report states that the highest intensity of shrimp fishing occurs on the Belgian coast from mid August until November. This activity is usually located within 1 NM of the coastline. The shrimp statistics do not, however, include shrimp fishing with nets towed by horses. This activity occurs throughout the whole year, except in bad (stormy) weather conditions.

Table I.3.8k: Number of shrimp fishermen on the 13th of October 1999 (MUMM 2000).

Location	Number of shrimp fishermen within 1 NM	Number of shrimp fishermen between 1 and 2 NM
Westhoek	0	0
De Panne	0	0
Sint-Idesbald	0	0
Koksijde	0	0
Sint-André	2	0
Oostduinkerke	4	1
Groenendijk-Bad	1	0
Nieuwpoort	2	0

Lombardsijde	1	1
Sint-Laureinsstrand	2	0
Westende	3	0
Between Westende and Middelkerke	5	1
Middelkerke	2	0
Raversijde	3	1
Mariakerke	0	0
Between Mariakerke and Oostende	5	1
Oostende	2	0

Figure I.3.8k: Number of shrimp fishermen on the 13th of October 1999 (MUMM 2000).



Beach angling

It is very difficult to assess the intensity of beach angling since very little detailed information exists.

Table I.3.8l gives the qualitative intensities of recreational beach angling found on the Belgian coastal website (Coastal website 2003). The qualitative intensity classes are based on the classification made by ECOLAS. ECOLAS N.V. (2000) made an inventory of all recreational activities (with license duty) in the Belgian coastal and offshore area. A classification of these activities was made based on the frequency of their occurrence during the year. Four categories were made:

- category A: activities that occur throughout the entire year.
- category B: activities that periodically occur between April and October, depending on the weather conditions.
- category C: activities that only occur during the summer season (July-August).

- category D: activities that only occur once in a year.

Table I.3.8l: Qualitative intensities of beach angling in the different coastal towns (Coastal website, 2003).

municipality	Beach angling
De Panne	B
Koksijde	A
Nieuwpoort	A
Middelkerke	B
Oostende	A
Bredene	A
De Haan	A
Blankenberge	A
Zeebrugge	B
Knokke-Heist	B

A recent V.V.H.V. inquiry (2003) (Vlaamse vereniging van Hengelsport Verbonden – Flemish Association for Angling Sport) gives some more detailed information in respect of the intensity of angling on the Belgian coast. However, the inquiry only registers information on the intensity of angling competitions. This only reveals a fraction of angling intensities occurring at sea and from the beach.

Two federations, organizing activities (mostly competitions) at sea/from the beach, are connected to the V.V.H.V., one for sea angling from boats (VVBZ) and one for beach angling (VFK).

Different clubs are associated with these federations. 51 clubs are associated with the VVBZ and 11 clubs are associated with the VFK. VVBZ clubs organize on average 5 sea angling activities per year per club (with an average angling duration of 5-6 hours and a shipping time of 1 hour). VFK clubs organize on average 10 beach angling activities per year per club (with an average angling duration of 4 hours). Table I.3.8m gives an overview of the location of the different clubs and the intensity of their angling activities (competitions). There's no information about the coastal location of the activities organized by the clubs that are not located near the coast (inland clubs).

Table I.3.8m: Overview of the angling activities of the clubs associated with the V.V.H.V. (V.V.H.V. 2003).

	sea boat angling clubs	**Average number of angling activities/year**	**Average number of hours angling/year**	**beach angling clubs**	**Average number of angling activities/year**	**Average number of hours angling/year**
Oostende	2	10	55	1	10	40
Blankenberge	1	5	27.5	1	10	40
Oostduinkerke	1	5	27.5			
Wenduine				2	20	80
Not located near the coast (inland)	47	235	1292.5	7	70	280
Total number	51	255	1402.5	11	110	440

Throughout the year the catches are very diverse, but global trends can be established. One of the most important target species is sole.

- October - March: young cod, whiting, dab and flounder
- April – September: eel, sole and sea bass

Fishing rods are made of carbon; length maximum 5 meters; fishing lines are made of nylon and between 25/00 and 35/00; and sinkers are made of lead with a maximum weight of 200 grams.

8.5 LAND YACHTING

8.5.1 Legislative framework

(updated by Cliquet A.)

Description

Due to the existing federations (e.g. LAZEF vzw) there is a uniform regulation that is applied internationally. This regulation consists of priority rules, a behaviour code and security rules. Besides this international regulation there are also municipal police regulations.

Legislation

(Maes and Cliquet 2005)

Municipal regulations concerning land yachting:

- General Police Regulation of Bredene: All traffic of land yachts, windsurf boards on wheels and other similar equipment that could be a danger for the bathers or beach visitors is prohibited in the dunes and on the beach during the period in which beach guards are active (art. 8.1.10).
- General Police Regulation of De Panne: Art. 87 and 99 (zones, periods), art. 88-90 (conditions), art. 91-95 (competitions), art. 96-98 (courses).
- Police regulation of Knokke-Heist concerning the beach: The use of land yachts and windsurf vehicles is allowed in certain zones during specific time periods (art. 26).
- General Police Regulation of Koksijde : Chapter 33, art. 1 (zones, periods), art. 2, 3 and 4 (conditions), art. 5-8 (competitions).
- General Police Regulation of Middelkerke: Art. 84.1 (zones, periods), art. 84.2-84.3 (conditions), art. 84.4-84.5 (competetions), art. 84.6 (insurance).
- Police Regulation of Nieuwpoort concerning the use of land yachts on the beach: Art. 1 and 2 (zones, periods), art. 3 (insurance), art. 4-5 (conditions).
- Police Regulation of Oostende concerning the beach and the dunes: The use of vehicles and boards on wheels with a sail is only allowed on the beach during the winter season (and only in specific zones) (art. 5).

8.5.2 Existing situation

8.5.2.1 Spatial delimitation

Land yachting is generally limited to beaches in Belgium. This is because beaches are the only locations with suitable surface areas and terrain characteristics. The West coast is the most suitable area for land yachting due to the broadness and hardness of the beaches. It is possible to ride from the harbour of Duinkerke (France) to Groendijk (Oostduinkerke) (Coastal website 2003).

Land yachting can only be executed during low tide and on the hard part of the beach. This means there are conflicts with other beach users (sun bathers ... etc). Conflicts with other users are further diminished because land yachting requires high wind velocities, which is a negative factor for sun bathing and other recreational activities on the beach (Coastal website 2003).

Although conflicts can occur with nature conservation, land yachting only causes minor disturbances through noise, emissions or garbage. In Germany (St. Peter Ording), the Netherlands (Ter Schelling) and the USA (Ivanpah Dry Lake) land yachting even takes place in nature conservation areas (Coastal website 2003).

It is important for the land yachting sport that the current zones can be used in the future and that the possible delineation of nature areas does not restrict the sport. Furthermore a passage should be made through the planned nature conservation zone along the border with France, since competitions are mainly transboundary events. If land yachting was to be prohibited on Belgian beaches the activity would likely disappear due to the absence of alternative areas where the sport can take place (broad and long, with a hard bottom) within Belgium (Coastal website 2003).

8.5.2.2 Type and intensity

Ten clubs organize land yachting with approximately 1000 members. 7 clubs offer the traditional land yachting, in addition to speedsailing and kitesailing (see below). The other 3 clubs only offer speedsailing (Coastal website 2003).

Land yachting can take place the whole year through, but the highest intensities are noticed between September and March (mainly caused by municipal regulations) (Coastal website 2003).

Table I.3.8n gives an overview of the coastal towns where traditional land yachting can take place and the corresponding frequencies.

Table I.3.8n: Location and frequency of traditional land yachting on the Belgian beaches (Coastal website 2003).

Coastal town	Traditional land yachting
De Panne	A
Koksijde	A
Westende	C
Oostende	C
Bredene	B
Blankenberge	C
Zeebrugge	A
Knokke-Heist	B

- category A: activities that occur throughout the entire year.
- category B: activities that periodically occur between April and October, depending on the weather conditions.
- category C: activities that only occur during the summer season (July-August).

Table I.3.8o: Number of land yachting days organized in De Panne and the corresponding number of participants (LAZEF 2003).

	1996	1997	1998	1999	2000	2001	2002
Total number of sport days	72	100	105	106	115	112	134
Number of participants		2855	2436	2811	2406	2606	2658

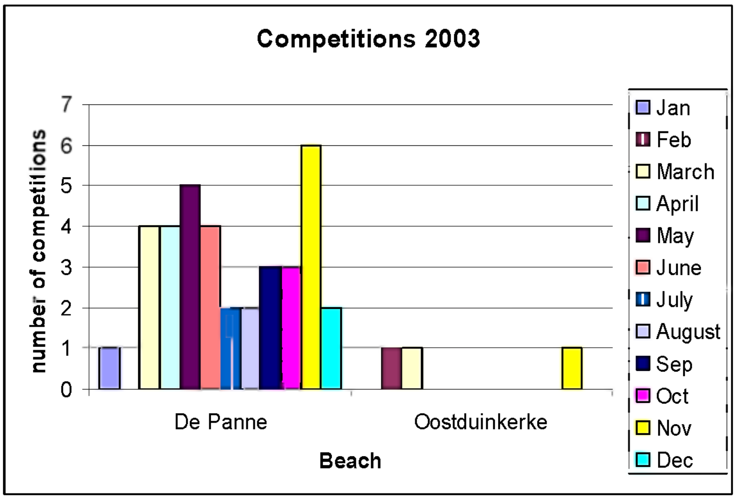
Overview of the national competitions

During these competitions a total distance of 2 km is covered, which comprises two turns (LAZEF (2003). The following table gives an overview of the frequency of the national competitions in De Panne and Oostduinkerke (the only coastal towns that organize such competitions) for 2003:

Table I.3.8p: Overview of the national land yacht competitions for 2003 (LAZEF 2003).

	Number of competitions 2003											
	Jan	**Feb**	**March**	**April**	**May**	**June**	**July**	**August**	**Sep**	**Oct**	**Nov**	**Dec**
De Panne	1	0	4	4	5	4	2	2	3	3	6	2
Oostduinkerke	0	1	1	0	0	0	0	0	0	0	1	0

Figure I.3.8l: Overview of the national land yacht competitions for 2003 (LAZEF 2003).



Special disciplines

Kitesailing:

Kitesailing (also called parasailing) is a kind of land yachting (class 8) whereby a buggy is steered by means of the feet while both hands are needed to operate a kite (LAZEF 2003).

Table I.3.8q: Location and frequency of kite sailing on the Belgian beaches (Coastal website, 2003).

Coastal town	Kitesailing
Koksijde	B
Oostende	A
Bredene	B
De Haan	B
Blankenberge	B
Knokke-Heist	A

- category A: activities that occur throughout the entire year.
- category B: activities that periodically occur between April and October, depending on the weather conditions.

Speedsailing:

A speed sail is a big (usually wooden) skateboard with bigger wheels, a fiberglass mast and a sail/geek resembling that of a wind surfboard.

A speedsail is considered as a class 7 land yacht (land yacht that is driven in standing position and which sail can only stand straight by the presence of the pilot), according to the international division (RIRC – Reglement International de Roulage et de Course – edited by the international federation FISLY) (LAZEF 2003).

Table I.3.8r: Location and frequency of speedsailing on the Belgian beaches (Coastal website 2003).

Coastal town	Speedsailing
De Panne	A
Nieuwpoort	B
Middelkerke	B
Bredene	B
Blankenberge	B
Knokke-Heist	A

- category A: activities that occur throughout the entire year.
- category B: activities that periodically occur between April and October, depending on the weather conditions.

8.6 SPORT ANIMATION ON THE BEACH

8.6.1 Legislative framework

(updated by Cliquet A.)

Description

Only municipal regulations concerning beach animation exist.

Legislation

(Maes and Cliquet 2005)

Municipal regulations concerning beach animation:

- General Police Regulation of Bredene: Chapter 8, 8.3: beach animation is only allowed during certain periods.
- General Police Regulation of De Haan: For the organization of beach and dike animation the permission of the Burgomaster is needed (art. 135).
- General Police Regulation of De Panne: Chapter 21 (organization of beach and dike animation): permission of the Burgomaster is needed (art. 171), periods (art. 172-173), conditions (art. 174-177).
- Police Regulation of Knokke-Heist concerning animation activities on public grounds: It is prohibited to organize animation activities on the beach and in the dunes (art. 1-2). Under certain conditions these activities can be allowed (art. 3).
- General Police Regulation of Middelkerke: The organization of publicity animation on dikes and beaches is limited (at. 41).
- Police Regulation of Oostende concerning the beach and dunes: Animation can only be organized on the beach with the permission of the city council (art. 6).

8.6.2 Existing situation

8.6.2.1 Spatial delimitation

The information on sport animation on the beach is very scarce.

8.6.2.2 Type and intensity

Very little information could be found regarding sport animation frequencies and intensities. The coastal website gives some background information (Table I.3.8s).

Table I.3.8s: Coastal towns where sport animation events are organized, with their corresponding frequency (Coastal website 2003).

Coastal town	Sport animation
Koksijde	C
Bredene	B
Blankenberge	B

- category B: activities that periodically occur between April and October, depending on the weather conditions.
- category C: activities that only occur during the summer season (July-August).

8.7 HORSEBACK RIDING

8.7.1 Legislative framework

(updated by Cliquet A.)

Description

Horseback riding takes place on the beaches and in the dunes of some coastal towns and is therefore mainly considered in municipal regulations.

Legislation

(Maes and Cliquet 2005)

- Decision of the Flemish Government of 26 April 1995 concerning the beach concessions, *BS* 29 August 1995: It is only possible to prohibit the exclusion of horseback riding on the beaches or in the dunes during the bathing season (July-August) (art. 8).

Municipal regulations concerning horseback riding:

- Police Regulation of Blankenberge concerning horseback riding on the beach and in the dunes: Horseback riding is prohibited during the summer season, except on the established bridle paths.
- General Police Regulation of Blankenberge: During the bathing season access to certain beach zones is denied to horses, donkeys and harnessed coaches (art. 192).
- General Police Regulation of Bredene: All traffic with horses and mounts is prohibited in the whole dune area, unless on the established bridle paths. Horses are only allowed on the wet beach outside the summer months (art. 9.3.1 and 9.3.2).
- General Police Regulation of De Haan: Horseback riding is prohibited on the beach at high tide and during daytime in the summer period. It is also restricted in certain periods and zones in dunes (art. 165-167).
- General Police Regulation of De Panne: All traffic with horses and mounts is prohibited in the whole dune and forest area, unless on the established bridle paths (art. 49 and 57). There are also restrictions for horseback riding on the beach during the summer season (art. 50).
- Police Regulation of Knokke-Heist concerning traffic with mounts on the beach, in the dunes, in the forest and on the public roads: All traffic with horses and mounts is prohibited in the dunes and forest, unless on the established bridle paths (art. 1), and during the summer season in certain beach zones (art. 2).
- General Police Regulation of Koksijde: All traffic with horses and mounts is prohibited in the whole dune area, unless on the established bridle paths (Chapter 22, art. 1). During the summer season all traffic with horses and mounts is prohibited on the beach and in the beach water (art. 2).
- General Police Regulation of Middelkerke: All traffic with horses and mounts is prohibited in the whole dune area. All traffic with horses and mounts is restricted on the beach in certain periods and zones.
- Police Regulation of Nieuwpoort concerning access of horses on the beach: Horseback riding is prohibited on the beach in the summer season from 8.00 am until 19.00 pm (art. 1). Ponies accompanied by an authorised person are allowed (art. 2).

- Police Regulation of Oostende concerning animals: All traffic with horses and mounts is prohibited in certain zones and periods on the beach. It is also probibited in dunes, except on the established bridle paths (art. 6-7).
- Police Regulation of Zeebrugge on sea bathing: All traffic with horses is prohibited from 9.00 am until 19.00 pm on the beach and in dunes during the summer season (art. 11).

8.7.2 Existing situation

8.7.2.1 Spatial delimitation

Horseback riding only occurs in certain coastal towns.

8.7.2.2 Type and intensity

Horseback riding can be done in Koksijde, Oostende, Bredene, De Haan and Zeebrugge and frequencies are given on the coastal website (table I.3.8t).

Table I.3.8t: Coastal towns where organized horseback riding takes place, with the corresponding frequency (Coastal website 2003).

Coastal town	Horseback riding
Koksijde	B
Oostende	C
Bredene	C
De Haan	B
Zeebrugge	B

- category B: activities that periodically occur between April and October, depending on the weather conditions.
- category C: activities that only occur during the summer season (July-August).

8.8 OTHER (UNORGANISED) BEACH RECREATION

8.8.1 Legislative framework

(updated by Cliquet A.)

Description

Other beach recreation (which is not organised by federations) includes sunbathing, playing, beach animation, walking … etc.

Legislation

(Maes and Cliquet 2005)

Regulations concerning sunbathing/swimming:

- Royal Decree of 4 August 1981 on a police and shipping regulation for the Belgian territorial sea, the ports and beaches of the Belgian coast, *BS* 1 September 1981; as amended: It is prohibited to swim or bath in the harbours of the Belgian coast (art. 44).

Municipal regulations concerning the geographical and temporal delineation of the (guarded) swimming zones/sun bathing areas:

- General Police Regulation of Blankenberge: Art. 171 and 172.
- General Police Regulation of Bredene: Chapter 8, 8.1.
- General Police Regulation of De Haan: Art. 127-128.
- General Police Regulation of De Panne: Chapter 19, art. 141-143.
- Police regulation of Knokke-Heist concerning the beach: Chapter 1, art. 2-4.
- General Police Regulation of Koksijde: Chapter 26, art. 1-3.
- General Police Regulation of Middelkerke: Art. 76-77.
- Police Regulation of Nieuwpoort concerning sea bathing: Art. 1-2.
- Police Regulation of Oostende concerning the beach and dunes: Art. 1.
- Police Regulation of Zeebrugge on sea bathing: Art. 1-2.

Regulations concerning beach cabins:

- Decision of the Flemish Government of 26 April 1995 concerning the beach concessions, *BS* 29 August 1995: There's no permission from the Flemish Minister for Public Works needed to locate permanent or movable beach cabins on the beach (art. 6, 3). The concession holders have to ask permission to use a proposed zone for the installation of beach cabins to the Ministry of the Flemish Community (department LIN, AWK).

Municipal regulations concerning beach cabins:

- General Police Regulation of Blankenberge: Art. 173-181; Police Regulation concerning windscreens on the beach.
- General Police regulation of Bredene: Chapter 8, 8.2.
- General Molice Regulation of De Haan: Art. 136.
- General Police Regulation of De Panne: Art. 151, art. 157-170.
- Police Regulation of Knokke-Heist concerning the beach: Art. 12, art. 14-16 (beach tents).
- General Police Regulation of Koksijde: Chapter 25 on beach cabines and beach tents.
- General Police Regulation of Middelkerke: Art. 78 on beach cabines and wind screens.
- Police Regulation of Oostende concerning the beach and dunes: Art. 7 (wind screens).
- Police Regulation of Zeebrugge concerning sea bathing: Art. 7-10 (beach cabines).

Regulation concerning vehicles on the beach:

- Municipal regulations concerning vehicles on the beach and in the dunes: All traffic with motorized vehicles in the dunes and on the beach is prohibited in the following coastal towns (Bredene, De Panne, Knokke-Heist, Koksijde, Middelkerke, Oostende, Zeebrugge). In certain municipalities an exception is made for vehicles of public services.

8.8.2 Existing situation

8.8.2.1 Spatial delimitation

There are no specific data available for these unorganised activities.

Unorganised recreational use of the beaches and dunes often conflicts with the main environmental goals for beaches, dunes and the sea. This includes such things as coastal defense and preservation of the natural environment.

