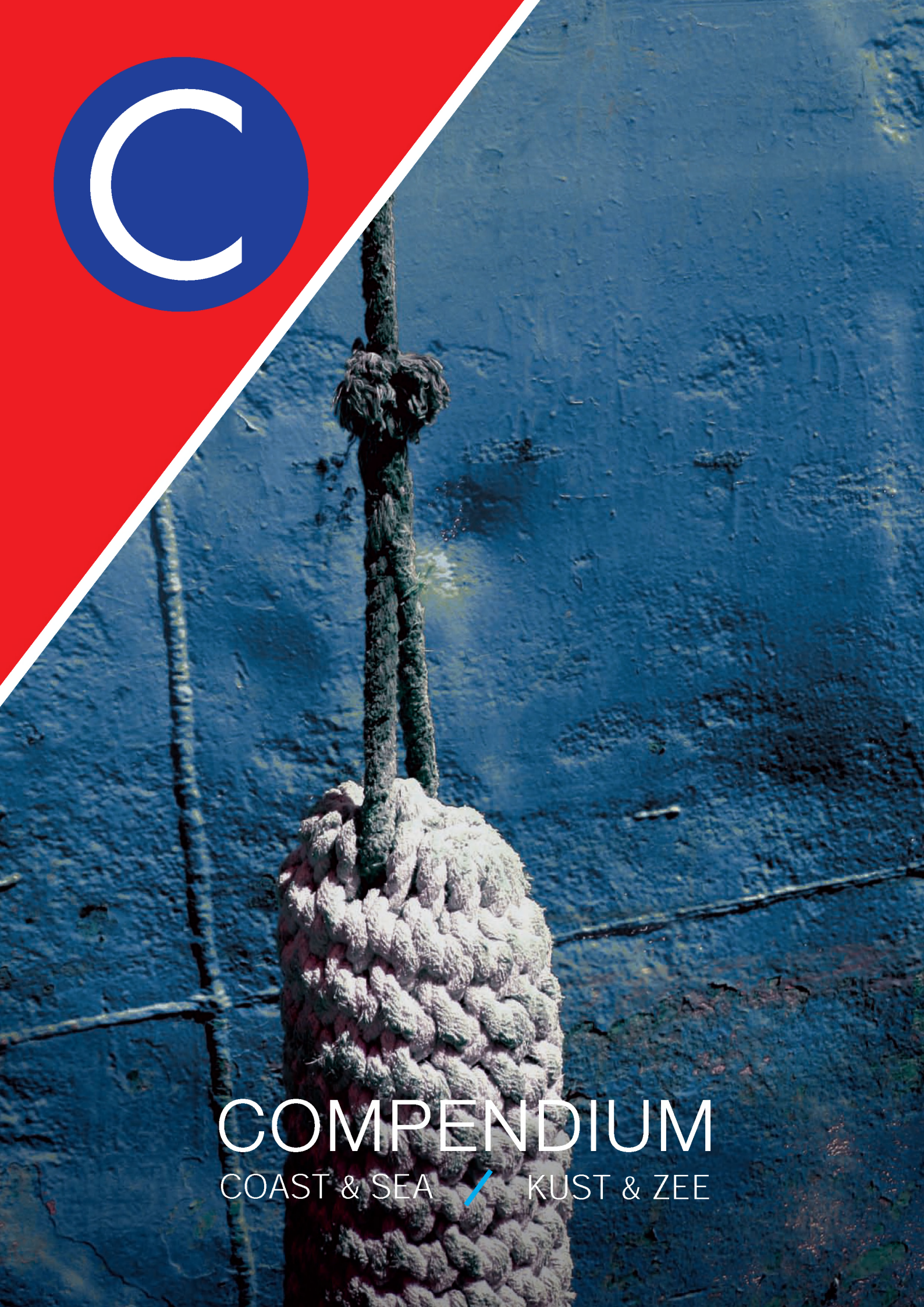

COMPENDIUM

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COMPENDIUM

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Integrating knowledge on the socio-economic, environmental and institutional aspects of the Coast and Sea in Flanders and Belgium

Colofon

The Compendium for Coast and Sea is an integrated knowledge document about the socio-economic, ecological and institutional aspects of the coast and sea in Flanders and Belgium. The Compendium results from a collaboration between multiple academic groups, governmental authorities, civil society organisations and discussion platforms dealing with coastal and marine issues and was coordinated by Flanders Marine Institute (VLIZ).