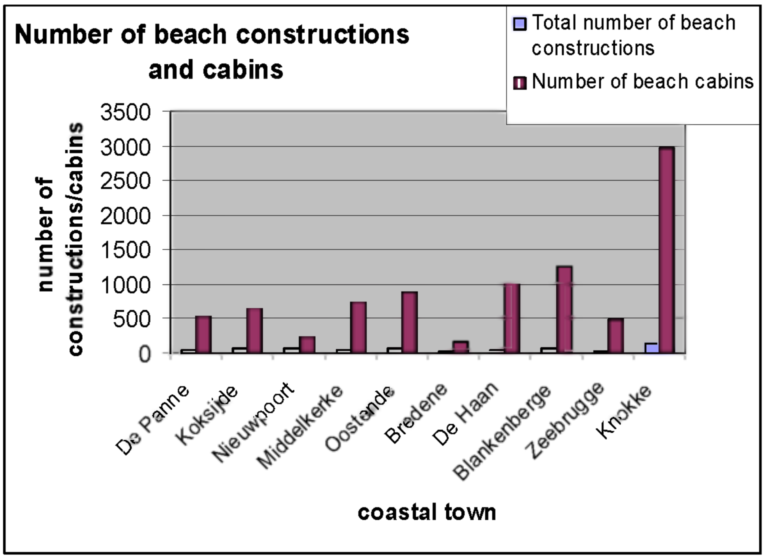
The increasing growth of coastal towns and holiday residencies next to the coastline has led to an increasing number of activities on the beach. These activities and related structures are largely spread along the beaches. People often gain access to different areas along a beach through the beach dunes. However, passage through the dunes results in the trampling of vegetation and has negative effects on the natural coastal defenses of a beach.

There's an increasing demand for the establishment of permanent structures on the beach, which cause much visual disturbance. Further, temporary structures are usually made of inappropriate materials and in a bad state of repair (PSEP 2003).

8.8.2.2 Type and intensity

PSEP (2003) made an inventory of the different types of constructions on beaches. Beach cabins were identified as one category of construction (Figure I.3.8m; also see § i 'Tourism'). Tourists usually use cabins to store recreational equipment. The number of such cabins on the beaches of the different coastal towns can be used to estimate the intensity of the unorganised beach recreation on these beaches.

Figure I.3.8m: Number of beach constructions and cabins in the different coastal towns (PSEP 2003)



8.9 INTERACTIONS APPLICABLE TO ALL SUBUSES

8.9.1 Suitability for user

Details – if applicable – can be found in the chapter that is specifically dedicated to "Suitability".

8.9.2 Impact on other users

Details – if applicable – can be found in the chapter that is specifically dedicated to "Interaction among users".

8.9.3 Impact on environment

Details – if applicable – can be found in the chapter that is specifically dedicated to "Interaction between users and the environment".

Biological

- High intensity of tourism and recreation can disturb the benthos of the beaches and the birds residing in the area.
- Noise impact
- Solid waste

Geophysical impact

- Disturbance of the sediment by recreational activities
- Solid waste

8.9.4 Impact on socio-economy

Details concerning the socio-economic importance of tourism in the coastal area can also be found in the final report of the MAREDASM project (Maes et al. 2002).

Economic

Commercial accommodations (hotels, camping accommodations, holiday centres, holiday villages) (Westtoer 2002):

Overall turnover based on the estimated average expenses per overnight stay:

- 1992 overall turnover = € 327600000
- 2000 overall turnover = € 341800000

Individual holiday rental homes (Westtoer 2002):

- 1992 overall turnover = € 424400000
- 2000 overall turnover = € 322500000

Second residencies (Westtoer 2002):

Almost no information on expenses during overnight stays in second residencies exists. Therefore an estimate of the overall turnover was based on hypotheses of expenses corresponding with those of commercial accommodations.

- 1992 overall turnover = € 300400000
- 2000 overall turnover = € 425000000

One day tourism (Westtoer 2002; Flemish Ministry of Employment and Tourism 2004):

No accurate and scientifically based data is available concerning the revenue generated by one-day tourism in the coastal towns. The following estimates of the total turnover made by one-day tourism are generated by using hypotheses on the expense patterns of the tourists (Westtoer 2002).

- 1992 overall turnover = € 469000000
- 2000 overall turnover = € 507000000

These estimates are based on the estimated number of day tourists stated by Westtoer (2002).

The statement of the Flemish Minister of Employment and Tourism (2004) gave the following estimate of the overall turnover made by one-day tourism:

- 2003 overall turnover = € 675000000

This number is based on an average expense of 35 € per person/day (estimated after an inquiry of 11,000 day tourists done by Westtoer).

Other sources (e.g. WES) calculated different numbers of day tourists, which makes it very difficult to draw conclusions on the extent and turnover of this activity. Further research is needed to determine the socio-economic importance of one-day tourism to the coast.

Social

Employment in the tourist/recreational sector (Westtoer 2002; Samuelov 1999):

Although incomplete, the only available dataset on employment in the tourist/recreational sector comes from the Provincial Service for Tourism and Recreation (Westtoer 2002). Employment due to tourism and recreation is generated by different sectors. Because it is difficult to separate the employment due to tourism and from that linked to local population, only those sectors with a direct link to tourism and recreation are included:

- accommodation facilities
- restaurants and bars
- real estate agencies
- recreation facilities

Not included are:

- shops
- bakeries
- hair dressers
- supply companies (indirect employment)

The number of registered compensated employers in the tourist/recreational sector of the coastal area is given in table I.3.8u.

Table I.3.8u: Number of registered compensated employers in the tourist/recreational sector in the coastal area (Westtoer 2002; Samuelov 1999).

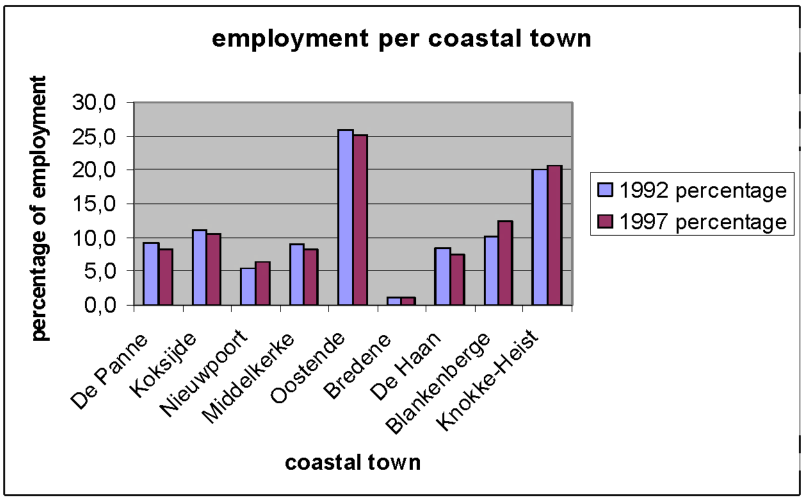
Sectors	1992	1997	2000
Accommodation (1)	2724	2689	2562
Restaurants and bars (2)	3120	3531	3923
Real estate agencies (3)	1085	1099	1102
Recreation (4)	873	950	1023
Total	7784	8269	8610

These numbers can be divided over the different coastal towns, and can give an idea of the socio-economic importance of the tourist/recreational sector for these towns (Table I.3.8v, Figure I.3.8n).

Table I.3.8v: Numbers of registered compensated employers in the tourist/recreational sector in the different coastal towns (Westtoer 2002; Samuelov 1999).

	1992						**1997**					
	1	**2**	**3**	**4**	**total**	**%**	**1**	**2**	**3**	**4**	**total**	**%**
De Panne	211	289	60	161	721	9.1	195	276	53	153	677	8.2
Koksijde	396	331	126	17	870	11.0	340	384	122	22	868	10.5
Nieuwpoort	223	126	68	6	423	5.4	303	150	62	5	520	6.3
Middelkerke	172	213	149	170	704	8.9	150	277	130	132	689	8.3
Oostende	604	913	278	246	2041	25.9	604	917	300	251	2072	25.1
Bredene	38	40	4	5	87	1.1	33	45	9	6	93	1.1
De Haan	433	167	57	1	658	8.3	351	209	62	1	623	7.5
Blankenberge	251	339	42	161	793	10.1	371	406	47	204	1028	12.4
Knokke-Heist	396	702	301	188	587	20.1	342	867	314	176	1699	20.5
total	2724	3120	1085	955	7884	100	2689	3531	1099	950	8269	100

Figure I.3.8n: Numbers of registered compensated employers in the tourist/recreational sector in the different coastal towns (Westtoer 2002; Samuelov 1999).



All coastal towns have the same percentages of compensated employment in 1992 and 1997, so the employment due to tourism and recreation seems not to have changed drastically over the years. This factor can be used to extrapolate the intensity of tourism/recreation in the different coastal towns.

Independent direct employment in the tourist/recreational sector:

Next to registered compensated employment, independent direct employment also occurs in the coastal area. These persons are mainly involved in restaurants, bars and in the entertainment sector (Table I.3.8w).

Table I.3.8w: Number of independent employers in the tourist/recreational sector in the coastal area (Westtoer 2002; Samuelov 1999).

Sectors	**1995**	**2000**
Restaurants and bars	1771	1605
Entertainment	169	264
Total	1940	1869

No detailed numbers per coastal town are available for this kind of employment.

In 2000 a total of 10479 persons were employed in the tourist/recreational sector.

Beach fisheries/shrimp fisheries:

Due to the limited amount of information concerning beach fishing/shrimp fishing it is not possible to make a socio-economic assessment of this activity. Another inquiry done by the V.V.H.V. (2002) investigated the socio-economic importance of beach angling but also that of all other angling disciplines (also angling in freshwater environments). Table I.3.8x gives an overview of some results of the inquiry.

Table I.3.8x: Results of V.V.H.V. inquiry (2002), compared to information from 1997.

	1997	**2001**
Total number of respondents	2348	1430
Percentage of beach anglers (from beach, dikes, … etc)	17 %	14.5 %
Percentage of sea anglers (from boats)	20 %	17 %
Number of beach anglers	399	207
Number of sea anglers	470	243

Anglers normally practice more than one angling discipline. In 1997 anglers practiced on average 2.3 disciplines and in 2001 this was on average 2.4 disciplines.

Taking this into consideration it is possible to calculate the chance that a certain discipline is executed at a certain moment in time (Table I.3.8y).

Table I.3.8y: Estimates that sea or beach angling was performed in 1997 and 2001 (V.V.H.V. 2002).

	1997	**2001**
Total number of respondents	2348	1430
Chance for beach angling (from beach, dikes … etc)	7.4 %	6.0 %
Chance for sea angling (from boats)	8.7 %	7.1 %
Total chance for beach + sea angling	16.1 %	13.1 %

When taking into account the number of anglers that obtained a fishing permit in 2001 (40000) and the percentage of respondents (40%) that had such permits, it is possible to calculate the total number of anglers in 2001, namely 175000. Since the inquiry was not representative of occasional anglers, which fish less than 10 times a year (only 1.7 % of the respondents), the total number of anglers in 2001 is definitely underestimated. Nevertheless, the total number of anglers can still be used as a guide to estimate percentages for different disciplines (Table I.3.8z).

Table I.3.8z: Numbers of beach and sea anglers in 2001 (V.V.H.V. 2002)

Discipline	Percentage	Number
Beach angling	6.0 %	10500
Sea angling (from boats)	7.1 %	12425
Total beach + sea angling	13.1 %	22925
Total angling	100 %	175000

Flemish anglers spent on average € 600 per year on their hobby in 2001. This amount includes that of angling material, bait and feeders, membership costs, permit costs, travel costs, boat rental, specific clothing, purchase of specific sport magazines, and books … etc. This gives the following turnover:

Table I.3.8aa: Total turnover for the different sea angling disciplines in 2001 (V.V.H.V. 2002).

	Beach angling	**Sea angling**	**Beach + Sea angling**
Total turnover (€)	6300000	7455000	13755000

Other sub-uses:

There are no socio-economic data available for land yachting/sport animation/horseback riding and other (unorganised) beach recreation.

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ECOLAS Environmental Consultancy & Assistance
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9 RECREATION AND TOURISM AT SEA

9.1 LEGISLATIVE FRAMEWORK

9.1.1 Spatial delimitation

Competent authority

General:

- Ministry of Social Affairs, Public health and Environment
- Ministry of Flemish government, competent for Agricultural affairs

Water-ski:

- Ministry of Transportation and Infrastructure, Directorate Maritime Affairs and Shipping, Shipping policy
- Ministry of Flemish government, Department of Environment and Infrastructure, Waterways and Maritime Affairs Administration, Unit Coastal waterways

Water scooters and jet ski:

- Ministry of Transportation and Infrastructure, Directorate Maritime Affairs and Shipping

Legislation

(Cliquet et al. 2004 ; Maes and Cliquet 2005)

International legislation:

- Council Regulation (EC) No 850/98 of 30 March 1998 for the conservation of fishery resources through technical measures for the protection of juveniles of marine organisms, *Official Journal L* 125 , 27 April 1998: This Regulation describes technical measures like mesh size, minimum share of target species for specific fisheries.
- Council Directive 76/160/EEC of 8 December 1975 concerning the quality of bathing water, *Official Journal L* 031 , 5 February 1976: This directive concerns the quality of water destined for therapeutic use and the water of swimming pools.

National legislation:

- Royal Decree of 4 August 1981 concerning a Police and Shipping Regulation for the Belgian territorial sea, the ports and beaches of the Belgian coast, *BS* 1 September 1981, as amended.
  - Competitions are forbidden in the Belgian territorial sea and in the marinas of the Belgian coast, except where a license has been obtained (art. 38, § 1 en 2). Along the beaches of the Belgian coast no vessel can depart into the sea unless departing from the places indicated by officials of the Waterways and Maritime Affairs Administration and within the limits determined by them (art. 39, § 1). A vessel can only come within 200 metres of a beach in the case of force majeure (art. 39, § 2).

- It is forbidden to fish in the fairways of the marinas and on the roads of those marinas. Fishing with square fishing nets or with fishing rods from the coastal defense structures of marinas is permitted where it does not disturb navigation (art. 10, §11). Article 40 settles fishery on the beaches.
- Nobody may, voluntarily nor involuntarily, endanger the safety of navigation or slow down this navigation by negligence or incapacity.
- Competitions are forbidden in the Belgian territorial sea and in the marinas of the Belgian coast, except for those having a license (art. 38, § 1 and 2). Along the beaches of the Belgian coast no vessel can depart into the sea unless departing from the places indicated by officials of Waterways and Maritime Affairs Administration and within the limits determined by them (art. 39, § 1). A vessel can only come within 200 metres of the beach in the case of superior power (art. 39, § 2).
- Pleasure crafts (a.o. kayaks) with a total length of ≤ 6 m, are prohibited to launch into sea with an offshore wind of ≥ 4 beaufort or an on-shore wind of 3 beaufort.
- Surfboards are prohibited to launch into sea when the wind blows 7 beaufort or more. Windsurfing is prohibited between sundown and sunrise (art. 37 bis). The practising of windsurfing is forbidden in the harbours of the Belgian coast (art. 38, §2). Surfboards cannot remove themselves more then half a sea mile from the coast (art.19, §1).
- The law regulating the maximum wind speed allowed for windsurfing initially caused problems of a practical nature . However, the law was recently changed and it now allows windsurfing up to a wind speed of 8 beaufort if the wind is offshore. The problem is that the responsibility was put on the several water sports associations. There is, however, no possibility to launch a rescue boat into the sea at a wind speed of 6 beaufort or above. The proposition is therefore to let the windsurfers practise their sport on their own risk, which also exists for sailing. The clubs can then decide themselves when they can't guaranty safety any longer and communicate this to their members (red flag). Whoever surfs during these times does so at their own risk, and the costs of any rescue will be imposed on that individual.
- In virtue of article 44 it is prohibited to swim or bath in the ports of the Belgian coast.
- Along the Belgian beaches vessels are prohibited to launch into sea except from the places indicated by officers of the management of waterways and within the borders appointed by them. Vessels may approach the coast up to a distance of less than 200 m above the low waterline at these places.
- Practising surf kayaking is only allowed in recognised water sport centres.
- Sailboats are not allowed to navigate (ply against the wind) in the fairways of the harbours of the Belgian coast or in the waters of these harbours. If they're equipped with mechanical driving forces, they ought to use these (art. 10, §9).
- Pleasure crafts take the shortest way to reach their destination in the Belgian harbours, without endangering the safety of navigation.
- Sailing courses can be organised in the harbours of the Belgian coast after being granted a license (art. 38, § 3).
- Along the beaches of the Belgian coast no vessel can depart into the sea unless departing from the places indicated by officials of the Waterways and Maritime Affairs Administration and within the limits determined by them (art. 39, § 1).
- A vessel can only approach the beach within 200 metres in case of "force majeur" (art. 39, § 2).
- Practising water-skiing in the harbours of the Belgian coast is prohibited (art. 38, §2).
- Pleasure vessels of less then 6 metres cannot launch into the sea when the offshore wind is 3 Beaufort or more or when the on-shore wind is 4 Beaufort or more (art.37,§1).

- Royal Decree of 14 August 14 1989 to establish additional national measures for the conservation and the management of fish stocks and for the control of fishing activities, *BS* 2 September 1989, as amended.
  - This enactment comprises additional measures in consideration of the compliance of EC-regulations concerning the conservation and management of fish stocks. The modifying enactment of 1996 comprises a distinguished restriction of sport fishery, in consideration of the protection of professional fishery.

- Law of 20 January 1999 on the protection of the marine environment in the marine areas under Belgian jurisdiction, *BS* 12 March 1999; as amended.
  - The King can take measures, proposed by the minister authorised for the protection of the marine environment and the minister of Agriculture, to restrict sport fishery in the sea areas (art.12, §2).
  - This law is meant to maintain biodiversity, the unharmed character and the nature of the marine environment. By this law every person practising an activity in the marine zone, is compelled to take the necessary precautionary measures to prevent damage and disturbance of the environment. Article 25 of the law for protection of the marine environment describes which activities are obligated to have a license.
  - Angling at sea with fishing boats need to suffice Royal enactment regarding the nautical inspection. Sport activities practised in-groups do need admittance of 'Service coastal waterways' or 'Piloting services'.
  - This law is meant to maintain biodiversity, and the unharmed character and nature of the marine environment. By this law every person practising an activity in the marine zone, is compelled to take the necessary precautionary measures to prevent damage and disturbance to the environment. Article 25 of the law for protection of the marine environment describes which activities are obliged to have a license.

- Royal Decree of 4 June 1999 concerning 1° the enrolment and registration of pleasure boats; 2° the Royal Decree of 4 April 1996 concerning the registration of seagoing ships and 3° amending the Royal Decree of 4 August 1981 concerning the Police and Shipping Regulations for the Belgian territorial sea, the harbours and the beaches of the Belgian coast, BS 14 August 14 1999.
  - Article 1 defines "pleasure vessel": a "vessel" with an overall length between 2,5 and 24 metres that is or is not used for profitable operations, in whichever form, does recreational navigation or is intended for it, with exception of vessels used or intended for the transport of more then 12 passengers.

Regional legislation:

- Decision of the Flemish Government of 26 April 1995 concerning beach concessions, *BS* 29 August 1995:
  - o The Flemish minister of public works or his deputy must give permission for the launching of vessels from beaches (art. 6, 2e).
  - o The concessionaire is obligated to keep the beach accessible at all times for rescue services (art.8, 5e). Concessionaires exploiting sea bathing areas ought to organise a rescue service to help drowning persons pursuant to article 9.
  - o The Flemish minister of public works or his deputy must give permission to launch vessels into the sea from the beaches (art. 6, 2^e).

Municipal regulations:

The following municipal regulations defines zones where non-motorised water sports can take place, and the specific conditions on how they can take place (qualifications, weather, dress … etc).

- Police Regulation of **Blankenberge** of 9 June 1987 concerning the launching into sea from the beach of surfboards, pleasure vessels and other gear for beach amusement; General Police Regulation of Blankenberge: Art. 200.
- General Police Regulation of Bredene: Art. 8.4- 8.5,
- General Police Regulation of De Haan: Art. 143.
- General Police Regulation of De Panne: art. 87-99, art. 178-184.
- Police Regulation of Knokke-Heist concerning the beach: Chapter 3.
- General Police Regulation of Koksijde: Chapter 19, Chapter 33.
- General Police Regulation of Middelkerke: Art. 84, 86-93.
- Police Regulation of Nieuwpoort concerning sea bathing.
- Police Regulation of Oostende concerning water sport activities launched from the beaches; Police Regulation of Oostende concerning pleasure vessels.
- Police Regulation of Zeebrugge concerning surfing from the beach.

The following municipal regulations define zones where motorised water sports are allowed, as well as the specific conditions (qualifications, weather, dress, etc.) under which the activities can take place.

- Police Regulation of Blankenberge concerning the launching of surfboards, pleasure vessels and gear from the beach for beach amusement.
- General Police Regulation of Bredene: Art. 8.6.
- General Police Regulation of De Haan: Art. 142, art. 143.8-9.
- General Police Regulation of De Panne: Art. 185-190.
- Police Regulation of Knokke-Heist concerning the beach: Art. 18, art. 24.
- General Police Regulation og Koksijde: Chapter 26, art. 12.
- General Police Regulation of Middelkerke: Art. 86
- Police Regulation of Oostende concerning water sport activities launching from the beach.

<u>Flexibility</u>

There is no flexibility permitted concerning the above regulations. Sea kayaking is only permitted in the designated areas and in accordance with the determined measures. Swimming is not permitted in any zones other than the prescribed bathing zones. Safety is only ensured in these zones by rescue services. The effectiveness of the guarded zones is illustrated by the fact that in the past 3 years there have been no drowning in guarded zones during the supervised times. Launching of pleasure boats from the beach into sea is only allowed in the designated areas and in compliance with the conditions of the regulation.

<u>Future perspectives</u>

No legal regulations have been put into place concerning the installation of fixed beach accommodations. Nevertheless 13 of the 15 clubs have a permanent building at their disposal, which has been permitted. Permanent buildings are necessary for hygienic and didactical reasons. The province of West-Flanders made (under mandate of AWZ) an inventory of all constructions on the beach and the dike in June 2000. This is called the 'Planning and legal framework for the use of the beach, dike and seawall' (Terra Coastal Zone Management 2000). Following its completion several hearings were organised to come to discuss the completed report and proposed regulations. It is anticipated the province will shortly submit proposed regulations to the Flemish Community.

The law concerning non-profit associations is creating problems with respect to sourcing more existing accommodation in coastal areas. All water sports associations are encouraged to open up their accommodation to non-members, and especially to tourists. The law concerning non-profit associations doesn't allow non-members to be charged, because this is then as a commercial activity. A solution needs to be found to this problem.

9.1.2 Intensity and frequency

Intensity/frequency per area-unit

Angling practitioners are subject to capturing minimum sizes. The capture of codfish and sea perch is limited to a maximum of 15 kg codfish and 5 kg sea perch per person per day.

Flexibility:

The allowed catch (quota) is determined every year.

9.2 ANGLING AT SEA

9.2.1 Description

This activity involves angling from a boat. Other types of "recreational fishery", for example the collection of mussels or other shellfish on the coast or BPNS, are not taken into account here.

Angling from a boat can be organised by private persons, angling associations or by commercial companies. According to the Ecolas inventory (2000) this activity is mainly organised by private persons.

Although recreational fishing is a nature-oriented form of outdoor recreation, the extent to which nature forms part of the experience varies according to the user. Some anglers are very focused on nature and peace, while others practise angling as a competition sport (sport fishermen).

The angling associations are not as large as the yachting-, sailing- and surfing clubs and are mainly occupied with the organisation of competitions. These associations don't have their own clubhouses on the beach or in the marina.

9.2.2 Subuses and description

Not applicable.

9.2.3 Existing situation

9.2.3.1 Spatial delimitation

Angling at sea from a boat is allowed 200 m above low waterline. Estimates of the spatial distribution of sports fishing at sea are based on the observations of the Institute for Nature Conservation.

Source

These results are based on data obtained from VVHV (Vlaamse Vereniging van Hengelsport Verbonden), the Flemish union of angling sport associations.

Other sources are:

Ecolas (2000)

Resource Analysis (2003)

V.V.H.V. (2002)

EAA (European Anglers Association) (2002)

Reliability margin

Data obtained from an inquiry of the VVHV, the Flemish union of angling sport associations, comprised their records of organised competitions.

The Ecolas report (2000) was based on a survey the tourist services in the coastal municipalities, the licenses supplied by 'Service Coastal Waterways of the Waterways and Maritime Affairs Administration of the Ministry of the Flemish government' and by 'Piloting Services' and the concerned legislation.

The data used for the spatial distribution of sport fishing at sea was extracted from the bird observation data collected by the Institute for Nature Conservation. During bird surveys records were also taken of the types of fishing vessels observed in the neighbourhood. This is not 100% reliable as the spatial distribution of sport fishery is dependent on the route of the bird surveys and the bird observer. Nevertheless, a rough picture of the distribution of sport fishing on the BPNS was obtained. Other data sources for sport fishing at sea were not available.

9.2.4 Type and intensity

Intensity per surface-unit

25% of the total inventory of public and commercial activities on the coast (Ecolas 2000) is related to angling (Map I.3.9a).

Angling related activities are most prevalent in Oostende and Nieuwpoort. However, they are also dispersed over the other municipalities (Ecolas 2000).

In 2000 there were a total of 20 angling associations, private persons or companies organising angling at sea. Eight of them were in Oostende, 5 in Nieuwpoort, 2 in Knokke-Heist and one company in Blankenberge, Bredene, De Haan, De Panne and Zeebrugge.

The VVHV (Vlaamse Vereniging van Hengelsport Verbonden), the Flemish Association for Sports angling has approximately 16000 members (salt and fresh water anglers) of an estimated total of 200000 angling sport practitioners (this is approximately 3.3% of the Flemish population). According to the memberships list of the VVHV there are 51 clubs that operate boats, which are grouped in the VVBZ (Vlaams Verbond Boothengelen op Zee), the Flemish association for boat angling at sea. The VVHV has 55 boats (with approximately 50 to 60 navigation days), which can each take up a maximum of 5 persons on board on each trip V.V.H.V 2002).

In the period 1997-2001 the number of members of the boat angling sports federation decreased by 20%. The VVHV estimates there are approximately 14000 boat anglers in Flanders.

These sport fishermen are mainly active closer to the coast. Reference is made to the location and intensity in the maps included in this report.

Frequency per unit of time

According to VVHV (V.V.H.V 2002), their associated clubs each organise on average 5 angling activities per year. The mean duration of a trip is approximately 5 to 6 hours, excluding the navigation time (which is about 1 hour).

During winter months (October till April) the angling activities mainly take place in an area of 5 or 6 mile from the coast. Competitions during summer months and under good weather conditions can take place on or just over the "Gootebank". This is the most distant location chosen by the organisation.

During winter months 'cod', 'whiting' and 'dab' are caught. In the summer mainly 'sole', 'whiting', 'dab' and 'mackerel' are captured.

In 2002 the number and weight of the captures during 32 boat angling competitions of VVBZ (Vlaams Verbond Boothengelen op Zee) were recorded (this is a sample of approximately 2/3 of all VVBZ competitions). In total 1400 fishermen participated and there was a total of 180 fishing-hours. Overall 31948 fish were captured representing a total weight of 8454 kg. This means an average of 23 fish were caught per participant. The average (total) weight caught per contestant was 6kg. This is a mean fish weight of approximately 265g.

The total amount of fish officially caught during offshore competition can thus be estimated to be in the range of 10 – 15 ton.

- Division according to time:

Activities related to angling occur during the whole year, depending on weather conditions. It goes without saying that during the winter months and bad weather no angling sport activities are practised.

- Division according to nature and time:

Angling activities organised along the coast by angling associations and angling trips at sea organised by private persons or companies almost all occur year-round (17 of the 20) in Oostende and Nieuwpoort and Knokke-Heist. There also are 2 angling activities (in Oostende) that occur periodical (April-October, depending on the weather) and one angling activity (in De Panne) in the category of one-time activities.

9.2.5 Interactions

9.2.5.1 Suitability for user

Details – if applicable – can be found in the chapter that is specifically dedicated to "Suitability".

Biological adequacy

No restrictions

Geological/physical adequacy

No restrictions

Hydrological adequacy

No restrictions

9.2.5.2 Impact on other users

Details – if applicable – can be found in the chapter that is specifically dedicated to "Interaction among users".

There is a conflict between recreational anglers at sea and professional fishermen. Professionals accuse recreational anglers of fishing a 'large' part of their quota. The recreational fishermen dispute this allegation and are extremely unhappy about the recent quota that has been imposed on codfish and sea perch to a maximum of 15 kg codfish and 5 kg sea perch per person per day. This has an economic impact on commercial operators within the recreational fishery.

9.2.5.3 Impact on environment

Details – if applicable – can be found in the chapter that is specifically dedicated to "Interaction between users and the environment"

Biological

The catches are very diverse throughout the year, but global trends can be established. From October till March the main preys are young cod, whiting, dab and flounder, while from April to September they catch sole, dab, whiting and mackerel.

It would appear, looking at the estimates, that recreational fishing has a small effect on the available fish stocks. In addition, an effect on the benthos can be expected.

Geological/physical

No/little impact

Hydrological

No/little impact

9.2.5.4 Impact on socio-economy

Economic

The numbers of fishing permits issued in Flanders since 1984 has decline.

A recent inquiry (n= 1430) by the Flemish Association for Sports angling (VVHV) (NELOS, Rudi Baert pers. comm. 2004) indicates that a boat angler spends approximately 900 Euro/year on its hobby[1]. This figure multiplied with 14000 boat anglers comes to 12.6 Mio Euro/year. This comprises boat rental, carrion, material costs, membership fees, licenses, accommodation and transportation costs, specific dress, purchase of specialised magazines, books, videos, etc.

Another conclusion of the VVHV inquiry is that a lot of boat anglers (who spend on average 900 Euro yearly, which is more then the 600 Euro spent yearly by an angler of another discipline) often practise their hobby in foreign countries, which means a 'loss' for the Flemish economy.

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[1] This inquiry is representative for frequent (approximately 45 fishing trips a year) Flemish anglers. It is not representative for the "occasional" angler who goes fishing less then 10 times a year

A survey of the Province of West-Flanders (1998) pointed out that fishermen go fishing in public waters on average 18 times a year and spend 9-10 Euro per trip (apart from the expenditure for basic materials). In total this annually amounts to 11.6 million Euro of cumulated expenditures.

The Ecolas report (2000) indicates the estimated returns of angling at sea amounts to 2.487 Mio Euro (Table I.3.9a). This is a significant part (29.2%) of the total yearly turnover (8505174 Euro) generated by all commercial and public activities inventoried at the coast in 2000. Angling associations mainly organise competitions on a non-profit basis. So the angling associations are not included in the assessment of the yearly turnover in this report.

Table I.3.9a: Overview of the assessment of the returns of angling at sea (Ecolas 2000)

Initiator	estimated numbers of days active / year	Cost price (Euro)	estimated number op participants	Return (Euro)
Vyvey-Noukens E	237	44.62	6	63517
Bvba Rederij Sportfishing	85	29.75	84	211915
De sportvissers	237	29.75	46	324677
Ship Technics bvba	237	44.62	10	105861
Nieuwpoort onbekend 1	237	44.62	10	105861
Nieuwpoort onbekend 2	237	34.71	10	82349
De sportvissers Albatros	237	29.75	46	324677
Ostend Jade	237	57.02	12	162336
Vzw PUB	192	24.77	12	57070
Bounty 1	237	29.75	35	247037
Bounty 2	237	24.79	48	282309
Sportvissers Marcella	42	32.23	43	57653
Franlis-Seeger Sunships	42	29.75	39	48266
Bvba Sunships	85	24.79	39	81985
Callebout Patricia	237	24.79	10	58814
Biervliet D	85	29.75	46	116049
Vermeulen E	292	44.62	12	156348
			TOTAL	2486724

It has to be noted that although information and several studies are available on the general socio-economic aspects of recreational fishing and angling, there are significant data gaps concerning angling in the Belgian sea.

Social

Activities correlated with angling are distributed over the whole year. Angling at sea has a largely fixed clientele. The angling associations tend to be regional. This means that people who live in a region or municipality tend to be members of an association.

9.3 SOFT NON-MOTORISED WATER SPORTS

9.3.1 Description

The coast is one of the most important tourist locations within Belgium, and the tourist-recreational use of this area is continuously increasing (PSEP 2003). The increase in water activities in the North Sea correlates with increasing beach recreation.

A distinction is made between non-motorised and motorised water sports. Non-motorised water sports are defined as all the water activities where no engine is involved.

9.3.2 Subuses and description

This category of non-motorised water sports comprises the following activities:

- canoe/kayak
- windsurfing
- swimming and rescue services
- sailing[2]

Canoe/kayak

Canoeists and those that kayak are distinguished by 2 groups, namely the experienced and inexperienced canoe and kayak navigators. The experienced practitioners mostly have their own canoe or kayak and are mainly focused on the peace and nature experience.

The inexperienced canoe and kayak navigators mainly rent a canoe or kayak. They are less focused on the surroundings, but more on the social contacts and the 'fun-aspect' of day canoeing or kayaking.

Windsurfing

Windsurfing is a sport in which you sail across the sea by standing on a board and holding onto a large sail. Some so-called 'dry marinas' exist along the Belgian coast. Sailboats without motors and windsurfers, amongst others, have their homeport in these marinas.

[2] Sailing with dinghies (small open lee board sailing boats, ranging from the smallest one-person boat -an optimist- to the bigger catamaran –which has to be sailed by several sailors)

Sailing

Sailing in the Belgian part of the North Sea comprises several categories of sailing activities. A distinction can be made between yachting and sailing with dinghies.

Yachting is defined as sailing cabin sailing vessels with an inboard or outboard auxiliary motor (see motorised water sports). Dinghies are small open lee board sailing boats, ranging from the smallest one-person boat -an optimist- to the bigger catamaran, which has to be sailed by several sailors) (Zeekajak, Bart Pauwels pers.comm. 2004).

It is only the latter category that will be considered in respect to soft non-motorised water sports.

Swimming and rescue services

Swimming activities can be divided into recreational swimming, which is only allowed in guarded zones, and competitions or organised swimming activities.

9.3.3 Existing situation

9.3.3.1 Spatial delimitation

Canoe/kayak

These activities mainly occur within 1 km of the coast. The vessels are launched into water from marked zones and subsequently navigate along the coastline for a couple of km.

Most kayak clubs in Belgium are connected to fresh water activities including such things as wild water kayaking, kayak polo, competitions … (all activities that are not practised at sea). There are several VVW water sport centres along the Belgian coast, some of which rent kayaks for recreation at sea. In theory kayak clubs should be connected to BLOSO, which keeps records of each club's program of activities at sea. In practice this is generally not the case, meaning that little information is available in respect of each club's activities at sea.

A distinction can be made between surf and sea kayaking. The former is practised within a 200-300 m zone from the low waterline, mostly during winter. Surf kayaking can be done along the whole coast (<200 m above low waterline), but preferred places are around the western stockade of Blankenberge and the harbour wall of Zeebrugge. Surf kayaking is mostly practised outside the 200 m low waterline, and generally doesn't go further than 2-4 nautical miles. Both activities are required to respect swimming zones.

Windsurfing and sailing

There are 15 water sports associations situated along the Belgian coast, divided over 9 of the 10 coastal municipalities, with a base on the beach (Table I.3.9b). Nieuwpoort is the only coastal municipality that does not have a beach club.

Table I.3.9b: List of sail/surf clubs along the Belgian coast (Source: Luc Geirnaert VVW, pers.comm.)

Municipality	Beach club
Knokke-Heist (4)	Surfers Paradise
	Royal Belgian sailing Club (RBSC) Het Zoute

	Royal Belgian sailing Club (RBSC) Duinbergen
	VVW Heist
Zeebrugge (1)	Rustyhouse
Blankenberge (1)	Offshore Surf club
De Haan (1)	Beach club De Windhaan
Bredene (1)	Twins club
Oostende (2)	Inside-Outside
	Ostend Sailing and Racing Club (OSCR)
Westende (1)	VVW Westende
Oostduinkerke (2)	Surf club Windekind
	Sand Yacht Club
Koksijde (1)	Koksijde Yacht Club
De Panne (1)	Side Shore Surfers

These clubs have historically grown as a result of individuals seeking a place to put their boat or surfboard on the beach. At the beginning of the '80s and on the initiative of BLOSO, the government indicated those beaches that could serve as launching zones for surfers and sailors. Swimming is not allowed in these zones. As most inhabitants of the flats preferred to swim right in front of their door, these zones were mostly installed on deserted places or places with no or few buildings. These associations installed showers and even built sanitary facilities on the beach.

Swimming and rescue services

Swimming in the Belgian part of the North Sea is only allowed in the guarded swimming areas. All defined zones are guarded from 10h30 to 18h30.

Table I.3.9c: Triathlon and swimming activities at the Belgian coast

TRIATHLON
Triathlon Blankenberge
Organised yearly by Blankenberge Offshore Surf club (available at www.surfclub.be on 08/07/2003). There is swimming in the sea, parallel to the coast and along the sea current, over a distance ok 1 km. Two buoys have to be rounded: the first buoy is situated near the place of departure of the Duinse Polders; the second is closer to the pier. (available at www.knokke-heist.be on 08/07/2003)
Beach triathlon Iron dude 2003 - Knokke-Heist
Surfers Paradise organises yearly a beach triathlon for all the members of the association. The competition includes a 500m swim in the sea.

SWIMMING AT SEA
Oostende
OOSTENDE Belgian Championship Short Distance (available at www.vzl.be on 08/07/2003, Open water/Competition Calendar), organised by Royal Ostend Swimming Club (available at www.ostendswimming.be on 08/07/2003)
Knokke-Heist
500m and 1500m swimming race at sea. Organisation by the sports department of Knokke-Heist. (available at www.knokke-heist.be on 08/07/2003)
Blankenberge
The sports department of Blankenberge City organises a 500 or 1500m swimming race at sea. This is in co-operation with the Beach rescue service and the swimming association of Blankenberge. (available at http://www.bvz.be/inhoud/Info/zeezwemmen.htm on 08/07/2003) Sea swimming each Saturday of July and August. Organisation: Beach rescue service of Blankenberge member of I.K.W.V. (available at www.blankenberge-online.be/strandredding.html on 08/07/2003)
LIFESAVING –SWIMMING
De Haan
Haanse Reddingsclub with 178 members
Westende, Middelkerke
Flanders Coast Lifesaving Team: 46 members
Oostende
Oostendse Reddingsclub: is no member of the 'Vlaamse Reddingscentrale', they don't participate in the championships

Source

These data and information are based on:

Ecolas (2000)

Resource Analysis (2003)

Interurban Coastal Rescue Services West-Flanders (2002)

Terra Coastal Zone Management (2000)

Vlaamse Reddings Centrale vzw. Veerle Van Raemdonck (telephone contact on 14/08/2003, mails), available at www.vrc.nu/sport/reddingsclubs.htm on 04/09/2003)

Luc Geirnaert, Verbond van Vlaamse Watersportverenigingen, pers. comm.

VYF Vlaamse Yachting Federatie. Membership list 2002 received on 26/08/2003

Zeekajak. Kano and Kajak Center, Wachtebeke. Bart Pauwels (contact op 20/02/2004)

Eliaerts et al. (1998)

Maes et al. (2002)

Reliability margin

The Ecolas inventory (2000) was based on survey of the tourist services in the coastal municipalities, the licenses supplied by 'coastal waterways service' and by 'Piloting services' and the concerned legislation.

The text is based on the sources mentioned above, on an information search of literature and websites and a telephone query of the sport services in the coastal municipalities.

Future perspectives

Water sports generally show diverse temporal trends: windsurfing for example has known an enormous growth, but is now only practised by a limited group. A new dynamic sport today is "kite surfing" (this is surfing at sea with a kite as sail). Other new trends in the non-motorised water sports activities are wave surfing (surfing on the waves on a board without sail), sea kayaking and –canoeing and sea rafting. Therefore the constant dynamic inherent within water sports continuously draws certain groups to the water (Resource Analysis 2003).