The Compendium for Coast and Sea can be consulted online: *www.compendiumcoastandsea.be*

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Citation:
Lescrauwaet, A.K., Pirlet, H., Verleye, T., Mees, J., Herman, R. (Eds.), 2013. Compendium for Coast and Sea 2013: integrating knowledge on the socio-economic, environmental and institutional aspects of the Coast and Sea in Flanders and Belgium. Oostende, Belgium, p. 326.
ISBN: 978-90-820731-6-4

Responsible publisher:
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Foreword by minister Lieten

The importance of the seas and oceans for the functioning of our planet, and therefore for the well-being of its people, cannot be overestimated. Seas and oceans represent a vast, untapped potential. This also applies to Flanders and the Flemish economy, since it represents an opportunity for 'blue growth' and 'blue economy' that we must not miss. The sea indeed plays a central role in numerous and major societal challenges at a global scale, but also in Flanders and Belgium and in the Belgian part of the North Sea. Think of the protection of our coasts against rising sea levels and super storms, the conservation of marine biodiversity and marine ecosystem services, the relationship between the sea and human health, food supply via sea fisheries and mariculture, innovation in maritime transport and sustainable port development, and the potential of new, globally emerging sectors such as marine biotechnology and blue energy. To face these challenges and to find solutions for the problems and the opportunities the sea offers, we need access to scientific knowledge. If we want to play a significant role as a region of knowledge at the European and global level, we must not only continue to invest and excel in marine research in the future, but also make efforts to ensure that scientific knowledge becomes accessible in an integrated quality-controlled and user-friendly format to potential users both at home and abroad.

This is exactly what the Compendium aims to achieve for the coast and sea: the regular production of a document that integrates relevant knowledge about our coast and sea for - among others - policy makers, as a support in the preparation of scientifically based policies.

However, in my view, the Compendium has more applications and potential user groups.

It is primarily a 'Blue Guide', a tool to inform interested citizens about the current state of play at sea and about who does what, where and how, in all fields of marine research, administration and policy. Current scientific knowledge should not only be accessible in a format that is useful for policy makers and marine and maritime professionals, but also for innovative entrepreneurs and researchers. In the decades to come, a large volume of new knowledge will have to be generated by excellent research at our universities and scientific institutes. The Compendium therefore aims to promote a multi- and interdisciplinary approach to marine research and create synergies so that our large but fragmented marine research community can pursue new and improved science and innovation.

However, we are also looking beyond the existing marine researchers as potential users. I see the Compendium as a tool in communicating about marine science. The sea has great attraction for people, and I am convinced that we can employ marine sciences – and their social relevance – to stimulate young men and women throughout Flanders (from West Flanders to Limburg) to choose for a career in science or technology. Hopefully, some of them will actually become the much needed, passionate marine professionals of the future.

This first Compendium shows that our marine and maritime research and education landscape compares to that of our neighbouring countries. It provides a good basis for the interaction between science and industry and for the translation of research products and applications that find their way to the European and global markets.

I would like to thank the 'Compendium team' and its secretariat, and all experts who contributed to the creation of this first 'Compendium for Coast and Sea 2013'. The Compendium can serve as a basis for future strategies and as a stepping stone for the development of a future policy on promoting a 'Blue Economy'. I consider the Compendium for Coast and Sea 2013 as a timely and successful initiative and hope you enjoy reading it!

Ingrid Lieten

Deputy Prime Minister
Flemish Minister for Innovation

Foreword by dr. Rudy Herman

Few people are aware of the fact that every second breath we take, contains oxygen produced in the oceans. This is only one of many processes that the seas and oceans provide as a service supporting life on earth. The Compendium for Coast and Sea 'oxygenates' the process in which current scientific knowledge about the seas and oceans is offered in an accessible and integrated manner.

The Compendium for Coast and Sea combines and integrates scientific, social, economic and institutional aspects of the coast and sea in Flanders and Belgium and includes three main components: i) a comprehensive background document that contains an overview of the marine research landscape, a summary of the different users and uses of the coast and sea, and an explanation of the 'Science – Policy Interface', ii) a brochure with an overview of Belgian Marine Research and iii) a website as an interactive platform for data and information to be updated, where possible, annually.

The Compendium is a tool to update information in a comparative and systematic way and to provide services – whenever required – in support of the network of marine scientists, the government and its scientific institutes, professional networks, and advisory and other bodies. This way, the Compendium contributes to the development of a science – policy interface for coastal and marine matters.

The Compendium for Coast and Sea 2013 is the result of a good and fruitful cooperation between researchers and experts from various levels of government and civil society represented in the Compendium Expert Group. The Expert Group also plays an important role in shaping the first version of the Compendium for Coast and Sea. Moreover, numerous co-authors and reviewers have made an essential contribution to the realisation of this Compendium for Coast and Sea 2013.