9.3.3.2 Type and intensity

Intensity per surface-area

Canoe/kayak:

No more specific information available.

Windsurfing and sailing:

The 15 associations along the Belgian coast counted in 2002 included 6833 permanent members (VYF Vlaamse Yachting Federtaie membership list 2002). Those members launch into sea from these beaches mainly to surf or sail in open boats. All clubs have permanent and non-permanent beach accommodation at their disposal. Besides the permanent members, the clubs organise sailing- and surf courses – traineeships for temporary or trial members. A limited study by VVW (Luc Geirnaert pers. comm.) showed the number of enrolments for those traineeships had increased from 2322 in 1988 to 7370 in 2001. 80 percent of the surf course trainees are between 11 and 16 years. 52% of sail trainees are between 8 and 13 years old, and 34% are over 20 years old.

The annual report (2002) of the Interurban coastal Rescue services West-Flanders (Interurban Coastal Rescue Services 2002) lists some recent facts and figures. The table below gives an overview of the guarded zones for windsurfing.

Table I.3.9d: Overview of guarded windsurf zones (Source: Interurban Coastal Rescue Services West-Flanders 2002)

Municipality	Number of guarded zones	Metres guarded zone
De Panne	1	300

Koksijde	5	950
Nieuwpoort	0	0
Middelkerke	1	400
Oostende	2	880
Bredene	1	300
De Haan	2	500
Blankenberge	1	500
Brugge	1	500
Knokke-Heist	5	1593
TOTAL	**19**	**5923**

46% of the total inventoried public and commercial activities (Ecolas 2000) are related to sailing, surfing and yachting. Activities related to sailing, surfing and yachting are dispersed over several municipalities. The sail- and surf clubs are mainly situated in Knokke-Heist. Municipalities with marinas (Blankenberge, Oostende, Nieuwpoort and Zeebrugge) can organise a lot of activities related to sailing, surfing and yachting all year-round.

Of the 37 activities in category 1 (all sailing-, yachting- and surf clubs or associations and private persons organising traineeships or courses relating to surfing and sailing), most of them take place in Oostende (6), Nieuwpoort (6), Blankenberge (5) and Knokke-Heist (5). The rest of the activities are dispersed over the other coastal municipalities.

The table below is based on the membership list of VYF (Vlaamse Yachting Federatie) of 2002. Missing values were collected through a phone survey on 16/10/03 of the clubs concerned (VVW Heist, VVW Westende).

Table I.3.9e: Overview of coastal surf- and yacht clubs associated to VYF

Name	Municipality	Activities	Number of members
Surfers Paradise	Knokke-Heist	windsurfing, kite surfing, catamaran, sailing	244
Side Shore	De Panne	windsurfing, kite surfing	35
Windekind	Oostduinkerke	windsurfing, kite surfing	155
Twins	Bredene	windsurfing, kite surfing, sailing, catamaran	435
Offshore	Blankenberge	windsurfing, kite surfing	75
KYC (Koksijde Yachting	Koksijde	catamaran, sailing,	196

Club)		windsurfing	
KYCN	Nieuwpoort	Sailing	1197
OSRC	Oostende	Catamaran, sailing	158
RNSYC	Oostende		375
RYCO	Oostende	Sailing	258
SYCB	Blankenberge	Sailing	269
WSKLumN	Nieuwpoort	Sailing	1349
ZSBM	Oostende		209
VVW Heist	Knokke-Heist	windsurfing, kite surfing, sailing, catamaran	650
VVW Inside-Outside	Oostende		410
VVW Nieuwpoort	Nieuwpoort		718
VVW Westende			100
TOTAL			**6833**

Swimming and rescue services:

The annual report of the Interurban Coastal Rescue Services West-Flanders (2002) lists some recent facts and figures. Table I.3.9f gives an overview of the guarded zones for bathers and Table I.3.9g shows the number of lifeguard daily on duty in 2002.

Table I.3.9f: Overview of guarded bathing zones (Source: Interurban coastal Rescue services West-Flanders 2002)

Municipality	Number of guarded zones	Metres guarded zone	period when zones are guarded
De Panne	5	2200	1/7-31/8
Koksijde	11	4835	All posts (4835m): 1/7-31/8 3 posts (1145m): 22/6-15/9
Nieuwpoort	5	1250	1/7-31/8
Middelkerke	16	6630	1/7-31/8
Oostende	8	3070	All posts (3070m): 1/7-1/9 2 posts (830m): 2 WE in June

Bredene	6	1170	1/7-31/8
De Haan	10	2500	1/7-31/8
Blankenberge	7	2100	18/5-22/9
Brugge	1	500	29/6-1/9
Knokke-Heist	11	3585	1/7-31/8
TOTAL	**80**	**27840**	

Table I.3.9g: Number of lifeguards daily on duty in 2002 (Source: Interurban Coastal Rescue Services West-Flanders 2002)

Municipality	May	June	July	August	September
De Panne	0	0	34	34	0
Koksijde	0	10	54	54	10
Nieuwpoort	0	0	23	22	0
Middelkerke	0	0	54	54	0
Oostende	0	10	28	28	0
Bredene	0	0	19	19	0
De Haan	0	0	43	43	0
Blankenberge	6	6	30	28	6
Brugge	0	0	9	9	0
Knokke-Heist	0	22	51	51	22
TOTAL	**6**	**48**	**345**	**342**	**43**

The next Table I.3.9h gives an overview of the incidents in 2002.

Table I.3.9h: Number of deaths by drowning and near deaths by drowning on the Belgian coast in 2002 (Source: Interurban Coastal Rescue Services West-Flanders 2002)

<table>
<tr><td rowspan="3">Number of deaths by drowning</td><td rowspan="2">During opening hours</td><td>In guarded zones</td><td>3</td><td rowspan="2">9</td></tr>
<tr><td>In unguarded zones</td><td>6</td></tr>
<tr><td>Off opening hours</td><td>In guarded zones</td><td>3</td><td>5</td></tr>
</table>

		In unguarded zones	2	
TOTAL number of deaths by drowning				14
Number of near deaths by drowning	During opening hours	In guarded zones	11	37
		In unguarded zones	26	
	Off opening hours	In guarded zones	1	2
		In unguarded zones	1	
TOTAL number of near deaths by drowning				39

Lifesaving-swimming:

According to the VRC (Vlaamse Reddingscentrale, Veerle Van Raemdonck pers. comm.), 2 championships (Flemish and Belgian Championship lifesaving open water) and 5 to 10 (depending on the weather) training sessions in the period June-September are organised yearly. These activities (competitions and training) last one day and are composed partly on the beach and partly in the sea. The tests are done in or close to the breakers. During competitions the VRC Rescue team accompanies the swimmers with 3 rescue boats. Approximately 10 to 20 people participate in the training sessions and championships usually attract around 100 participants.

<u>Frequency per unit of time</u>

Canoe/kayak:

Little information is known about kayaking. Sea-kayak, however, only takes place occasionally and generally does not occur during the high summer peak. Some water sport centres organise courses. In 2003 the VVW water sport club of Heist attracted about 25 students for the kayak courses (during 6 days). Furthermore, small groups of people (around 6) kayak 1 to 2 times a month at sea (pers. Comm. Bart Pauwels).

More then half of the questioned practitioners of canoeing/kayaking (and rowing/water bicycle) (n=26) reported that they do their sport only a few times a year (Resource Analysis 2003).

Windsurfing/sailing:

Activities related to sailing and surfing occur during the whole year. They are dependent on weather conditions. It goes without saying that during the winter months and bad weather no sailing and surfing activities are practised (Ecolas 2000).

An inquiry of WES (2002-03) showed that 75% of the respondents (n=8) practised windsurfing only a few times a year. The questioned sailors (n=46) reported going sailing more often: that is 72% go sailing at least once a month (and 50 % go sailing at least once a week) (Resource Analysis 2003).

In Table I.3.9i information is given about the time expenditure of sailing from a WES-inquiry.

Table I.3.9i: (mean) Time expenditure of sailing (n=33), WES-inquiry 2002-03 (% and in hour)

Description		Sailing
Time expenditure	Less then 2 hour	6.1
	2 to 3 hour	9.1
	3 to 4 hour	6.1
	At least 4 hour	78.8
	Total	100.0
Mean time expenditure		6.3

Swimming and rescue services:

The swimming frequency (n= 78) was more variable, ranging from a few times once a week, to a few times once a month and to a few times once a year (Resource Analysis 2003).

<u>Source</u>

These data and information are based on:

Ecolas (2000)

Resource Analysis (2003)

Interurban Coastal Rescue Services West-Flanders (2002)

Terra Coastal Zone Management (2000)

Vlaamse Reddings Centrale vzw. Veerle Van Raemdonck (telephone contact on 14/08/2003, mails), available at www.vrc.nu/sport/reddingsclubs.htm on 04/09/2003)

Luc Geirnaert, Verbond van Vlaamse Watersportverenigingen, pers. comm.

VYF Vlaamse Yachting Federatie. Membership list 2002 received on 26/08/2003

Zeekajak. Kano and Kajak Center, Wachtebeke. Bart Pauwels (contact op 20/02/2004)

Eliaerts et al. (1998)

Maes et al. (2002)

<u>Reliability margin</u>

The Ecolas inventory (2000) was based on a survey of the tourist services in the coastal municipalities, the licenses supplied by 'coastal waterways service' and by 'Piloting services' and the concerned legislation.

The text is based on the sources mentioned above, on an information search of literature and websites and a telephone query of the sport services of the coastal municipalities.

9.3.3.3 Data gaps

It has to be noted that although information and several studies are available on water recreation in general (i.e. inland and coastal waters), there are significant data gaps concerning non-motorised coastal water sports in Belgium. Studies such as the framework of the Management plan Water recreation (Resource Analysis 2003), of the Waterways and Maritime Affairs Administration (Ministry of the Flemish Community), give useful information from surveys of water recreation in Flanders (practised frequency, expenditure annoyances … etc). However, additional inquiries and studies need to be executed in order to build up coastal-specific parameters. Furthermore, the existing studies give no insight into the density or the geographical distribution of the activities.

An interesting study by Resource Analysis (2003), concerning the economic impact of the entire water recreation, gives useful numbers for yearly turnover, (coefficients to calculate) added value and employment (based on turnover) and a coefficient to calculate the percentage of capital that finds its way back to the government through taxes and (excise) duty. To be able to determine which share of the added value, employment … etc is generated in Flanders (at the coast), regional input-output models have to be made available.

The number of practitioners that are members of a water sport associations and -clubs underlines the considerable size/magnitude of the sector. Although general figures for Flanders are available, there are no specific figures for the coastal region.

9.3.4 Interactions

9.3.4.1 Suitability for user

Details – if applicable – can be found in the chapter that is specifically dedicated to "Suitability".

Biological adequacy

No restrictions

Geological/physical adequacy

No restrictions

Hydrological adequacy

No restrictions

9.3.4.2 Impact on other users

Spatial conflict

Non-motorised water sports:

Because all non-motorised water sports take place within 1 km above the low water line, normally no major spatial problems should occur for this recreational group.

According to the sector, correct canoe- and kayak behaviour encourages respect for nature and other recreational users (e.g. anglers). Nevertheless, other non-motorised sports use the defined bathing zones to launch into sea, despite the fact that this is expressly prohibited. Stricter supervision and compliance should be provided to avoid this in the future.

Other users:

As most use of the BPNS takes place beyond 1 km, no major problems are expected. However, the creation of i of new nature conservation areas could cause problems.

Intensity conflict

The WES inquiry (2002-03) shows that 21.6% of respondents (n=88 in a coastal marina) experience nuisance from other vacationers/users. The most frequent reported types of nuisance are in descending order: jet ski's, in the amount of general activity, speedy navigation, motorboats, bicycles, cars, motorcycles, inexperienced sailors, fishermen and dogs walking around freely (Resource Analysis 2003).

9.3.4.3 Impact on environment

Biological

No/little impact

Geological/physical

No/little impact

Hydrological

No/little impact

According to the MareDasm study of the University of Ghent (Maes et al. 2002) the following types of pollution originate from beach recreation[3]:

Toxic pollution:

Swimming and sunbathing potentially causes adverse environmental effects through the use of suntan oil, which may significantly contribute to oil pollution. Suntan oil doesn't contain mineral oil, but rather the less harmful vegetable oils such as paraffin and stearine. Furthermore, it contains emulsifiers and UV-captors, the effect of which on the water system is unclear. The oil load of the whole North Sea is estimated to be between 71000 and 150000 tonnes yearly. It is clear that the input of suntan oil is negligible in relation to these numbers.

Eutrophication:

Excretion products of bathers (urine and sweat) can contribute to eutrophication. In the coastal zone the contribution of beach recreation to the total nitrogen- and phosphor emission amounts up to maximum 0.1 % and is thus a negligible contribution.

Physical pollution:

Possible acoustic and visual disturbance of beach recreants, surfers and catamarans can have an impact on the water system. These could possibly be expressed as number per hectare. Recurring disturbances

[3] Beach recreation comprises recreational activities at and departing from the beach, such as swimming, sunbathing, angling, walking, surfing and sailing.

can render certain areas on the beach and in the dunes unusable as feeding, resting and breeding places for birds and marine mammals. It is however not expected they will have a large-scale effect.

Biological pollution:

Bathers can directly introduce faecal coli forms into the environment, such as *Escherichia coli*, enterococci and human pathogens. These pollutants don't naturally occur in marine water, but they can be relatively easy excreted by humans and other warm-blooded (homoeothermic) animals. Typical problems associated with the presence of these microbiological indicator organisms and human pathogens are mainly related to human health such as gastro-intestinal problems and irritations of skin, eyes, ears and respiration.

Perceptual pollution:

Obviously the noise and views of busy beach recreation can have a negative effect on the "sense of-place" at the coast.

9.3.4.4 Impact on socio-economy

Economic

Awareness is growing that leisure time, recreation and tourism activities are not only a cost to municipalities and regions, but also the source of revenue and employment. For certain regions, like the coast, (water) recreation and – tourism is or can be an important catalyst for the economic development.

Swimming and rescue services:

Table I.3.9j: Number of recruited lifeguards

Municipality	**May**	**June**	**July**	**August**	**September**
De Panne	0	0	45	44	0
Koksijde	0	15	74	81	16
Nieuwpoort	0	0	36	26	0
Middelkerke	0	0	72	72	0
Oostende	0	10	55	55	0
Bredene	0	0	26	27	0
De Haan	0	0	56	55	0
Blankenberge	8	8	43	38	8
Brugge	0	0	14	14	0
Knokke-Heist	0	22	63	63	22
TOTAL	**8**	**55**	**484**	**475**	**46**

Surfing and non-motorised sailing:

Table I.3.9k: Overview of the total returns inventoried by Ecolas in 2000

Nature of activity	Return (EURO)
Surf- and sail clubs[4]	1065942
Traineeships and courses[5]	644523
TOTAL	**1710465**

The total (some 80) inventoried public and commercial activities in the sea area of Belgium generate income for about 150-200 people. In summer months this can rise due to student employment.

Social

Activities related to sailing and surfing have a fixed and broad clientele. That means that only people already involved participate, but that there is a broad range of ages that participate. Sail- and surf clubs organise traineeships for members and non-members during summer. Most sail- and surf traineeships are meant for young people. The traineeships take place over the course of a week, and trainees generally stay in the coastal municipality during that time. Most sail- and surf clubs have programs designed to increase proficiency, which existing members regularly join. These clubs also organise competitions including: club competitions and/or national competitions. These competitions can entice some hundred spectators at a time.

Clubs and associations bring together many people. They don't restrict their activities to the summer months, but are generally accessible to their members and the public throughout the year. This is certainly true for sailing- and surfing clubs.

The survey (WES 2002-03, n=47) shows that 72.3% of the sailors in Flanders are a member of a water sport club.

In Flanders 25% of the respondents (n=128 other activities on the water) are members of a water sport club (WES-inquiry 2002-03).

[4] The activities comprise the rental of sailing- and surfing material, organisation of traineeships and courses, and the storage of sailing- and surfing material of members. Reckoning with an average of 300 members, rental of material of 120 hours yearly, storage of material from 25 persons and the organisation of 6 traineeship/courses with 15 participants.
[5] Reckoning with the cost price and the number (2-5) of people employed

9.4 MOTORISED WATER SPORT AT SEA

9.4.1 Description

The coast is one of the most important tourist destinations in Belgium and the intensity of tourist-recreational use of this area is continuously increasing (PSEP 2003). The increase in beach recreation correlates with an increase in water activities in the North Sea. A distinction is made between non-motorised and motorised water sports.

Motorised water sports are defined as all water activities where the intensive use of an engine is involved.

9.4.2 Sub-uses and description

The motorised water sport activities at sea can be subdivided into:

- speed navigation (motor boating, jet ski, water ski);
- passenger navigation;
- recreational navigation;
- (wreck) diving.

Speed navigation

The term "speed navigation" includes a wide range of recreational activities on the water. In this project speed navigation is mainly used in respect of speedboats, water-skis and jet skis.

Water-ski navigation includes 7 basic disciplines: classic, racing, barefoot, wake boarding, disabled, show-ski and cable-ski. Most of these disciplines demand a waterfront that is as flat as possible (Resource Analysis 2003).

Passenger navigation

Passenger navigation is defined as vessels transporting a minimum of twelve passengers. Passenger navigation caters to the tourist-recreational aspect of activities by offering certain trips between or via interesting locations.

Passenger navigation is thus defined as 'boat trips within a harbour or between two coastal cities', excluding ferry traffic (fixed transport routes, which are classified as 'shipping').

The yearly amount of people that passenger navigation transports is remarkable. One vessel represents the equivalent of several yachts. This branch therefore provides an important contribution to making the population acquainted with water recreation and water tourism. It can be argued that passenger navigation is a very democratic form of water recreation. Besides the fact that passenger navigation can be considered as water recreation in its own right, the incentive it provides to take part in other forms of water recreation and -tourism cannot be underestimated (Resource Analysis 2003).

Motorised recreational navigation

Recreational navigation on the coast consists not only of motorised tour boats, but also of sailing yachts. According to the MareDasm report of the University of Gent (Maes et al. 2002) recreational navigation in the North Sea consists mainly of cabin sailing boats and with only 5% made up by of motorboats.

Diving

Although some sources (Eliaerts et al. 1998) classify diving as a non-motorised water sport activity, in the frame of our study we consider it as a motorised water sport based on the fact that diving activities in the Belgian part of the North Sea are concentrated on wrecks. These wrecks are scattered on the offshore seabed and can only be reached by motorised boats.

9.4.3 Existing situation

9.4.3.1 Spatial delimitation

The motorised water sports are only allowed outside 200m of the low waterline, except in the assigned launching zones and in case of force majeure.

Source

Ecolas (2000)

Resource Analysis (2003)

Inquiry results of Rudi Baert, responsible for diving activities in the North Sea of NELOS (Nederlandstalige Liga voor Onderwateronderzoek en-sport vzw) (2004)

Maes et al. (2002)

Eliaerts et al. (1998)

Reliability margin

The Ecolas inventory (2000) was based on a survey of the tourist services of the coastal municipalities, the licenses supplied by 'coastal waterways service' and by 'Piloting services', and the concerned legislation.

The text is based on the sources mentioned above, on an information search of literature and websites and a telephone query of the sport services of the coastal municipalities.

Flexibility

The launching zones are well defined.

Future perspectives

The constant dynamism inherent to water sports continuously attracts new groups of consumers to the water (Resource Analysis 2003).

Examples of recent trends in motorised water sport activities include jet-skis, banana- boating (this is an inflated banana which is drawn behind a motorboat), para-sailing (a parachute pulled by a motorboat) and wave-carting (navigating at sea in group with special jet-ski boats).

9.4.3.2 Type and intensity

Intensity per surface-unit

The Ecolas inventory (2000) of commercial and public activities on the coast recorded 13 commercial companies organising offshore excursions in 2000. According to that inventory companies or persons organising a sea trip with a (amphibian) boat or sailboat are mainly situated in Oostende (6) and Nieuwpoort (4). Further activities are situated in Blankenberge (1), Middelkerke (1) and Zeebrugge (1).

55% of the trips at sea with an (amphibian) boat that are organised by a company or person take place from April to October, 40% are year-round and the rest takes only place in July and August (Ecolas 2000).

According to the federation Waterski Vlaanderen (WSV) none of their member clubs organise water-skiing activities on the Belgian coast. Most of their clubs are situated in the province of Antwerp where they practise their sport on inland water.

According to the NELOS inquiry (NELOS, Rudi Baert pers. comm. 2004) 45 diving clubs (with a total number of 3759 members) go diving in the North Sea. Approximately 1850 dives take place every year. An average dive is 30 to 45 minutes long. The duration of a full diving trip is 12-14 hours. There are generally 2 dives per trip. The wrecks that are regularly dived on include (in order of importance): Trifels, Bruno Heineman, Birkenfelds, Pepinella, Garden City, Tubantia, Paris, Wolf, Hermes, Marthe, etc. The dive clubs jointly use a limited number of boats: Aquarius (21 metres, diesel), Stream (catamaran, 13 metres, diesel, 400 pK, Nieuwpoort, 12 divers, 66 diving days from May to November) and Dive Star (21 metres, diesel, 4-takt/8cylinders, Nieuwpoort, 12 divers).

Frequency per unit of time

The WES-inquiry (n=17) 2002-03 (Resource Analysis 2003) shows that speed navigation (motor boating) is practised in 40% of cases, which is several times a week but not daily. Jet-ski activities mainly occur with a low frequency, a few times per year (42.9%) or once every few months (28.6%).

Approximately 1850 dives (reported by NELOS) take place over a total of 438 diving days each year. There are no diving activities from November up to May. In May and October only sporadic dives take place. The peak season for diving is in the warmer months: June, July, August and September (NELOS, Rudi Baert pers. comm. 2004).

Future perspectives

The management plan for Water recreation (Resource Analysis 2003) gives an indication of some prospects:

Water-ski en speedboats:

There is an EU-emission directive (emission of hydrocarbon) that is presently being completed, which will result in many present out board motors becoming illegal.[6] As a result people will need to convert to more expensive types of motors, and it is expected that the number of practitioners will decline. It is also feared that the sport will become more elitist (Resource Analysis 2003).

At present the EU-standard (emissions), which is applicable to all new boats, determines that the maximum allowed noise limit is 90 dB (A). Also of importance are the emission standards[7] or the noise limits, which are measured from shore (Vlarem). These are dependent of the type of area and the time of the day.

[6] This relates to the proposition that the European Commission filed on October 2000 to enact a Directive regulating exhaust and noise emissions from the motors of pleasure vessels.
[7] Emission standards are location specific noise limits (qua spatial zoning) measured from the shore at certain times of the day.

Jet-ski:

Since the beginning of the jet-ski-sport there has been public fear towards the sport. People are fearful of the noise and the speed of the vessels. This is nourished by negative publicity that the sport gets from the media. The past years have only seen a couple of accidents resulting from unsound jet-ski behaviour.

The increased level of organisation of the sector (among others in the form of the BJSBA) has contributed in the mean time to a sort of code of conduct and self-regulation of behaviour within the sector.

Alternative speed navigation categories:

Besides the more common speed navigation forms such as water-skiing, jet-skiing and navigating with a speedboat, some less known and variants have emerged over the past few years, such as 'knee-boarding', 'para-sailing', 'air chairing', 'surfing' and 'surf jetting'.

All these activities can be practised within the designated zones for speed navigation. However, not all these activities can be practised at the same time on the same water surface, because of the requirement for specific water conditions (with or without waves) and the specific behaviour of the sports people during the activity (e.g. straightway vs. Unpredictable). Para-sailing is an activity that is often practised at the coast. Practical and safety considerations require that there are, amongst other things, no trees, buildings or high voltage cables in the near surroundings of the parachute (Resource Analysis 2003).

The main threat to these types of speed navigation is the number of practitioners of this sport (Resource Analysis 2003). Often they originate as an experiment on already existing types of speed navigation such as water-skis. After this time there is a sudden increase in the number practitioners (often youthful), whose enthusiasm is fuelled by advertising and fashion. Subsequently many of these types of speed navigation activities pass away quietly, as new variants appear. Some variants grow to complete water sports in their own right, such as wake boarding.

Alternative speed navigation activities face similar issues to more regular types of speed navigation, such as the number of speed navigation zones and environmental regulations.

Passenger- and pleasure navigation:

The Water recreation plan (Resource Analysis 2003) states that an increase of the number of sailing yachts is expected in the future, as a result of increasing purchasing power and the evolution to more active leisure activities in a natural setting. The growing interest can be correlated to the growing number of students getting a degree. The number of sailing schools is also increasing.

There has also been a shift to bigger and more exclusive ships. Thanks to all of these developments the marinas have experienced an increasing need for extension of capacity. The existing infrastructure of marinas is being extended, but this still doesn't meet rising demand.

At the same time some marinas have experienced an ageing membership. To address this marinas have introduced new activities to attract more young people (traineeships, putting boats at their disposal), and to persuade the existing members to become involved in more activities (sailing competitions, tour navigation in-group). The activities of the sea scouts are important in this light for arousing interest in water and navigation from a young age, which augments a new generation of recreational navigators (coastal).

The Water recreation plan (Resource Analysis 2003) further notes that the passenger navigation sector is just starting to organise itself. Recently owners of the vessels used for passenger navigation united themselves in a Flemish Federation for Passenger navigation, and in a Flemish consultation- and advice committee on passenger navigation. Generally it is thought passenger navigation will continue to grow.

There is also a trend of working with themes. Some ship owners utilise themes to be able to distinguish themselves from competitors. Theme navigation is not so widespread in Flanders. The environmental boat has already gained some fame, but other projects are less well known. At present there are several original initiatives including: company receptions, marriage parties,... etc, but there are still many possibilities. The high cost of renting a passenger vessel and crew is still the most important factor inhibiting demand for this type of product.

In some locations the expansion of recreational navigation can lead to environmental nuisances including water pollution, noise disturbance, disturbance of non-motorised water recreation, etc. Nuisances can range from such things as exceeding the maximum speed to the dumping of rubbish during time trips.

9.4.3.3 Data gaps

It has to be noted that although there are several studies available on water recreation (i.e. inland and coastal waters), there are significant data gaps concerning the motorised coastal water sports in Belgium. Studies such as the Management plan Water recreation ((Resource Analysis 2003), of the Waterways and Maritime Affairs Administration (Ministry of the Flemish government), give useful information from surveys of water recreation in Flanders (practised frequency, expenditure, annoyances, etc.). But additional inquiries and studies need to be undertaken in order to build up coastal-specific parameters. Furthermore, the existing studies give little or no insight into the density or in the geographical distribution of the activities.

Resource Analysis (2003) undertook an interesting study concerning the economic impact of the water recreation. This study gave useful numbers for yearly turnover including, coefficients to calculate added value and employment (based on turnover) and a coefficient to calculate the percentage of capital that finds its way back to the government through taxes and (excise) duty. In addition regional input-output models have to be available to determine which share of the added value, employment … etc is generated in Flanders (at the coast). However, specific research data on Flemish/coastal level is lacking.

The number of vessels circulating in the Belgian part of the North Sea is another interesting parameter. This parameter was reconstructed in a study based on registered matriculation plates in Belgium and an estimate of the part in possession of foreigners and an estimate of boats possessed by Belgians which are abroad (Resource Analysis 2003).

In addition to the above information, the number of practitioners that are members of a water sport association and -clubs underlines the considerable size/magnitude of the coastal sector. Again figures for Flanders as a whole are available, but not specifically for the coastal region.

9.4.4 Interactions

9.4.4.1 Suitability for user

Biological

No restrictions

Geological/physical

No restrictions

Hydrological

No restrictions

9.4.4.2 Impact on other users

Spatial conflict

Yacht – and sailing clubs:

The marinas at the coast have a total surface area of 188100 m². The main port is Nieuwpoort (56% of the total surface). The marina in Oostende represents 25% of the total surface. The one in Blankenberge represents 15%, while Zeebrugge only possesses a small percentage of the total marina surface on the Belgian coast (Ecolas 2000).

Table I.3.9l: Overview of yachting- and sailing clubs (source Ecolas 2000) and number of landings (Source: Luc Geirnaert, Verbond van Vlaamse Watersportverenigingen (VVW) pers. comm.)

Municipality	Club	Number of landings	Surface		Total surface	%	Total
			Water (m²)	Ground (m²)			
Blankenberge De Smet De Naeyerlaan 68	Vissersfolklore Ontspanning Na Arbeid	?	2000	0	2000	1.06%	15.03%
Blankenberge Havenplein 3	Scarphout Yachtclub Blankenberge VZW	250	9045	1390	10435	5.55%	
Blankenberge De Smet de Naeyerlan 1	Vrije Noordzeezeilers	150	5039	0	5039	2.58%	
Blankenberge Oude Wenduinsesteenweg 4	V.V.W. Blankenberge	655	7600	3200	10800	5.74%	
Nieuwpoort Halvemaanstraat 2b	Watersportkring van de Luchtmacht VZW	370	16000	31820	47820	25.42%	55.92%
Nieuwpoort Krommehoek	Koninklijke Yachtclub Nieuwpoort VZW	350	14060	0	14060	7.47%	

Nieuwpoort Watersportlaan 11	V.V.W. Nieuwpoort	1000	35800	7500	43300	23.02%	
Oostende Vindictivelaan	Mercator jachthaven	320	36015	0	36015	19.15%	26.39%
Oostende Dr. Ed. Moreauxlaan 2	Royal Yacht Club Oostende	200	7780	2590	10370	5.51%	
Oostende Montgommerykaai 1	Royal North Sea Yacht Club	120	2893	368	3261	1.73%	
Zeebrugge Oude vismijn, rederskaai	Royal Belgian Sailing Club	?	5000	0	5000	2.66%	2.66%
Total		**+3415**	**141232**	**46868**	**188100**	**100%**	**100%**

Marinas on the Belgian coast are in high demand, when examined in terms of the demand for berths and their occupation. According to available estimates there is an increasing shortage of berths in coastal marinas. Bardyn (2001) estimates the current deficiency to be 1879 units (Resource Analysis 2003).

Besides the fact that there has been a shift to bigger and more exclusive ships, there is also a demand to more berths. Marinas have extended their capacity to address the shortage of berths. Nevertheless, the extended infrastructure of marinas still doesn't meet demand (Resource Analysis 2003).

Intensity conflict

Soft types of recreation:

It is difficult to practise speed navigation at the same time as "soft" types of recreation like kayaking because of the waves and safety matters.

9.4.4.3 Impact on environment

Biological

The existence of several types of speed navigation and the location-specific possibilities for expansion are subject to the location-specific emission standards (noise limits) measured from shore at certain times of the day.

Geological/physical:

Navigating with motorboats contributes to acoustic disturbance. While concrete information about the effects is missing and it is assumed that these effects are limited. The visual disturbance by recreational navigation can be calculated by combining the number of boats in the summer season with the geographical distribution of recreational navigation.

Hydrological:

No relevant impact is to be expected.

Toxic pollution:

The Risk Analysis Marine Systems (RAM) gives information concerning the possible emission of oil with benzoapyrene (BaP) and fluoranthene (Flu), Copper, Zinc, Lead and TBT. These pollutants mainly come from cabin sailing boats (Maes et al. 2002).

The speed at which organotin associations/connections leach out from anti-fouling paints depends on the type of paint used. Self-grinding paints especially leach during navigation and to a lesser extent when lying idle. Conventional paints leach continuously. Contrary to professional navigation, mainly conventional paints are used in recreational navigation, as these vessels mainly lie idle. During periods of lying idle and the cleaning of the boats, TBT can be introduced into the harbour. The water in the marinas is being renewed due to tidal movements and thus it forms a source of TBT-load to the North Sea. The study mentioned calculated a mean emission of 1 g TBT daily during lying idle and 2.5 g TBT daily during navigation, for a cabin sailing boat of 40 m^2. Since 1989, TBT-containing paints have been banned by Europe on sea-going vessels under 25 m (mainly recreational vessels) (Directive 89/677/EC). The International Maritime Organization (IMO) adopted an Assembly Resolution in November 1999 and a Convention in 2001, to ensure a global ban on the application of organotins in antifouling paints in new coatings by 2003 and its presence on every vessel in service by 2008. This ban has been endorsed by the European Community in Regulation 782/2003/EC.

Zinc in the form of zinc-anodes is used in recreational navigation as cathode protection. The zinc-anode dissolves slowly and thus prevents corrosion of the metal parts such as the screw propeller and the ship's shell. It is estimated that approximately 50% of Dutch vessels at sea are protected by a zinc-anode, and zinc emissions amount up to about 600 g yearly per vessel (Maes et al. 2002). Similar numbers are to be expected for Belgium's recreational vessels. In recreational navigation "bronze-bottom" paint is used which contains copper. It is not known, however, how many of the total amount of sea-going recreational vessels in Belgium uses copper-containing paint.

Possible sources of BaP and Flu in recreational navigation are leaching and wastage of the ship's skin (from anti-fouling tar products), and exhaust fumes from both outboard- and inboard motors. For Dutch recreational vessels a mean emission was calculated from the ship's shell as 0.11 g BaP and 3.4 g Flu yearly per vessel. The recreational navigation on the North Sea consists mainly of cabin sailing boats and only for 5% of motorboats. The total emission of BaP and Flu from recreational navigation appears to be relatively small and is determined by emission from the ship's skin (Maes et al. 2002).

Gasoline and diesel fuel may contain lead. This lead can end up in the seawater with the exhaust fumes. Inboard motors excrete 85% of the exhaust fumes under water and outboard motors 100%. Lead additionally ends up directly in the sea through angling. This lead, however, sinks quickly into the soil where the leaching velocity of lead is very low (Maes et al. 2002).

Eutrophication:

A Dutch study calls the contribution of NO_X to the North Sea by recreational vessels negligibly small (KNWV 1991). It can be assumed this is also the case for the Belgian part of the North Sea.

Oil pollution:

The use of outboard motors (lubrication) in recreational navigation leads to an emission of oil to the surface water. The emission to the water was calculated as being 5.2 g oil per kg of gasoline (Van Bentum 1993). Based on the assumption that one kg of drained oil per day gives rise to the formation of an oil slick of 0.5 m², the surface of the oil film can be calculated (oil film of 0.0026 m²).

9.4.4.4 Impact socio-economy

Economic

Awareness is growing that leisure time recreation and tourism are not only a cost to a municipality or region, but also a source of revenue and employment. Coastal recreation (water) and tourism can be an important catalyst for economic development for certain regions.

Table I.3.9m: General overview of the total returns of motorised water sport activities inventoried by Ecolas in 2000

Nature of activity	Return (EURO)
Maiden trips and boat trips	1244587
Rental of sailboats and sailing cruises[8]	520576
Yachting- and sailing clubs	2542987
TOTAL	**4308150**

Table I.3.9n: Detailed overview of the assessment of the return of trips at sea inventoried by Ecolas in 2000

Organisator	**% time usage**	**Number of days yearly**	**Frequency daily**	**Cost price EURO**	**Maximum participants**	**Correction**	**Turnover**
Dalle Fernand	80%	62	7	3	40	28	29165
Zeezeildopen de Bon Vivant	80%	154	3	13.14	12	12	58279
VW Sailing Team	80%	180	3	23.8	50	35	359856
Seastar (zomer)	80%	62	2	16.61	150	105	173010
Vanhoutte Ronny	80%	62	11	3	40	28	45830

[8] Reckoning with the rental price and duration of the activity.

Organisator	% time usage	Number of days yearly	Frequency daily	Cost price EURO	Maximum participants	Correction	Turnover
Link bvba	80%	84	20	1.12	25	18	26342
Rederij Euro-Line	80%	104	3	7.44	300	210	389975
						Total	1082457
					Total turnover of maiden trips and boat trips[9]		**1244825**

Table I.3.9o: Detailed overview of the assessment of the turnover of yachting- and sailing clubs inventoried by Ecolas in 2000

Yachting club	*Number of landing stages*	*Turnover*	*Surface (m²)*	*Retribution*[10]	*ratio*
Mercator jachthaven	320	237978	36015	44639.43	18.76%
V.V.W. Eurojachthaven Nieuwpoort	1000	743681	43300	53668.95	7.22%
North Sea Yachtclub	120	89241.7	3261	4041.904	4.53%
Royal Yacht Club	200	148736	10370	12853.28	8.64%
Koninklijke Yachtclub Nieuwpoort	350	260288	14060	17426.91	6.70%
				mean	9.17%
	For the 11 clubs in Table I.3.9l	**Total**	**188100**	**233144**	
		Turnover	**2542987**		

The turnover of inventoried yacht- and sailing clubs amounted to 2.543 Mio EURO (value 2000), and was mainly derived from 'landing stage' charges (Ecolas 2000).

The total impact of coastal marinas on the economy is much higher than the estimated returns, because of the many indirect effects (purchase of boats and material, hotel and catering industry, provision of services, tourism … etc). The study estimates that the total added value of coastal marinas to be about 25.26 million euros (Resource Analysis 2003).

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[9] Extrapolation to all inventoried maiden trips and boat trips. (only of the 7 activities in table 2 numbers were known)
[10] Retribution is 1.24 EURO/m²

The total inventoried public and commercial activities which require a permit (Ecolas 2000) in the sea area of Belgium generate income for about 150-200 people. In summer months this can rise due to hiring of students.

Occupancy rate in the coastal marinas:

At present there is little accurate data available concerning the tourist activity in the marinas (Maes et al. 2002). According to estimates of the province of West-Flanders, yachts yearly realise 340000 overnight stays, with a mean occupation of 3 persons per night per vessel and approximately 30 overnight stays in the home port (or another port along the Belgian coast)[11].

Turnover in the marinas:

There is virtually no data available regarding the expenditure of coastal tourists that are accommodated on their yacht in the coastal marinas. Therefore, only a very rough estimate can be made of the turnover in the marinas. Expenditure can be classified in yearly recurring costs on the one hand and expenses during the stay in the marina on the other hand. The Province of West-Flanders estimates the expenditure per night to be about 32 euro for stays overnight aboard yachts. The fixed cost per vessel is estimated at about 1735 euro yearly[12] (Maes et al. 2002).

Table I.3.9p: Estimate of the return in coastal marinas, 2000 (Source: estimates by Westtoer 2002, Province West-Flanders)

Units	Expenditures per unit (€)	Total estimated expenditures (mio €)
Fixed costs (3.057 vessels)	1735	5.3
Overnight stays (340.000)	32	10.9
Total		16.2

The total yearly turnover from coastal marinas is estimated to be 16.2 million euro. However, this number doesn't take into account visitors from other marinas that spend the night on the Belgian coast. Besides this, the presence of a marina plays an important role in the attractiveness of a coastal community[13].

It is clear that the socio-economic interest of overnight stays in the coastal marinas cannot be correctly reported and that further research is required.

The WES inquiry (Resource Analysis 2003) divided the mean annual expenditures for sailing in the following categories (Table I.3.9q).

[11] Strategisch Beleidsplan voor toerisme en recreatie aan de Kust, o.c., p. 156.
[12] Strategisch Beleidsplan voor toerisme en recreatie aan de Kust, o.c., pp. 160-161
[13] Strategisch Beleidsplan voor toerisme en recreatie aan de Kust, o.c., p. 156.