The methodology followed is replicable, transparent, gradual and internationally comparable. The approach is focused on a cost-efficient and effective product that can be developed and used in the long term. Furthermore, this Compendium 2013 is the start of a process based on new contributions and suggestions that will enhance its further integration in an international context. With the current rapid development of 'Blue Growth', the importance of marine sciences is expected to increase substantially in the coming years. The new developments and relevant insights regarding marine research in the European and international contexts will be systematically taken into account in the next versions of the Compendium.

I would like to thank the Compendium team and its secretariat and the members of the Expert Group for the inspiring and good cooperation over the past two years. I also thank all the experts and staff who have contributed to the creation of this first Compendium for Coast and Sea 2013 in a very constructive way. This positive cooperation is promising for the future development of the next versions of the Compendium and it has already provided a good foundation for the development of a future policy regarding the promotion of 'Blue Growth'.

I hope this Compendium will broaden your understanding of the events and developments in Flanders and Belgium with regard to the coast and sea, and hope you enjoy reading it.

dr. Rudy Herman

Chairman of the Expert Group Compendium for Coast and Sea 2013
Senior researcher, EWI Department, Flemish government

Table of contents

chapter 1

chapter 2

chapter 3

Readers' guide to the Compendium for Coast and Sea

Integrating knowledge on the socio-economic, environmental and institutional aspects of the Coast and Sea in Flanders and Belgium

In the marine and maritime field, there is a growing demand for scientifically sound and up-to-date information in response to societal issues and problems. These questions often arise from the increasing need for an integrated approach which does not only take into account the results of physical, chemical, biological, ecological and geological research into the marine system, but also socio-cultural, economic and institutional aspects. Although such information is partially available, it is generally highly fragmented, sector-specific or poorly accessible. The 'Compendium for Coast and Sea' aims at aggregating the disperse information and data from Flemish and Belgian marine and maritime research. The Compendium discusses the thematic research conducted in marine and coastal ecosystems and estuaries, including policy-supporting research and research focusing on applications or sectors, covering a broad range of scientific disciplines. The integrated and multidisciplinary character of the Compendium aims to increase the communication within the broad network of marine scientists and experts who are professionally involved with the coast and the sea. Furthermore, it increases the visibility and accessibility of marine research. In this regard, the Compendium fits in with the European aspirations for a sustainable and *Integrated Maritime Policy* and *Integrated Coastal Zone Management*.

The Compendium for Coast and Sea is an initiative of the Flanders Marine Institute (*VLIZ*). The mission, goals and ultimate objectives of this publication are under the auspices of an *expert group* with members from the research community, government and civil society organisations. The expert group is supported by the Compendium secretariat (VLIZ) for the daily tasks and collaborates intensively with the VLIZ Scientific Board, a network of coauthors and reviewers and international experts for the realisation of the Compendium. In this regard, the Compendium should be considered as a collective effort.

The Compendium focuses on the Belgian part of the North Sea (BNS), the adjacent estuaries and the coastal area. The Scheldt Estuary is discussed as well, as this region constitutes an important connection between the sea and the hinterland. Depending on the theme, it may be desirable to use a cross-border approach. Europe and the North Sea area both offer a geographic context for the Belgian and Flemish situation, especially with regard to the European Integrated Maritime Policy.

The target audience of the Compendium for Coast and Sea are scientists, the broad group of experts who are actively and professionally involved with the coast and sea – at an international, European, national, regional and local level – as well as representatives from business and drivers of innovation.

The document is published in English (the *lingua franca* of science) and Dutch, and will be published with a fixed frequency. The Compendium is published online on: *www.compendiumcoastandsea.be*. On this website, the most recent versions of the texts will be disseminated after each (interim) update.

The Compendium for Coast and Sea includes an extensive background document which describes the marine scientific landscape (**Chapter 1**); summarises the knowledge on different user functions of the coast and sea as well as integrated themes, such as Integrated Coastal Zone Management, Marine Spatial Planning and the Scheldt Estuary (**Chapter 2**); provides a non-exhaustive overview of relevant regulations and policy instruments and elaborates on the marine science-policy interface (**Chapter 3**). Additionally, a series of associated communication products is being developed which will be available on the website as well.

The Compendium for Coast and Sea is an objective and impartial knowledge document based on facts, figures and scientific and legal sources. Considering the portal function of the Compendium, the document aims at providing an overview of the most relevant and up-to-date information and knowledge. Given that this exercise requires an ongoing effort, the forwarding of lacking pertinent publications, time series, figures, legislation etc. to the Compendium secretariat is strongly encouraged.