Table I.3.9q: Mean annual expenditures for sailing, WES-inquiry 2002-2003 (in Euro)

Sailing	Mean annual expenditures per boat boot (in Euro)	Number of observations in the sample	Remarks
Membership	1045	17	
Maintenance of the boat	1135	16	
Fuel	70	10	
Insurance	360	14	
Landing costs	680	2	Mean annual expenditures per boat if the boat ties up in another port then the home port
Course fees	800	2	Mean annual expenditures per person if lessons are followed

Social

Companies/persons organising a (amphibian) boat trip don't have a fixed clientele and are dependent on weather conditions. Vessels such as the 'Seastar' and 'Euroline' can go on in less favourable weather conditions. Sailing trips are on the other hand more dependent on the weather. Most sailing trips occur between the first half of April and the end of September, because the weather conditions are best during this period. Sailing trips organised in the early- and late season are largely on appointment or only take place during the weekends. Cruises organised by shipping companies mainly bring together day-trippers or people on holiday at the coast.

Activities relating to sailing and yachting have a fixed, broad clientele. That means only persons interested in this activity participate in these activities, but the age is very diverse. Clubs and associations bring together many people. They don't restrict their activities to the summer months but are virtually year round accessible to the public. This is certainly true for yachting- and sailing clubs.

The sailing- and yachting activities thus attract a specific audience while conversely sailing and pleasure cruises have a broad audience.

The inquiry (WES 2002-03, n=47) shows that 72.3% of the sailors in Flanders are a member of a water sport club.

In Flanders 25% of the respondents (n=128 other activities on the water) are members of a water sport club (WES-inquiry 2002-03).

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10 AQUACULTURE

10.1 DESCRIPTION

Aquaculture in the Belgian part of the North Sea consists mainly of restocking experiments of sole (*Solea solea*) and turbot (*Psetta maxima*). Additionally mussel (*Mytilus edulis*) - and oyster (*Ostrea crassostrea*) culture is studied respectively in the open sea and in enclosed areas.

"Stock enhancement" or "enhancement aquaculture", involves the culture of species in land-based hatcheries and nurseries, and their subsequent release into the wild, where they can grow and take part in reproduction or be captured for consumption.

Belgian restocking experiments are primarily focused on commercially important flatfish, viz. sole (*Solea solea*) and turbot (*Psetta maxima*). Research efforts aim to economically produce high quality restocking material, especially with respect to adaptiveness to natural conditions and the genetic pattern of the reared fish controlled reproduction.

The Sea Fisheries Department started with research on the possibilities of renewing fish stocks in the North Sea through restocking in 1997. The turbot was chosen as the model species on which to perform a restocking experiment within the Belgian coast due to its high market value. The capture of this species in wild is subject to direct restrictions (turbot is after all a quota-species). The production in captivity is at present under satisfactory control.

The Belgian "enhancement" program was executed in several steps, to discover the circumstances for an optimal growth and survival of the released turbot. The first stage investigated whether the cultivated turbot could adapt to the natural environment. In the second stage the quality (survival, biological resistance…) of the cultivated turbot and their preconditioning to the natural circumstances was examined. The final stage of the research is focused on mass release, with a cost benefit analysis being made.

Through the amelioration of the seawater quality the cultivation of shellfish, such as the long line mussel culture in the open sea at Nieuwpoort, has again become feasible in Belgian coastal waters.

Finally, the Sea Fisheries Department is carrying out studies on the optimisation of intensive aquaculture using re-circulation systems and other more environment friendly production techniques, in order to improve fry quality and to minimise the impact on the environment. To achieve that aim it has a fully operational hatchery and nursery installation (including a direct connection with the sea for seawater intake) for the production of juvenile fish, particularly flatfish.

10.2. SUBUSES AND DESCRIPTION

Not applicable

10.3. LEGISLATIVE FRAMEWORK

(updated Cliquet A.)

Competent authority

Since 2002, aquaculture at sea has been re-assigned to the Flemish Government.

Legislation

(Maes and Cliquet 2005)

International legislation:

- Council Regulation (EC) No 2371/2002 of 20 December 2002 on the conservation and sustainable exploitation of fisheries resources under the Common Fisheries Policy, *Official Journal L* 358, 31 December 2002.

National legislation:

- Law of 20 January 1999 on the protection of the marine environment in the marine areas under Belgian jurisdiction, *BS* 12 March 1999; as amended. The deliberate introduction of non-native organisms in sea areas is prohibited, except where a license is granted by the King. The in-deliberate introduction of non-native organisms through the ballast water of ships can be forbidden. The deliberate introduction of genetically modified organisms in the marine environment, native or not, is completely prohibited (art. 11).

Regional legislation:

- Decision of the Flemish government of 21 April 1993 concerning the introduction of non-native animal species into nature, *BS* 31 July 1993.
    - The introduction of non-native species into nature is forbidden in the Flemish Region, except with a license.

10.4. EXISTING SITUATION

10.4.1. Spatial delimitation

Turbot

In June 1998, 1962 turbot were released into a zone (51°12’00 N en 02°45’60 E) that was closed temporarily for fishery.

Sole

The release of sole juveniles in 2000 took place in coastal waters (between Nieuwpoort and Bredene), more precisely in the area at the west side of the "Stroombank". This area had previously been used for the release of turbot. In dialog with the commercial fishery industry, this area was closed on a voluntary basis to all fisheries and was made recognizable by buoys. The locations of the buoys that defined the area for scientific research were:

- 1. 51°12,35 N - 02°42',00 E
- 2. 51°12',65 N - 02°42',97 E
- 3. 51°13',00 N - 02°44',05 E

- 4. 51°13',37 N - 02°45',18 E
- 5. 51°13',90 N - 02°46',25 E
- 6. Zuidstroombank lightbuoy
- 7. 51°12',07 N - 02°46',32 E
- 8. 51°11',87 N - 02°45',33 E
- 9. 51°11',63 N - 02°44',25 E
- 10. Weststroombank lightbuoy

The release of sole in 2001 (18/06/2001) did not take place at open sea but in the fairway to the port of Oostende.

Long line mussel culture

A few research and feasibility projects have taken place along the Belgian coast with long line mussel cultures. The challenge for these projects was that long line mussel culture is at open sea[1] and not - as usual in other European countries - in naturally protected bays (France, Scotland, Norway) or in a closed arm of the sea (the Netherlands). The reasons for mussel culture at open sea are that the water quality is better at open sea than closer to the coast (especially bacteriological), and that the Belgian coastline has no natural bays to cultivate shellfish. The long line culture therefore needed to be robust enough to endure the strong currents and storms in the southern North Sea. The main destructive force appeared not to be nature but human activity. Despite the fact that the installation was anchored in an area where no passage was allowed (in dialogue with the Piloting services and the service of Sea fisheries), the culture was several times passed over and largely destroyed. The few remainders of long line culture however gave extraordinary good results and the project was continued.

The long line mussel culture was transferred to a zone closer to the coast and better protected against the passing of ships. On this location the spat settlement (the fixation of young mussels to a hard substrate) was so spectacular that thinning out should be considered in the future. There is already a big interest from our northern neighbours in buying the young mussels for their Zeeuwse bottom cultures, because of the disappointing spat settlement in the Waddenzee. The Waddenzee is the traditional area for spat collection for the Zeeuwse mussel cultivators.

Location

- Phase 1: "north of Buiten Ratel 1999". This was a closed zone where no passing was allowed. In 1999 1200 metres of long line mussel culture was placed. Unfortunately several ships did pass this area, displacing the lines and causing them to get intertwined.
- Phase 2: "D1-buoy 2000". This is an area of 0.09 km² north of the "Noordpas", namely around the D1-buoy (an extension of the "Smal bank"). The fact that a shallow shipwreck lies at this site, and an East Cardinal buoy is present, means that this site cannot be used for fishing or navigation. The construction consisted in total of 45 harvesting ropes with a length of 10 metres each, a total of 450 m of harvesting rope. As this construction showed some shortcomings a further phase was executed.
- Phase 3: "D1-buoy 2001". During the project the construction was regularly altered according to the needs and problems encountered. The new long line mussel culture had 2 stages. In the first phase, the collection of mussel larvae, the construction consists of a main cable with a length of 100 m attached to carrying buoys. 20 Polypropyl harvesting ropes (15 metres in length, 12 mm thick) are attached to this main cable. During the second phase the harvesting ropes are taken

[1] In a zone of 5 to 10 mile in front of the coast of Nieuwpoort

out of the water to collect the young mussels. These are subsequently graded and put into culture stockings which are installed under floating cages. In 2001 19 of the 20 hanging installations were destroyed by vessels passing the area.

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Reliability margin

The 2 above-mentioned institutions are the leaders in the field of aquaculture in Belgium and the ARC enjoys international recognition of its competencies.

Future prospects

Further research on the restocking programs of sole and turbot, with the main emphasis on raising the survival rate of the released animals.

Feasibility study on the integration of aquaculture and stock enhancement in wind farms. National co-operative programme - Financed by the Belgian Government.

10.4.2. Type and intensity

Intensity surface-unit

Turbot:

In June 1998, 1962 Turbot[2] were released in a zone (51°12'00 N en 02°45'60 E) that was temporarily closed for fishery activities. Of the 1962 released animals 313 were reported recaptured in the first year and a half – a recapture of approximately 16%, which is relatively high in comparison with other European restocking projects. Results show that the juvenile turbot stayed mainly in front of the Belgian coast during the first months after release, more precisely in the surroundings of the Thornton Bank, the Oostdyck and the Bergues Bank. Starting around October/November, the animals migrated to deeper water, and moved more northwards to the southerly North Sea. From the release area the turbot dispersed with an average velocity of 0.1 nautical miles a day, and an average dispersal coefficient of 7.5 square nautical miles. In springtime the migration pattern was characterised in general by a return to less deep coastal water, while some penetrated into the English Channel.

[2] 5BW/EOGFL29B/A.4.1. Uitzetten van gekweekte tarbot met het oog op re-stocking

Sole:

In 1999[3] an experiment with sole – the commercially most important species for the Belgian sea fishery- was conducted. On June 8th 2000 some 500 sole were marked and released into the Belgian coastal waters. Another 10000 were released in springtime 2001.

In 2000 two groups were released: the first on June 29th 2000 and the second on 18th of December 2000.

The release of sole in 2001 did not take place at open sea but in the fairway of the port of Oostende. In total 1222 marked sole were released on June 18th 2001. The average length was 16.4 +/- 1.7 cm.

The project ended early and the number of recaptured animals was very limited. The results show, however, that the released sole can adapt to the natural environment, as a very good growth was reported (for example 5.4 cm growth in less then 3 months). Probably the recapture numbers will get higher as the sole migrate to deeper waters.

Long line mussel culture:

The results of the long line mussel culture are:

- Phase 1: "north of Buiten Ratel 1999". The mussel seed attached to the harvesting ropes and the growth was good (an estimated biomass of 6 kg/metre harvesting rope). There was no growth of barnacles or other animals or algae, which means that the mussels do not need to be cleaned after harvesting.
- Phase 2: "D1-buoy 2000". The location looks promising because of the rich growth of mussels (exact production numbers can only be given when a cage is being harvested). Characteristic again was the absence of barnacles or other animals or algae, which means that the mussels do not need to be cleaned after harvesting.
- Phase 3: "D1-buoy 2001". The growth on the cages was very large, namely 21 kg/metre harvesting rope. This means thinning out is necessary to maintain high production and growth. The growth was very good. In 10 months some mussels had reached a length of 6 to 7 cm. This means that at the beginning of the mussel season mussels are ready to be harvested.

Frequency per unit time

Turbot:

First release experiment of turbot: June 1998.

Sole:

First release experiment of sole: 29th of June 2000 and 18th December 2000.

Second release experiment of sole: 18th of June 2001.

Long line mussel culture:

The Flemish mussels show a very fast growth, and reach a length of 4-5 cm after 6 months, with maxima of 7 cm. The return is high, with 21kg mussels per metre rope, where hanging culture normally only yields 10 kg/m.

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[3] 5BW/EOGFL43B/A.4.1. Uitzetten van gekweekte Noordzee tong met het oog op re-stocking

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Reliability margin

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Future prospects

Complementary utilisation of the wind farm by the fishery industry:

1. Use closed area for restocking

Restocking of turbot, sole or other fish species.

2. Limited fishing on commercially important species

It is possible that wind farms may enable fishery of lobster and octopus. Furthermore the artificial reef attracts big predators such as conger, codfish and sea perch, which have a high commercial value. In such conditions the revenues in relation to production can be much higher than for the North Sea in general, because specific fishing techniques have to be used, which are potentially very efficient and result in less discards.

3. Long line mussel culture

A combination wind farm-shellfish culture (mussels, oysters, etc.) is currently thought to be one of the best options for the future. As wind farms are off limits to navigation, hanging cultures of mussels can be installed directly under the water surface, without the risk of being damaged. However, the water quality around the wind farms must meet stringent demands for the cultivation of shellfish.

4. Free fish farming at sea

The concept of a free sea farm relies on the conditioning of land based cultivated fry to recognise an acoustic signal that the fish associate with food (Pavlov-reflex). Once the fish are conditioned to the signal, they can be released into the open sea, preferably into places suitable for fattening up and/or their full life cycle. Such a location can then be further built out with artificial reefs or other aggregating structures, which provide additional stimuli and conditions (increasing natural prey animals, hiding places against predators,…etc) to stick to that location. Once the fish have reached the landing length, fishermen can catch the schools with selective fishing gear.

10.5. INTERACTIONS

10.5.1. Suitability for user

Biological suitability

A feasibility study in 1993 indicated that the water quality of the North Sea is too poor to make commercial aquaculture possible. An alternative proposition was made to perform aquaculture in Zandvoorde by the pumping up of salt water.

Since 1971 the quality of mussels at different locations along the Belgian coast has been examined. In respect of heavy metals, and more specifically mercury and lead, there is a linear decline over time. This is mainly due to a lesser influx of heavy metals through rivers and during the discharge of dredging from the ports of Oostende and Zeebrugge. A decline of PCB concentrations in the meat of the mussels has also been observed. In other words, the water quality of the coastal water has improved in comparison with 10 years ago.

10.5.2. Impact on other users

Spatial conflict

Shipping:

The cultivation of mussels (*Mytilis edulis*) in hanging culture is disrupted by the movements originating from maritime shipping. A possible solution to this problem is to cultivate mussels in the surroundings of wind farms where no navigation will be allowed.

Tourism:

Aquaculture can compete with leisure activities, as they are often located close to the coast.

10.5.3. Impact on environment

Biological

Stock enhancement:

The technique of stock enhancement consists of parent-animals kept in captivity till spawning. Afterwards the larvae and juveniles are cultivated under controlled conditions until they reach an optimal length to be released in the wild. In nature these animals grow further until they're large enough to be caught. Not all released fish are captured in the following years, so the remainder can take part in reproduction and contribute in this way to recruitment. The introduction of cultivated animals in the 'nursery rooms' has little or no negative impact on the environment, because the carrying capacity of most habitats is not fully exploited.

Aquaculture:

Many of the aquaculture farms operate without a negative impact on the environment. However, the farming of shrimp and salmon has been found to have a negative impact on the environment. Overcrowding seems to be the major cause of environmental problems. (Marsh and Wolslegel 1998)

Adverse effects from aquaculture result from: (a) solid or soluble wastes (source nutrient pollution); (b) chemical and pharmaceutical usage; and (c) wildlife interactions. The effects of aquaculture vary according to the type of farm and the surrounding environment (NOO 2002).

Fish farms, especially, release high number of wastes (uneaten faeces and fish food) into the environment. Impacts typically associated with severe organic enrichment are a reduction in sediment oxygen levels and the subsequent production and release of methane and toxic hydrogen sulphide (Pearson and Rosenberg 1979). Changes in sediment chemistry affect the benthic ecosystem, and may result in major changes to the species composition of sediment flora and fauna in affected areas (Ritz and Lewis 1989).

The one area of aquaculture production that produces minimal nutrient pollution is mollusc farming. Because oysters, clams, scallops, and mussels consume the existing phytoplankton, mollusc farmers do not need to use feeds that will not lead to the reduction of oxygen levels in the water.

Particular concerns also exist over the risk of genetic contamination and ecosystem disruption. Such concern could adversely affect the "quality" status, and demand, for aquaculture products.

In addition, shrimp and salmon need to be fed by other fish, such as sardines and mackerel, for survival. Growing a pond of salmon may require three to five pounds of wild fish (Marsh and Wolslegel 1998). As a result, shrimp and salmon consume more protein than they produce. If the growing of fish produces a net loss of protein, then aquaculture creates a negative ecological impact.

As mentioned, nutrient enrichment by aquaculture can have negative effects on the environment, but nutrient enrichment of water bodies may in turn affect the aquaculture production. Water bodies provide nutrients beneficial to aquaculture production in some extensive culture systems (e.g. seaweeds, molluscs). However, excessive loadings with urban and industrial wastes can have severe consequences for aquaculture operations, particularly shellfish culture, when exposed to contamination by toxic pollutants, pathogens and phycotoxins (algae blooms). With increasing aquatic pollution and physical degradation of aquatic habitats by other developments, aquaculturists can face risks such as mass mortality of farmed stock, disease outbreaks, product contamination and reduced availability of wild seed or broodstock (http://www.fao.org).

Environmentalists are also concerned with the installation of sound devices by salmon aquaculture farmers and the killing of wild predators. Sound devices are intended to eliminate seals from intruding into the farming area. To control bird and mammal predation, some aquaculturists have resorted to killing the wild animals.

Biological pollution is another environmental problem related to aquaculture because ecosystems are being altered and biodiversity is being reduced. For instance, aquaculture can be the cause of the introduction of non-native species from one area to another.

Farm structures and the use of machinery and boats can alter benthic communities by modifying and disturbing habitats (NOO 2002).

Geological/physical

Sediment accretion and compaction can result from heavy machinery used in algae, fish and shellfish growing areas (Buschmann et al. 1996; Laffoley 2000; Cooke and McMath 2001; Crawford et al. 2001).

Hydrological

The local hydrodynamics of an area are altered by aquaculture structures such as intertidal racks, trestles, long-lines, wharf facilities and fish cage infrastructure (Kaiser et al. 1998).

10.5.4. Impact on socio-economy

Economic

At present the long line mussel culture is still in a testing phase. A cost benefit analysis will soon be made, to examine whether the cultivation of Flemish mussels on a larger scale is economically feasible. An important condition of the commercial production of shellfish is the regular monitoring of bacterial contamination of the cultivation water and of the mussels, and of the phytoplankton in the cultivation water. Especially the latter is of importance, because some types of phytoplankton can cause intoxication such as DSP (Diarrhoeic Shellfish Poisoning) and PSP (Paralytic Shellfish Poisoning) to the consumer.

The research into the cultivation of mussels at the Belgian coast can open the way to more diversification of fishery products and lead to a new typical regional product for the 'Middenkust': the Flemish mussel. This would not only break the monopoly of the Zeeland mussel, but at the same time give a new dynamism to the Middenkust. Several actors such as the distribution sector, the fish processing companies, the fishmonger's shops, the hotel and catering industry and the whole tourist sector, can benefit.

Social

With the growing world population, the demand for proteins raises. To suffice the food supply of the future generations, the actual fishery production (fish- crustacean and molluscs) should rise by half. Such a rise is impossible. Aquaculture is one of the most promising branches within the agro-industry as it continues to show significant growth. Yet aquaculture will not be able to suffice the growing demand for proteins, especially because aquaculture is mainly focused on luxury products, such as oyster, salmon, turbot, rockcod, snapper….etc

Clearly there exists a need for alternative methods to raise fish production. One of them is the artificial accruement of fish stocks by releasing cultivated juvenile fish, otherwise known as "stock enhancement" or "enhancement aquaculture".

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11 SCIENTIFIC RESEARCH VESSELS

11.1 DESCRIPTION

For completeness of users of the BPNS a short description of the use of research vessels will be given. As this activity is, compared to other uses, very small, this chapter should be viewed essentially as supplementary information.

Two vessels are currently used for scientific research: the Belgica and the Zeeleeuw.

The Belgica

The oceanographic research ship RV Belgica A962 belongs to the Belgian State and falls under the responsibility of the Belgian Science Policy. The ship and its scientific equipment are managed by MUMM, which is also responsible for planning and organising scientific campaigns at sea. The Belgian navy provides the crew and takes care of the operational aspects as well as the moorage in Zeebrugge, the Belgica's home port. The vessel was laid down on October 17th 1983 at the BOEL shipyard in Temse, and commissioned on July 5th 1984.

This all-purpose research vessel, which spends around two hundred days a year at sea, both monitors the quality of the marine environment and undertakes numerous expeditions for scientific research.

The Belgica monitors the quality of the North Sea by constantly collecting all sorts of data on the biological, chemical, physical, geological and hydrodynamic processes which take place there. In addition to this, the ship is a floating laboratory for researchers from the universities and scientific institutes of Belgium in their quest for a better understanding of the structure and working of the ecosystem of the North Sea.

In addition the Belgica is also used during incidents at sea. As soon as reports come in of a shipping incident involving a dangerous load or an oil spill, the Belgica change course immediately if necessary and makes its way to the site of the catastrophe. In this case, its task is primarily to examine the impact of the incident on the sea environment by taking regular water samples and measurements.

The Zeeleeuw

The Fleet Division (Waterways and Marine Affairs Administration, Environment and Infrastructure Department of the Ministry of Flanders) and the Flanders Marine Institute (VLIZ) cooperate to organize scientific cruises with the Zeeleeuw in the Belgian coastal waters and the Westerschelde estuary. The Fleet Division owns the Zeeleeuw, bears the operational costs and provides the crew. VLIZ takes care of the cruise schedules and manages the collectively used research equipment and infrastructure.

The vessel Zeeleeuw, formerly the pilot vessel 2, was built in 1977 to serve as a pilot tender to bring pilots to and from Vlissingen to the anchorage area Westhinder. The Authorities of Flanders decided that this vessel would be put into operation for marine scientific research as a platform for sampling campaigns. In 2000 the vessel was updated and renovated into a multifunctional research vessel.

11.2. SUBUSES AND DESCRIPTION

Not applicable

11.3. LEGISLATIVE FRAMEWORK

(updated by Cliquet A.)

Legislation

(Maes and Cliquet 2005)

International legislation and Belgian implementation:

- United Nations Convention on the Law of the Sea, Montego Bay, 10 December 1982: Part XIII on schientific research
    - Implementation in Belgium:
        - Law of 18 June 1998 on the approval of the Convention on the Law of the Sea of 10 December 1982 and the Agreement relating to the implementation of Part XI of the United Nations Convention on the Law of the Sea of 10 December 1982 of 28 July 1994, *BS* 16 September 1999.

National legislation:

- Law of 22 April 1999 on the Belgian exclusive economic zone in the North Sea, *BS* 10 July 1999: art. 40-45 on scientific research in the territorial sea and the exclusive economic zone.
- Law of 20 January 1999 on the protection of the marine environment in the marine areas under Belgian jurisdiction, *BS* 12 March 1999; as amended: art. 8 (scientific research is allowed in marine reserves); art. 10 (exceptions to species protection for scientific research); art. 14 (measures for dead or wounded marine mammals), art. 25 (no environmental permit is required for scientific research).

11.4 EXISTING SITUATION

11.4.1. Spatial delimitation

Both ships operate troughout the whole of the BPNS. No specific delimitations exist on the BPNS for use of both vessels, except those dictated by good seamanship (water depth, collision risk, etc.) and areas forbidden for access with vessels.

The spatial location of the operation of the vessel is registerd automatically (GPS) by the vessels at a high frequency. For the prupose of this project locations were rounded to the nearest 1/10 of a minute or 1/1000 of a degree (Zeeleeuw). The locations were collected for the years 2002 and 2003, and the number of observations per 10 second period (Belgica) or 5 second period (Zeeleeuw) within each grid was counted (Maps I.3.11a-b).

Source

MUMM (Management Unit of the North Sea Mathematical Models and the Scheldt estuary)
Gulledelle, 100
B-1200 Brussels (St Lambrechts-Woluwe/Woluwé-St Lambert), Belgium
http://www.mumm.ac.be

VLIZ (Flemish Institute of the Sea)
Pakhuizen 45-52
B-8400 Oostende, Belgium
http://www.vliz.be

Reliability margin

The reliability of the data is very high. The 2 above-mentioned institutions are each responsible for one research vessel. They both enjoy international recognition of their competencies and are both recognised as international data management centres.

Future prospects

Spatial location and intensity are depending on the specific research budgets that are funded by regional, national or international programs, and that include ship time. Part of the activity is also dedicated to monitoring and management activities that will normally continue in the future.

11.4.2. Type and intensity

Intensity of use is expressed in two ways. A difference is made between activities at high speed (>1 knot) and activities at low speed (<= 1 knot). Low speed corresponds quite well to sampling activities (trawling, coring, etc.), whereas high speed corresponds to "normal" sailing or sampling at high speed (eg. bathymetry). As described above number of counts for each grid cell (0.1 min or 0.001 degree) were collected for the years 2002 and 2003 (Maps I.3.11a-b).

Source

Serge Scory
MUMM (Management Unit of the North Sea Mathematical Models and the Scheldt estuary)
Gulledelle, 100
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Francisco Hernandez
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Pakhuizen 45-52
B-8400 Oostende, Belgium
http://www.vliz.be

Reliability margin

The reliability of the data is very high. The 2 above-mentioned institutions are each responsible for one research vessel. They both enjoy international recognition of their competencies and are both recognised as international data management centres.

Future prospects

No specific points to be remarked.

11.5. INTERACTIONS

11.5.1. Suitability for user

The whole of the BPNS is suitable for exploration by research vessels. The only limitation is the draught of the vessel. However, if very shallow areas need to be explored other ships or vessels can be used (eg. rigid inflatable boats).

11.5.2. Impact on other users

No relevant impact on or conflict with other users could be identified. This activity is manageable with all other activities.

11.5.3. Impact on environment

Impact on the environment is basically similar to impact described for shipping, with the additional remark that due to its nature, research vessels are normally designed or adapted to have minimal impact. Sampling has such also has a minor impact.

11.5.4. Impact on socio-economy

The direct impact on socio-economic aspects is very limited. This will be restricted to the jobcreation and their economic consequences for crewmembers.

11.6. REFERENCES

Maes, F. and Cliquet, A., 2005. Codex wetgeving kustzone, Brugge, Vanden Broele, vol. 2.

http://www.mumm.ac.be/EN/Monitoring/Belgica/index.php accessed on May 10 2005

http://www.vliz.be/En/Activ/zeeleeuw.htm accessed on May 10 2005

http://www.mil.be/navycomp/units/index.asp?LAN=en&FILE=unittext&ID=669&PAGE=1&MENU=0
accessed on May 10 2005

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12 NATURE CONSERVATION

12.1 DESCRIPTION

The term 'Nature conservation' includes all coastal and marine areas that have received (or could receive) some kind of protection status, together with information on valuable marine areas.

12.2 SUBUSES AND DESCRIPTION

Different types of nature conservation areas can be distinguished and each of them have separate types of uses:

- **Ramsar sites** ('Wetlands of international importance'): *The Convention on Wetlands of International Importance especially as Waterfowl Habitat*, signed in Ramsar, Iran, in 1971, is an inter-governmental treaty which provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources (RAMSAR 2004). The Ramsar convention defines wetlands as comprising of stretches of marsh, peat land or natural or artificial water, either permanent or temporary, where the water is static or running, fresh, briny or salty, including stretches of seawater where the depth does not exceed 6 metres at low tide (MUMM 2003). Appropriate wetlands should be included in the list of wetlands of international importance if they play an international role from an ecological, botanical, zoological, limnological or hydrological point of view. The Conferences of the Parties worked out criteria for designation sites as wetlands of international importance. One of the criteria is the so-called 1% criterion: if the wetland is home to at least 1% of the bio-geographical population of a bird species ecologically depending upon these wetlands each season, then this zone will be included in the list of wetlands of international importance for birds as a priority. The Convention on Wetlands came into force for Belgium on 4 July 1986.
- **Beach reserves**: Nature reserves situated on the beach.
- **Marine protected areas**: All marine areas receiving a degree of protection under the Law of 20 January 1999 on the protection of the marine environment in the marine areas under Belgian jurisdiction are considered to come within the meaning of this term. These could be integral or specific marine reserves, special protected areas or special areas of conservation, closed areas or buffer zones.
- **NATURA 2000 areas**
  - **Habitats Directive areas**: The Habitats Directive (Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora) provides for the establishment of a coherent ecological network of special conservation zones. This network, Natura 2000, is designed to guarantee the conservation of a minimum level of biodiversity in Europe. The types of habitat that take priority include, amongst others, sand banks with only a shallow covering of seawater (definition habitat 1110 Pal.Class 11.25: Sand banks with permanent shallow covering of seawater (rarely more than 20 m below MLLWS). The Habitats Directive also recognizes that conserving habitats of great value and the diversity of landscapes makes it possible to conserve marine diversity. This is why the shallow sandbanks are to be protected as a priority (MUMM 2003).
  - **Birds Directive areas**: Pursuant to article 4 of the European Birds Directive (Directive 79/409/EEC of 2 April 1979 on the conservation of wild birds) the Member States need to take protection measures for the sea and coastal areas where birds, described in Annex I, are

living, so that they can continue to exist and reproduce in these places. Similar measures need to be taken for bird species that aren't mentioned in Annex I, but which occur in high densities or are threatened or very rare. A number of species occurring in the North Sea satisfy these (internationally determined) criteria and so the species or their habitats need to be protected.

12.3 LEGISLATIVE FRAMEWORK

(updated by Cliquet A.)

12.3.1 Ramsar sites

Description

The area of the Coastal Banks in the territorial sea is designated as a Ramsar area, but no protection measures (as indicated in article 3 (1) of the Convention) have been taken. The Flemish territorial sites that have been designated as Ramsar areas are protected with certain measures (regulations on environmental impact assessments and Decree on vegetation changes; see Cliquet (2000), but these Flemish measures are not valid in the territorial sea, as this falls under the competence of the federal government. Attempts to designate the Coastal Banks as a nature reserve failed, which can be considered as a breach of article 4 (1) of the Convention.

Another area in the coastal zone that was designated as a Ramsar area was the Zwin area (including the beach zone in front of it). As this site is situated in the Flemish Region, certain measures (regulations on environmental impact assessments and Decree on vegetation changes) apply.

Legislation

(Cliquet et al. 2004 ; Maes and Cliquet 2005)

- International Convention on Wetlands of International Importance especially as Waterfowl Habitat, Ramsar, 2 February 1971).

  - Implementation in Belgium:

    - Law of 22 February 1979 concerning the approval of the Convention on wetlands of international importance especially as Waterfowl Habitat, *BS* 12 April 1979.

    - Royal Decree of 27 September 1984 concerning the designation of water areas of international importance, *BS* 31 October 1984, amended by the Decision of the Flemish Government of 27 May 1987, *BS* 1 August 1987.

12.3.2. Beach reserves

Description

The Baai van Heist was designated in 1997 as a Flemish nature reserve (Ministerial Decree of 22 October 1997, *BS* 18 December 1997, amended by the Ministerial Decree of 13 July 2000, *BS* 5 September 2000). The coordinates of the area were not given; only a description is available: the area situated in Knokke-Heist between a western boundary which lies at 10 metres distance from the eastern dam of the harbour of Zeebrugge parallel with the eastern dam, the dike, the mean low water line and a eastern boundary which lies at 500 metres distance from the eastern dam of the harbour of Zeebrugge (not numbered in the land register).

The beach of the Ijzermonding was designated in 1999 as a Flemish nature reserve (Ministerial Decree of 3 March 1999, *BS* 9 April 1999, extended by the Ministerial Decree of 27 September 2001, *BS* 24 October 2001). The coordinates of this area were not given; only a description is available: area situated in Nieuwpoort, along the channel of the river Ijzer and including the grounds, known in the land register as Nieuwpoort, first division, section F, parcel numbers 6 F2, 6 S, 6 T, 6 X, 6 Y, 6 A2, 6 E2, 6 G2, 6 K2, 8 B, 10 C2, 6 H2, 10 X, 10 Y, 10 B2, 10 D2, 10 E2, 10 F2 and 351 G, with a total surface area of 52 ha 61 a 54 ca. This area also includes: the entrance way and adjacent pool, known in the land register as Nieuwpoort, first division, section H/2, parcel number 349 B2; the regional property between the eastern low harbour dam (not including the dam itself) of the channel of Nieuwpoort; the high water line (including the dune foot reinforcement); the low water line of the sea charts (which constitutes the boundary between the Flemish Region and the territorial sea); and an eastern boundary that lies 1100 metres from the eastern low harbour dam of the channel of Nieuwpoort, is orientated perpendicular to the high water line, and connects the high water line with the low water line as shown on the sea charts.

This latter nature reserve was extended to 53 ha 11 a 06 ca with the inclusion of the regional property (not numbered in the land register) situated between the former eastern boundary line of the nature reserve, the low water line of the mean low water spring (as indicated on the sea chart) and the high water line (including the concrete dune foot reinforcement and the second groin with respect to the harbour dam of the channel of Nieuwpoort).

Although the designation of an area as nature reserve is the most stringent way to protect these biotopes, it is clear that two beach reserves alone will be insufficient to protect the beaches in a sufficient way (Herrier 2002).

Another problem associated with beach reserves is the seaward boundary. The division of jurisdiction between the federal and the regional government means that the seaward boundary is located at the low water line. Beyond this line the federal government holds jurisdiction. Despite this the beach forms an ecological entity with the sublitoral zone. There are also certain uses, like beach fisheries, which can cause disturbance to the beach reserve from the zone beyond the low water line. To be able to protect the beach reserves in a sufficient, and ecologically justified way, the designation of marine reserves, adjacent to the beach reserves is of utmost importance (Herrier 2002). The legal basis for designating marine protected areas, including marine reserves adjacent to beach reserves, is set out in the Law of 20 January 1999. This law provides for future marine nature reserves to be integrated and for activities that are unrelated to management of the nature reserve to be prohibited. However, certain exceptions exist:

- Commercial fisheries are still allowed, but the activities can be limited or prohibited by the King after a common recommendation of the Minister of Agriculture and the Minister of Environment (art. 8, iv). Note: recreational fisheries are prohibited in the nature reserves.
- Shipping and military activities are still allowed, but can also be limited by the application of certain legal decrees.

Area specific nature management has yet to be implemented. However, the Royal Decree of 21 December 2001 was implemented by the federal government in order to avert the threat of beach fisheries beyond the low water line.

Only a small part of the beaches on the Belgian coastline receive protection under the Dune Protection Decree of July 1993.

The wet beach and large parts of the dry beach have not received any planological designation on the regional plans, even though they are included in the definition of nature areas under the Royal Decree of 28 December 1972. Even with a nature designation it wouldn't be possible to exclude all adverse activities from these beach areas. This is because, for example, the regulations on urban development for nature areas are very limited. Still it would help if certain parts of the beach were given a nature designation, because nature conservation measures are coupled to a planological 'nature' designation (for instance when the areas of Flemish Ecological Network are determined or when the spatial execution plans are developed).

Several regulations in the Royal Decree of the 4th of August 1981 limit the use of the Belgian beaches (including beach nature reserves).

For construction works in beach nature reserves special permits or concessions are required (see paragraph on 'Coastal Defense').

Legislation

(Cliquet et al. 2004 ; Maes and Cliquet 2005)

- Decree of the 21 October 1997 concerning nature conservation and the natural environment, *BS* 10 January 1998, as amended (= Decree Nature Conservation):
    - Article 34 (For these (beach) nature reserves a managing plan needs to be implemented and advisory commission needs to be installed)
    - Article 35 (declaration of prohibitions in the (beach) nature reserves (can be deprived by the managing plan if necessary). These prohibitions are extended with the prohibitions of the Ministerial Decree of 23 October 1975 concerning the regulations on the control, the police and the traffic in State nature reserves, outside the public streets, *BS* 31 December 1975.
- Baai van Heist: Managing plan: Ministerial Decree of 13 July 2000, *BS* 5 September 2000 / Advisory Commission: Ministerial Decree of 16 November 1998, *BS* 7 January 1999.
- Ijzermonding: Managing plan: not yet determined / Advisory Commission: Ministerial Decree of 21 May 1999, *BS* 17 August 1999.
- Decree of 14 July 1993 concerning the protection measures for the coastal dunes, *BS* 31 August 1993, as amended:
    - This Decree holds the legal basis for a building prohibition in the protected dune areas, but does not offer protection against other activities, like intensive recreation. The Baai van Heist was protected as a protected dune area by the Decision of the Flemish Government of 4 October 1995, *BS* 25 October 1995; ratified by the Decree of 29 November 1995, *BS* 30 November 1995.
- Royal Decree of 28 December 1972 concerning the design and implementation of the draft regional plans and regional plans, *BS* 10 February 1973.
- Royal Decree of 4 August 1981 on a police and shipping regulation for the Belgian territorial sea, the ports and beaches of the Belgian coast, *BS* 1 September; as amended.

12.3.3. Marine protected areas

Description

The legal basis for designating marine protected areas is provided under the Law on the Protection of the Marine Environment. The Law provides authority for the designation of marine protected areas and the implementation of appropriate nature conservation measures that are necessary for the protection of such areas. The law also provides a basis for taking specific protection measures in favour of certain species and contains a prohibition on hunting birds and marine mammals (Maes et al. 2000).

'Marine protected area' in the law is a general term and includes several categories: marine reserves, 'special protected areas' (Birds Directive), 'special areas of conservation' (Habitats Directive), closed areas and buffer zones.

In future marine nature reserves all activities will be prohibited unless they are included within the following exceptions:

- Commercial fisheries are still allowed, but the activities can be limited or prohibited by the King after a common recommendation of the Minister of Agriculture and the Minister of Environment (art. 8, iv). Note: recreational fisheries are prohibited in the nature reserves;
- Shipping and military activities are still allowed, but can also be limited by the application of certain legal decrees.

Legislation

(Cliquet et al. 2004 ; Maes and Cliquet 2005)

- Law of 20 January 1999 on the protection of the marine environment in the marine areas under Belgian jurisdiction, *BS* 12 March 1999; as amended.
- Royal Decree of 21 December 2001 concerning the species conservation in the marine areas under Belgian jurisdiction, *BS* 14 February 2002.

12.3.4. Habitats Directive areas

Description

Several areas of land within the Region of Flanders are already designated as Special Areas of Conservation under the Habitats Directive, but no marine areas are yet designated (only proposed!). When this happens the protection measures determined by the Directive should be transposed into federal legislation.

Parts of Belgium's beaches have been designated as Special Areas of Conservation (e.g. existing beach nature reserves), but no coordinates of these areas are given (only maps of the areas available).

Legislation

(Cliquet et al. 2004 ; Maes and Cliquet 2005)

- Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora *Official Journal L* 206, 22 July 1992 P. 0007 – 0050, as amended.

- Implementation in Belgium:

    - Decree of 21 October 1997 concerning nature conservation and the natural environment, *BS* 10 January 1998, as amended by the Decree of 19 July 2002, *BS* 31 August 2002.
    - Decision of the Flemish Government of 24 May 2002 concerning the designation of areas which are presented to the European Commission as Special Areas of Conservation, in execution of article, part 1 of the Directive 92/43/EEG of the Council of the European Communities of 21 May 1992 concerning the conservation of natural habitats and the wild fauna and flora, *BS* 17 August 2002.
    - Law of 20 January 1999 on the protection of the marine environment in the marine areas under Belgian jurisdiction, *BS* 12 March 1999; as amended.

12.3.5. Birds Directive areas

Description

Several areas of land within the Region of Flanders are already designated as Special Protected Areas under the European Birds Directive. When this happens the protection measures determined by the Directive should be transposed into federal legislation.

Parts of Belgium's beaches are designated as special protected areas (e.g. beach adjacent to Zwin area) under the Birds Directive, but no coordinates for these areas are given under the Annexes.

Legislation

(Cliquet et al. 2004 ; Maes and Cliquet 2005)

- Council Directive 79/409/EEC of 2 April 1979 on the conservation of wild birds, *Official Journal L* 103, 25 April 1979 P. 0001 – 0018, as amended.