In line with the 'open access policy', the cited references are made publicly available as much as possible by means of the integrated marine information system (IMIS) of VLIZ. In the digital version of the Compendium for Coast and Sea and on the website, the publications can be consulted through hyperlinks. In the printed version, the references have superscript codes (e.g. *Maes et al. 2004* [70936]), which can be entered on the website (*www.compendiumcoastandsea.be*, via 'Sources') in order to consult the publication concerned.

At the end of every (theme-)chapter, a reference list is provided with the specifications (number, title, date, abbreviation, etc.) of the legislation cited in the respective chapter. This reference list allows to consult the coordinated legislation through official databases (*Eurlex*, *Belgian Official Journal* and *Justel database*).

The abbreviations and acronyms used are explained in the list of acronyms.


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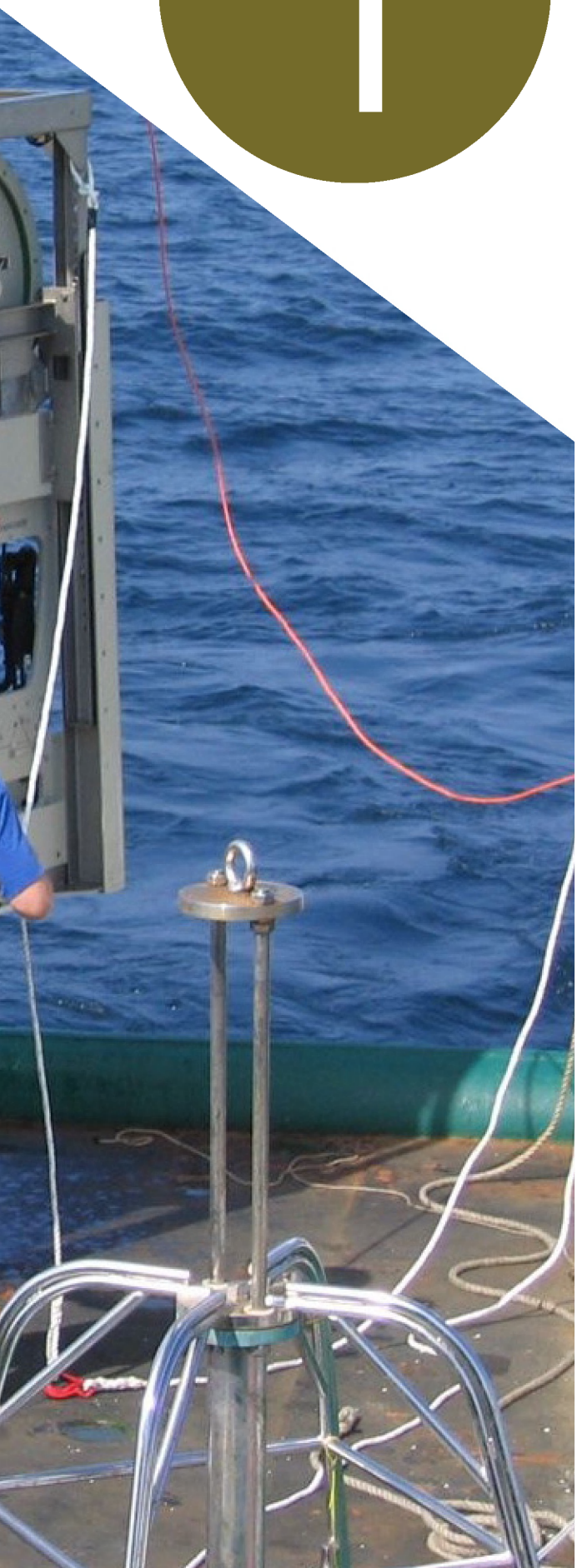

Chapter 1

Marine research

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Herman, R., Mees, J., Pirlet, H., Verleye, T., Lescrauwaet, A.K., 2013. Marine research. In: Lescrauwaet, A.K., Pirlet, H., Verleye, T., Mees, J., Herman, R. (Eds.), Compendium for Coast and Sea 2013: integrating knowledge on the socio-economic, environmental and institutional aspects of the Coast and Sea in Flanders and Belgium. Oostende, Belgium, p. 12-71.

Foreword

The marine sciences in Flanders and Belgium stand out as a diverse and complex landscape, characterised by a broad range of expertise. Over 80 different research groups - with more than 1,000 marine scientists and specialised staff - are dedicated to coastal and marine research. Within this landscape, Flanders Marine Institute (VLIZ) acts as a coordination and information platform for marine and coastal research in Flanders, and supports and promotes the visibility and international impact of Flemish marine research and international marine education.

To receive guidance with regard to its science-supporting tasks, VLIZ consults 4 times per year with a team of scientists in the Scientific Committee, which advises the Board of Directors on all scientific and research-support activities of VLIZ. This committee represents *inter alia* the marine research groups associated with the Flemish universities and scientific institutes. The Scientific Committee consists of three bodies: the Scientific Board provides science-based advice to the Board of Directors; the Guidance Committee meets annually in a plenary meeting open to a broad group of marine scientists to discuss relevant new and planned activities; the thematic Expert Working Groups consist of relevant experts from Belgium and abroad and may be established for a limited or an extended period of time. Through these structures, VLIZ provides a platform to the wider network of marine scientists and experts from Flanders and Belgium, and also abroad.

The Compendium for Coast and Sea aggregates up-to-date information and data from Flemish and Belgian marine research. It is an objective knowledge document that integrates the socio-economic, environmental and institutional aspects of the coast and sea in Flanders and Belgium. Developing a Compendium is in line with the strategic objectives of VLIZ, as stipulated in its statutes and in the agreement between the Flemish Government and VLIZ.

The present chapter 'Marine Research' focuses in particular on an inventory and description of marine research - including a brief history - in Flanders and Belgium, and presents this in a broader European context. In the chapter 'Marine Research', objective figures are reported in a replicable way so that trends can be detected and new developments can be mapped. In the future, the current inventory can be expanded with additional measurements in terms of institutional capacities, bibliometric indicators, financial resources, emerging issues in research, etc. In this context, all research conducted in the marine, estuarine and coastal domain, including policy-supporting research and research focused on practical applications and sectors, is covered under the common denominator of 'marine' research. The results of the inventory were examined and validated by an Expert Panel of marine scientists and representatives of the research field. The Expert Panel thus supports – together with the Expert Group 'Compendium for Coast and Sea 2013' - the results of the present mapping of the marine research landscape. Along with the brochure 'Belgian Marine Research - an overview', it maps the organisation and dimension of marine research, its research resources and knowledge output. The results of this inventory and qualitative description may be used in the future to identify knowledge gaps, bottlenecks and opportunities for marine research.

As coordinator of the initiative, VLIZ aims to contribute with the Compendium for Coast and Sea 2013 to an efficient communication within the network of marine scientists, policy makers and experts, and to increase the visibility and accessibility of marine research in Flanders and Belgium.

dr. Jan Mees

Director of VLIZ

1 Marine research

1.1 Introduction

Seas and oceans play a crucial role in the overall functioning of the earth. As a storage of energy, the oceans have a major impact on the climate and water cycle. Oceans absorb a large part of the atmospheric carbon dioxide, and one third of the oxygen that is available for life on the earth, is produced by the world's oceans. Moreover, the seas and oceans contain a significant part of the biological diversity on the planet. In terms of economy, the importance of the seas is still growing: maritime transport and ports, tourism, the applications in the field of renewable energy and marine biotechnology, the exploitation of living and non-living resources, as a source of food, etc. Nevertheless, seas and oceans are the least explored and studied areas on earth. Research does not only play a role in unveiling this knowledge, or to use this knowledge for the purpose of economic and social development; research at sea and on marine ecosystems is essential to understand global processes and ecosystem functioning and manage them in view of a sustainable future.

The chapter 'Marine research' in the Compendium for Coast and Sea provides an overview of marine research in a global, European and local context. It maps the marine research landscape in Flanders and in Belgium on the basis of quantitative measurements related to research capacities, research resources and knowledge output. A description of the research themes and contents and the nature of the research partnerships, provides a review of the expertise and diversity of the marine research community.

1.2 Marine research: the global context

Research on seas and oceans has a distinct and global dimension. It is therefore not surprising that several initiatives and organisations make the efforts to coordinate their marine research programmes at an international level. The United Nations (UN) play an important role in this global context, with the Intergovernmental Oceanographic Commission (*IOC*) of the United Nations Educational, Scientific and Cultural Organisation (UNESCO) being mandated for the coordination and execution of programmes for research and observation of the oceans, exchange of oceanographic data and information, services and training. In the Ocean Science Section, research is conducted on *ocean acidification*, climate change (*WCRP*) and its effects on ecosystems and coral reefs (*GCRMN*, *GLOBEC*), climate change and adaptation in (Western) Africa (*ACCC Africa*, *ACCC-WAfrica*), the ecology and effects of harmful algal blooms (*IOC-HAB*, *GEOHAB*), global nutrient supply from river and water catchment areas toward seas and oceans (*Global NEWS*), marine spatial planning (*IOC MSP*) and coastal zone management (*ICAM*, *SPINCAM*). The Ocean Science Section also provides support to the UN Regular Process and *Assessment of Assessments*.