- Implementation in Belgium:

    - Decree of 21 October 1997 concerning nature conservation and the natural environment, *BS* 10 January 1998, as amended by the Decree of 19 July 2002, *BS* 31 August 2002.
    - Decision of the Flemish Government of 17 October 1988 concerning the designation of Special Protected Areas conform article 4 of the Directive 79/409/EEG of the Council of the European Communities of 2 April 1979 concerning the conservation of wild birds, *BS* 29 October 1988, as amended.
    - Law of 20 January 1999 on the protection of the marine environment in the marine areas under Belgian jurisdiction, *BS* 12 March 1999; as amended.

12.4. EXISTING SITUATION

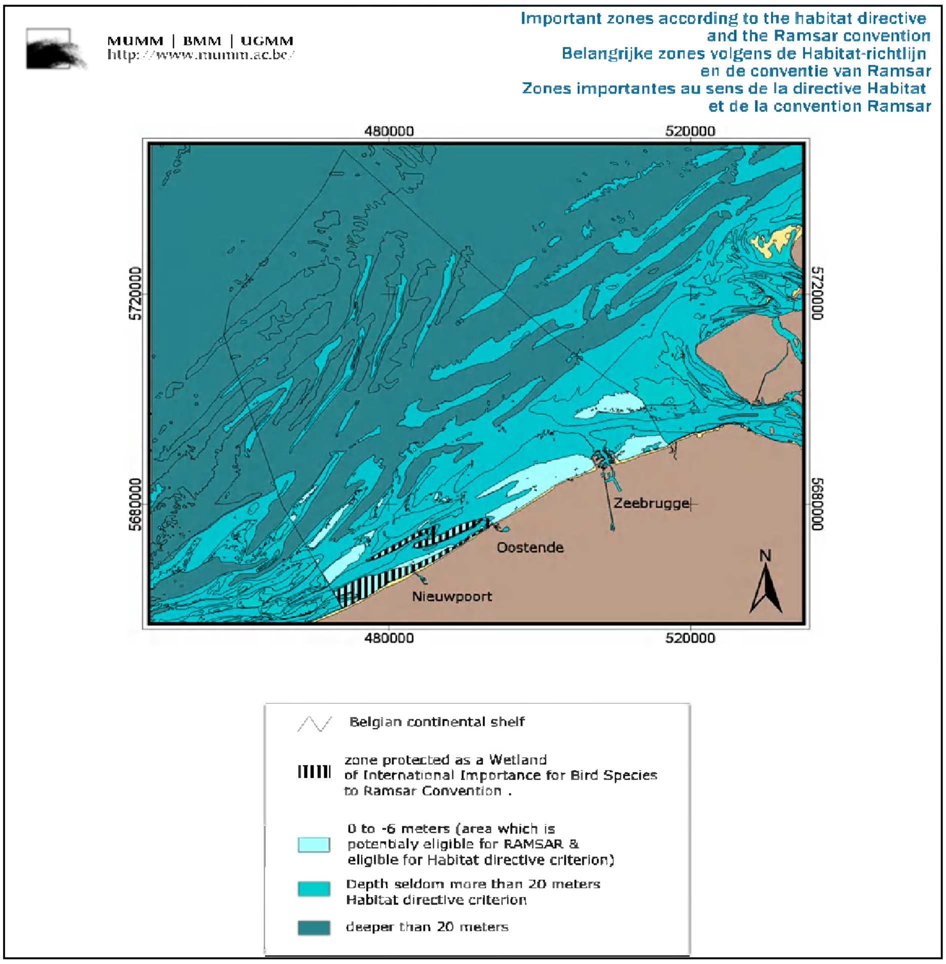
12.4.1. Ramsar sites

12.4.1.1. Spatial delimitation

The coordinates are given on the RAMSAR site (RAMSAR 2004) (Map I.3.12a).

Figure I.3.12a (MUMM 2003) gives an overview of the zones which are potentially to be included in the list of RAMSAR sites (represented in light blue) and which are already designated as a RAMSAR site (indicated with vertical lines).

Figure I.3.12a: Important zones according to the Habitats Directive and the Ramsar Convention (MUMM 2003).



Belgium presently has 6 sites **designated** as Wetlands of International Importance, with a surface area of 7935 hectares. Only **two areas** are situated in the study area of the project (MUMM 2003). A Ramsar zone has been approved in the Belgian part of the North Sea in order to protect the Black Scoter (Flemish Banks area). A detailed description of the two Ramsar sites is given on the RAMSAR website (Ramsar 2004):

<u>Flemish Banks area</u>

This should actually be named the **'Coastal Banks area'**:

General description:

The sandbank area, from Oostende to the French-Belgian border, extends 3 nautical miles from the baseline (although the Vlaamse Banken extend further into the sea) and shallower than –6 m MLLWS. The site includes the lowest zone of the beach and adjacent marine waters overlying submerged banks. (Ramsar site no. 326, designated since 27/09/1984).

Ecological features:

The area is used by large numbers of wintering grebes and sea ducks and provides important winter foraging and roosting areas for numerous species of shorebirds.

Human activities at the site:

Commercial fishing, water-based recreation, sand and gravel extraction.

Disturbance/Threats:

Wintering sea birds (especially sea ducks and grebes) are regularly disturbed by boats, especially sailing boats during the weekends (large yacht harbour in Nieuwpoort). The impact of recreational fisheries was very high, but dropped in 1996 due to the implementation of some Royal Decrees (RD of 11 March 1996, *BS* 28 March 1996 and RD of 12 April 2000, *BS* 3 May 2000). Tourists badly disturb foraging waders on the beach, especially during the summer season and on sunny weekends in the winter. The water quality of the North Sea along the Belgian coast is not very good, due to the direct outlet of sewage pipes etc. Negative effects on the ecosystem have not yet been noted. Apart from the chronic oil pollution, as elsewhere along the North Sea coasts, there are sometimes more important but local oil spills. Physical disturbance due to sand and gravel extraction also occurs in this area.

Human activities in the surroundings:

Recreation / military activities.

Disturbance/Threats: Pollution from outside the Belgian territorial waters (coming from the Channel). There are also military activities between Nieuwpoort and Lombardsijde (shooting exercises).

Conservation measures taken: all hunting is prohibited along the beach and in the marine areas under Belgian jurisdiction.

Zwin, including adjacent beach zone (Ramsar 2004):

General description:

Sharing the border with the Netherlands the site, created as bird habitat in the 1960s, consists of saltmarsh, mudflats, creeks and artificial brackish pools connecting it to the North Sea. The site is the southernmost remainder of a late medieval estuary. A shallow creek at the eastern end, which forms an open connection to the North Sea, feeds a system of four brackish lagoons. The water level in these lagoons is kept artificially high. The whole area often floods during winter and at spring tides (Ramsar site no. 328, designated since 27/09/1984). This area is also designated as a Special Protected Area under the EC Birds Directive and is classified as a Nature Reserve and Classified Landscape.

Ecological features:

The mudflats support pioneer vegetation communities, the saltmarsh consists of numerous species of salt-resistant plants. It's an important area for staging, roosting, wintering and breeding various species of water birds.

Human activities at the site:

Nature conservation, education and tourism.

Disturbance/Threats

Heavy recreation and silting up of the creeks.

Human activities in the surroundings:

Agriculture (more intensive, arable land).

Disturbance/Threats: threats exist on the Dutch side, where tourism is still increasing. Holiday villages have been built in the buffer zone of this reserve resulting in increased recreation pressure. The buffer area of the former grasslands and shrubs is used for cattle grazing. Farmers in the polder area (arable land and small grasslands) regularly disturb geese and other waterfowl from their fields. Lowering the intensity of grazing, and the amount of fertilisers used, could result in an increase of indigenous flora and fauna.

Conservation measures taken:

The area has been designated as a Classified Landscape since 1941 and is zoned as a Nature Reserve on rural planning maps. 125 ha of the reserve is situated in Belgium while a further 25 ha of the reserve is located within the Netherlands. External factors (mainly sand deposits on the beach of Knokke-Heist) have gradually increased silting of the creeks, mudflats and saltmarshes. This has caused the reserve to be less frequently flooded during high tides and decreased the reserves ornithological importance, mainly as a feeding area. In 1989 the Minister of Public Works decided to support the necessary works to re-open the main inlet creek (on the Dutch border). As a first attempt about 150000 m^3 of sand was removed in November 1989 to restore a regular tidal rhythm. Reintroduction programs in the wildlife park, which is adjacent to the reserve, have lead to an increase in feral populations of Greylag Geese (*Anser anser*), Night Heron (*Nycticorax nycticorax*) and White Stork (*Ciconia ciconia*). Although sheep graze on some of the saltings, no shooting is allowed within the Zwin reserve.

12.4.1.2. Intensity and identification

"Intensity" of nature protection areas is expressed as the "status" (designated or proposed) and the degree of protection (not, partly or totally protected).

Ramsar sites	Zwin (beach area)	Designated	Protected
	Coastal Banks area	Designated	Partly protected

12.4.2. Beach reserves

12.4.2.1. Spatial delimitation

Coordinates were deduced from the descriptions in the jurisdiction or found on the website of OC GIS-Vlaanderen (2003). In 2001 2 beach reserves were designated on the Belgian coast. These are called 'Baai van Heist' and 'Ijzermonding'. The 'Ijzermonding' is actually a nature reserve that stretches further inland, but the beach part of the nature reserve is designated as beach reserve. The low water line is the seaward boundary. No new beach nature reserves have been designated since 2001.

12.4.2.2. Intensity and identification

"Intensity" of nature protection areas is expressed as the "status" (designated or proposed) and the degree of protection (not, partly or totally protected).

Beach reserves	Baai van Heist	Designated	Protected
	Beach adjacent to Ijzermonding	Designated	Partly protected

12.4.3. Marine Protected Areas

12.4.3.1. Spatial delimitation

Coordinates were deduced from the website of OC GIS-Vlaanderen (2003), according to descriptions of the proposed areas. The two proposed areas were:

- The Coastal and Flemish Banks area (which largely consist out of two parts):
  - sub-area Trapegeer – Broersbank
  - sub-area Stroombank
- The marine part of the 'Baai van Heist'

Since no marine reserves or other Marine Protected Areas are yet designated for the Belgian marine area, it could be useful to investigate where the most important (or most valuable) marine areas are situated for the different ecosystem components. Haelters et al. (2004) have already undertaken an investigation on marine avifauna and three important bird areas have been identified (see above, Birds Directive areas). This type of information isn't available yet for other ecosystem components. The project BWZee (2004-2006, financed by the Belgian Science Policy) was initiated in May 2004 and will produce a full-coverage biological valuation map for the BPNS, considering both benthos and avifauna. This map will reveal which areas are most valuable for the maintenance and protection of these ecosystem components. Because this map will only be available in 2006, the identification of valuable biological areas in this report should be viewed with caution. The benthic life of the BPNS is distributed along three gradients: a sedimentological gradient and two geographical gradients. The distribution of the meio- and macrobenthos is mostly determined by the sedimentological gradient, while the epi- and hyperbenthos is mostly distributed along the onshore-offshore and longitudinal geographical gradients. Gheerardyn (2002) made a preliminary biological valuation map for the macrobenthos of the BPNS and this study revealed three important areas for macrobenthos:

- the western Coastal Banks (the area comprising the sand banks Trapegeer, Den Oever and Broersbank and the gullies Potje and Westdiep)
- the Flemish Banks (the area comprising the sand banks Middelkerkebank, Kwintebank, Buiten Ratel and Oostdijck and the gullies between these sand banks)

It should be noted that these two areas are not necessarily valuable biological areas for other benthos components. However, both areas mentioned above have a broad diversity in sediments and are situated along the onshore-offshore gradient. The longitudinal distribution gradient is lacking, but by proposing another conservation area in the eastern coastal zone, for instance the De Vlakte van de Raan, this can be solved. Due to the lack of biological data for this area an objective evaluation of its biological value isn't possible at this time.

For commercial fish species, important areas can be visualised by investigating their spawning and nursery areas (UKOOA 2004). An overview of these areas is given in Table I.3.12a.

Table I.3.12a: Overview of the spawning areas and nursery grounds on the BPNS for some commercial fish species.

Area of BPNS	Important area	Commercial Species	Period	Importance (in comparison to North Sea)
Small strip along coast	Nursery ground	Sole		Low
Coastal zone	Nursery ground	Plaice		Low
BPNS except coastal zone	Spawning area	Plaice	December-March	Medium
		Sprat	May-August	Medium
		Sandeels	November-February	Medium
	Nursery ground	Sandeels		Medium
Western part	Spawning area	Lemon Sole	April-September	Low
	Nursery ground	Lemon Sole		Low
North-western corner	Spawning area	Herring	November-January	Low
North-eastern corner	Spawning area	Cod	January-April	Low
Northern part	Spawning area	Whiting	February-June	Low
Entire BPNS	Spawning area	Sole	March-May	High
	Nursery ground	Mackerel		High
		Cod		High
		Sprat		High

It can be concluded that the entire BPNS is important for the selected fish species to some degree, but the species most dependent on the area for their reproduction seem to be Mackerel, Cod and Sprat. However, no clear patterns can be deduced from these rough maps.

When the BWZee project is finalized the resulting marine biological valuation maps will form a more scientifically sound information source to aid in policy decisions concerning the designation of sites as marine nature reserves.

12.4.3.2. Intensity and identification

"Intensity" of nature protection areas is expressed as the "status" (designated or proposed) and the degree of protection (not, partly or totally protected).

Proposed marine reserves	Coastal and Flemish Banks area	Not officially proposed	/
	Marine part of Baai van Heist	Not officially proposed	/

12.4.4. Habitats Directive Areas

12.4.4.1. Spatial delimitation

Coordinates were deduced from the descriptions in the jurisdiction or found on the website of OC GIS-Vlaanderen (2003).

The scope of application of the Habitats Directive includes the light blue and blue zone referred to above in Figure I.3.12a.

An examination of the figure reveals that this category is clearly found in the maritime zone under Belgian jurisdiction. Approximately 85% of the relevant zones are located in the territorial sea.

The Habitats Directive also recognizes that conserving habitats of great value, and the diversity of landscapes, makes it possible to conserve marine diversity. This is why it is a priority to protect the shallow sandbanks (MUMM 2003).

Typical bird species occurring in high concentrations and characteristic for shallow sandbank ecosystems (Maes et al. 2000):

- Guillemot – *Uria aale* – Zeekoet
- Razorbill – *Alca torda* – Alk
- Gannet – *Morus bassanus* – Jan van Gent

An area of 17000 ha, comprising the entire existing Ramsar 'Flemish Banks' site, has been **proposed** to the European Commission to be considered as a **Special Area of Conservation under the EC Habitats Directive** in the North Sea (federal territory) (Maes et al. 2000).

Several areas in the coastal zone (of the study area, Flemish territory) have already been designated as Special Areas of Conservation under the Habitats Directive:

- Dune area adjacent to the Westhoek (De Panne)
- Dune area Oostduinkerke-Bad
- Dune area Groenendijk-Bad
- Dune/beach area adjacent to Ijzermonding (next to channel)
- Dune area between Middelkerke and Westende-Bad
- Dune area on right hand side of channel Oostende
- Dune area between De Haan and Wenduine
- Dune area between Wenduine and Blankenberge
- Dune area on right hand side of Blankenberge
- Beach zone Baai van Heist
- Beach adjacent to Zwin area.

12.4.4.2. Intensity and identification

"Intensity" of nature protection areas is expressed as the "status" (designated or proposed) and the degree of protection (not, partly or totally protected).

Habitat areas (on Flemish territory)	Adjacent to De Westhoek (De Panne)	Designated	Protected
	Oostduinkerke-Bad	Designated	Protected
	Groenendijk-Bad	Designated	Protected
	Ijzermonding (east of shipping channel)	Designated	Protected
	Between Middelkerke and Westende-Bad	Designated	Protected
	East of shipping channel Oostende	Designated	Protected
	Between De Haan and Wenduine	Designated	Protected
	East of Blankenberge	Designated	Protected
	Baai van Heist	Designated	Protected
	Beach zone adjacent to the Zwin area	Designated	Protected
Habitat areas (on federal territory)	Trapegeer-Stroombank area	Proposed	/

12.4.5. Birds Directive Areas

12.4.5.1. Spatial delimitation

Coordinates were deduced from the descriptions in the jurisdiction or found on the website of OC GIS-Vlaanderen (2003).

A report by Haelters et al. (2004) identifies important bird areas. The identification of important bird areas in Belgian marine waters is based on original results from regular ship based surveys (1992-2002) completed by the Institute of Nature Conservation. The identification of important bird areas is obviously a prerequisite to their designation as Birds Directive Areas.

The species (and their habitats) found within the BPNS area that need protection pursuant to Annex I of the Birds Directive are:

- Sandwich Tern – Sterna sandvicensis – grote Stern
- Common Tern – Sterna hirundo – Visdief
- Little Tern – Sterna albifrons – Dwergstern

Four other species reached the 1% population limit in the Belgian sea during the period 1992-2002:

- Great-Crested Grebe – Podiceps cristatus – Fuut
- Little Gull – Larus minutes – Dwergmeeuw
- Common Scoter – Melitta nigra – Zwarte Zee-eend
- Great Skua – Stercorarius skua – Grote Jager

The most important areas for these species can be selected by using GIS to interpret data from species surveys. The Great Skua is not concentrated within sea areas. Accordingly, an area-directed conservation policy is not ideal for this species. The Little Tern is very rarely counted at sea. Instead the Little Tern concentrates in the vicinity of the eastern dam, within the harbour of Zeebrugge, which is a foraging area. This foraging area is entirely enclosed by the most important concentration area of Common Tern. When the most important areas for the Great-Crested Grebe, the Common Scoter, the Sandwich Tern, the Common Tern and the Little Gull are merged into one map, three areas appear as most appropriate for the protection of these species, namely:

- an area on the west coast (off Koksijde and De Panne), from the low water line up to 6 NM
- an area on the middle coast (Middelkerke – Bredene), from the low water line up to 6 NM in the western part and between 1.5 and 6 NM from the coast in the eastern part of the area
- an area enclosing the front part of the harbour of Zeebrugge

Generally, the areas closer to the coast are more important for most key species. Several coastal areas (Flemish territory) have already been designated as Special Protected Areas under the Birds Directive:

- beach zone adjacent to the Zwin
- area left of the harbour of Zeebrugge
- beach zone in De Panne

12.4.5.2. Intensity and identification

"Intensity" of nature protection areas is expressed as the "status" (designated or proposed) and the degree of protection (not, partly or totally protected).

Bird areas (on Flemish territory)	Beach zone adjacent to the Zwin area	Designated	Protected
	West of harbour of Zeebrugge	Designated	Protected
	De Panne	Designated	Protected
Bird areas (on federal territory)	Off Koksijde and De Panne	Not officially proposed	/
	Off Middelkerke-Bredene	Not officially proposed	/
	Area enclosing harbour of Zeebrugge	Not officially proposed	/

12.5. INTERACTIONS

12.5.1. Suitability for user

Details – if applicable – can be found in the chapter that is specifically dedicated to "Suitability".

12.5.2. Impact on other users

Details – if applicable – can be found in the chapter that is specifically dedicated to "Interaction among users".

12.5.3. Impact on environment

Details – if applicable – can be found in the chapter that is specifically dedicated to "Interaction between users and the environment".

The designation of a nature conservation area should result in a standstill or improvement of the ecological/physico-chemical quality of the area. Since different stakeholders heavily use the BPNS, the designation alone will not be effective to achieve this, and protection measures will have to be applied to the area.

The effect of designating an area as an MPA is still not known and there are different opinions in respect of the possible outcomes (deterioration, no effect, improvement). For a discussion on this topic please refer to Rabaut (2004).

12.5.4. Impact on socio-economy

No data exists on the socio-economic effects of designating nature conservation areas in the Belgian coastal zone. Obviously the closure of certain areas for fisheries and/or aggregate extraction will have significant economic effects on those sectors.

12.6. REFERENCES

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