Programmes and services for operational data and monitoring of oceans include the Global Ocean Observing System (*GOOS*), the Joint Technical Commission for Oceanography and Marine Meteorology (*JCOMM*, in joint cooperation with *WMO*), the International Oceanographic Data and Information Exchange (*IODE*), the International Ocean Carbon Coordination Project (*IOCCP*) and the Global Ocean Ship-Based Hydrographic Investigations Programme (*GO-SHIP*).

The IOC is – together with the other UN entities that develop ocean-related activities – part of the *UN-OCEANS* network, promoting a higher level of cooperation on ocean and coastal issues at the global level. Within this network, the *Convention on Biological Diversity* (CBD), the International Maritime Organisation (*IMO*), the UN Environmental Program (*UNEP*) and the UN Development Program (*UNDP*) are of particular relevance to marine and coastal research (see also **Chapter 3** for an overview of UN entities and mandates). The 'Oceans Compact initiative' (*Ki-Moon 2012* [229187]) of the UN secretary-general sets out a strategic vision for the UN system with regard to its ocean-related mandates, consistent with the *Rio+20 agenda (2012)* [229189]. The UN Conference Rio+20, which took place 20 years after the first meeting (1992) in Rio de Janeiro (Brazil), focuses on a global agenda for sustainable development with a specific chapter on Oceans and Seas.

Several other international scientific networks and programmes focus on marine research, such as the Partnership for Observation of the Global Oceans (*POGO*), World Association of Marine Stations (*WAMS*), Census of Marine Life (*CoML*), Global Ocean Ecosystem Dynamics (*GLOBEC*), Integrated Marine Biogeochemistry and Ecosystem Research (*IMBER*), Variability and Predictability of the Ocean-Atmosphere System (*CLIVAR*), International Study of Marine Biogeochemical Cycles of Trace Elements and their Isotopes (*GEOTRACES*) and the International Council for Science (ICSU) *Future Earth Programme*. The international research programme *DIVERSITAS* integrates research on biological diversity at the global level and collaborates with a wide range of partners, including the UN, to address

these issues. The International Council for the Exploration of the Sea (*ICES*) is a cooperation of 19 countries bordering the North Atlantic Ocean and adjacent seas with the aim to exchange scientific information and provide expert advice to governments and commissions of the European Union (EU) and Regional Sea Conventions. Finally, the Organisation for Economic Co-operation and Development (*OECD*) works on oceans and seas related topics, e.g. on Marine or Blue Biotechnology (*OECD 2013* [229022]).

In May 2013, the EU, the US and Canada launched a joint alliance on Atlantic Ocean research through the transatlantic *Galway Statement on Atlantic Ocean Cooperation (2013)* [229229]. The goal is to connect the ocean observation efforts of the three partners in the Atlantic Ocean and study the interplay with the Arctic Ocean in view of a sustainable use of resources.

Other research and development (R&D) is conducted to support the tasks of international organisations responsible for the implementation of the international conventions on maritime transport, prevention and control of (oil) pollution, dumping of waste at sea and safety and environmental protection. An overview of these organisations, bodies and treaties is available in **Chapter 3**.

1.3 Marine research: the European context

EUROPEAN POLICY AND PLATFORMS FOR RESEARCH AND INNOVATION

EU science policy and organisation

Within the European Commission (EC), several agencies are responsible for (marine) science policy. The Directorate-General for Research and Innovation (*DG Research & Innovation*) is responsible for the development and implementation of European research and innovation policies. Its policy goals are oriented towards the European strategy for economic growth (*Europe 2020*) and innovation (*Innovation Union*), one of the 7 initiatives within the Europe 2020 strategy. DG Research & Innovation is also responsible for financing and for establishing financial instruments for scientific research, such as the European Framework Programmes (FPs, see below).

The seventh Framework Programme (FP7) is aimed at financing both competitive and cooperative research in the context of the EU goals for employment, competitiveness, living standards and the EU leadership in the global knowledge economy (Europe 2020 strategy). The goal is to achieve a European Research Area (*ERA*) (*COM (2000) 6*) in which free exchange of scientists and knowledge is stimulated.

The European Research Council (ERC) is an independent entity within the DG Research & Innovation, and finances ground-breaking research by outstanding scientists from FP7. The European Research Executive Agency (*REA*) of the EC is a funding body responsible for managing large parts of FP7 (2007-2013). Independent entities conducting specific research for the EC include e.g. the Joint Research Centre (*JRC*) and the European Environment Agency (*EEA*), supported by the European Topic Centers (ETCs) and the European Environment Information and Observation Network (*Eionet*).

Investments in international networks and cooperation

In Europe, the research agendas are mainly determined by the competent governmental bodies of Member States (for Belgium, see **Policy context for scientific research in Flanders/Belgium**). 88% of all public investments in research and development are designed, financed and evaluated at the national and local levels (*Acheson et al. 2012* [229008]). Research on oceans and seas, however, is in particular need of a coordinated European strategy and an active partnership between European Member States because of the inherently high costs associated with marine research and the fact that it relies on research facilities which are not always accessible to all European researchers. Aligning objectives and pooling available financial resources and capacities allow addressing the challenges in terms of protection, sustainable use and management of European marine waters in an effective and coordinated way. Moreover, it stimulates the conversion of scientific information and knowledge into innovation and research applications (*Navigating the Future IV, European Marine Board, 2013* [226874]).

The FP7 specific programme (SP) 'COOPERATION' enhances transnational research cooperation between universities, industry and research centres on the one hand and governmental bodies on the other, both in the EU and with third countries. Furthermore, this programme focuses on joint activities such as the horizontal ERA-NETs, on projects in

the context of *Article 185*[1] (the former Article 169) of the EU Convention and on joint technological initiatives and platforms. The *ERA-NET projects* (since FP6) provide a formal platform to develop networks and co-operations in research and technology, both at the European level and in international partnerships. A number of these ERA-NET projects are situated in the marine field, e.g. *MarinERA*, *AMPERA*, *MariFish* and *SEAS-ERA*. Complementary to the SP Co-operation (SP1), IDEAS (SP2) is focused on supporting excellent 'frontier research'; 'PEOPLE' (SP3) is focused on the support of training and career development of researchers, and 'CAPACITIES' (SP4) is focused on fostering the improvement of research capacities and environment across Europe (i.e. infrastructures, research for the benefit of SMEs, international cooperation, etc.).

The FP7-OCEAN programme 'Ocean of Tomorrow' is oriented towards multidisciplinary marine research in preparation of Horizon 2020 (*COM (2011) 808*), a programme to facilitate multidisciplinary research and innovation in different fields, technologies and disciplines. Horizon 2020 aligns the 'FP for research' with the targeted innovation measures of the Competitiveness and Innovation Framework Programme (*CIP*) and the European Institute of Innovation and Technology (*EIT*).

Joint Programming (JP) offers an integration and coordination platform for European Member States in order to make efficient use of the available national budgets and organisational resources for research by, e.g., drafting joint research agendas and aligning priorities for co-operation in the long term. Contrary to the FP, JP is a bottom-up approach and the JP Initiatives (JPI) offer ways to initiate the process of JP. Since 2009, 10 JPIs have been launched, including the initiative for 'Healthy and Productive Oceans and Seas', also referred to as *JPI-Oceans*.

Cooperation in research is also stimulated through the European Innovation Partnerships (*EIP*), Joint Technology Initiatives (*JTI*), Coordination and Support Actions (*CSA*) and the co-operation agreements on scientific research between and with Member States as described in *Article 185* of the EU Convention. The European Strategic Forum for Research Infrastructure (*ESFRI*) supports a coherent and strategic approach to policies for research infrastructure in Europe, and facilitates initiatives leading to a better use and development of this infrastructure at the European and international level. Two initiatives within ESFRI are of particular relevance to marine research: the Integrated Carbon Observation System (*ICOS*) and the E-Science European Infrastructure for Biodiversity and Ecosystem Research (*Lifewatch*).

There are several examples of partnerships between research institutes at the European level such as the European Fisheries and Aquaculture Research Organisation (*EFARO*), the European Global Ocean Observing System (*EuroGOOS*), the European Network of Marine Research Institutes and Stations (*MARS*), Marine Genomics Europe (*MGE*) and Marine Biodiversity and Ecosystem Functioning (*MarBEF*) (now operating jointly as *EUROMARINE*), the EU Technology Platform *Waterborne* and *EurOcean*. Marine research is also an important component in support of the operational tasks of different European and regional organisations: e.g. the EU Management Committee for Marine Pollution (MCMP), the European Maritime Safety Agency (*EMSA*) and the Central Dredging Association (*CEDA*).

Strategic research agendas and visions for the future

A number of networks and consortia with a strong representation in the European research community are oriented towards the development of a vision and preparation of strategic agendas for marine research. The European Marine Board (*EMB*) develops the interface between marine research and marine-maritime policies, and draws up Position Papers on research priorities and strategies for European marine research such as *Navigating the Future IV (2013)* [226874] (figure 1).

The *EurOCEAN conferences* offer a platform for those involved in the research-policy interface, both at the European level and in Member States. These conferences allow the European research community to participate in shaping the European vision for marine research through the '*Galway Declaration (2004)* [70720]', the '*Aberdeen Declaration (2007)* [229005]' and the 'Ostend Declaration (2010) [204867]'. The '*Brest Declaration (2011)* [228814]' specifically deals with marine research infrastructure (figure 1).

1 Article 185 (ex. Article 169) of the Lisbon Treaty allows the European Union to participate in research programmes financed by different European Member States, including participation in structures associated with the implementation of national research programmes. An example is the BONUS programme for the Baltic Sea.

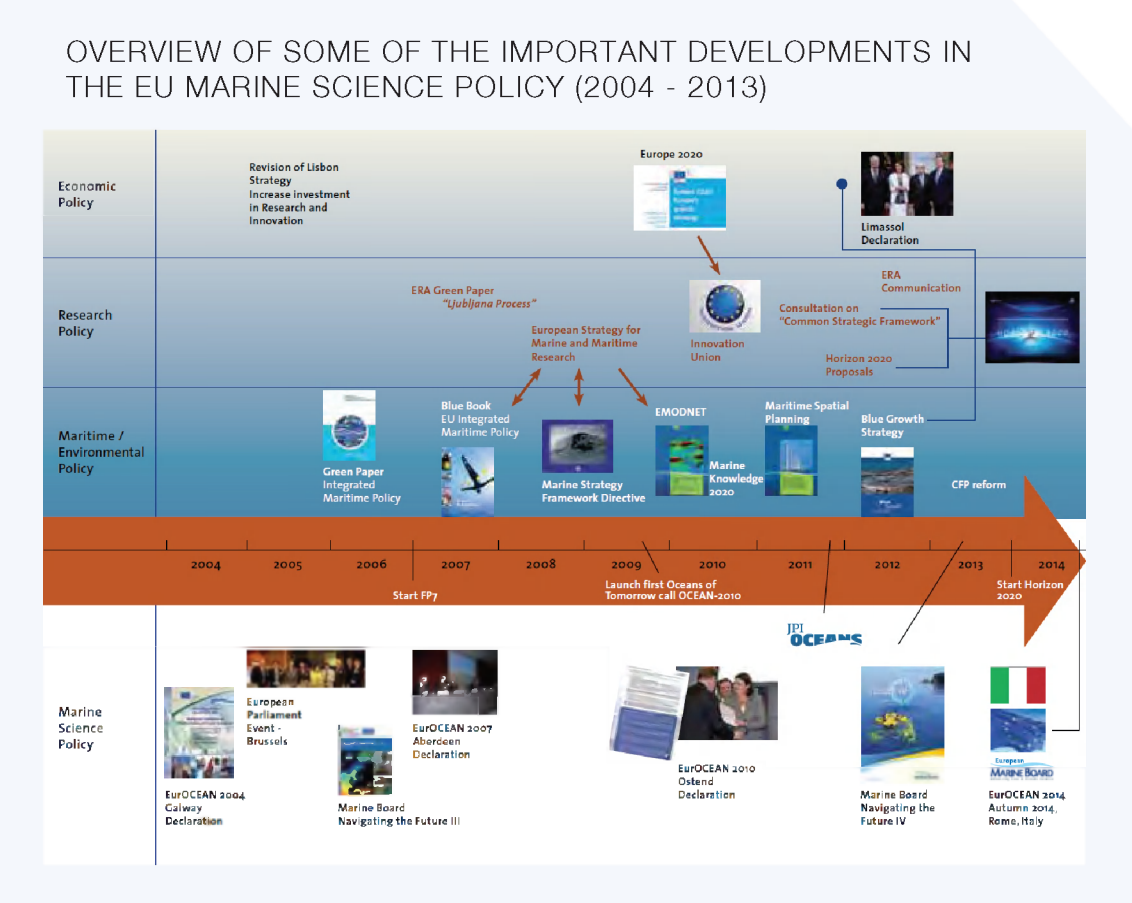

Figure 1. Overview of some of the important developments in the EU marine science policy between 2004 and 2013 (source: *Navigating the Future IV (European Marine Board, 2013)* [226874]).

EUROPEAN POLICY INSTRUMENTS AS DRIVERS FOR MARINE RESEARCH

Different policy domains of the EC with regard to coasts, seas and oceans affect marine research in Europe in a significant way. The *Integrated Maritime Policy* (*IMP*, *COM (2007) 575*) is a cornerstone in these policies. The *IMP* aims at a more coherent approach to maritime issues and a higher degree of coordination between the different policy domains involved. The *IMP* integrates a number of transversal policy instruments in the fields of Blue Growth (*COM (2012) 494*), Marine Knowledge (*COM (2010) 461*) (see below), Maritime Spatial Planning (*COM (2013) 133*), Integrated Maritime Surveillance (*COM (2009) 538*) and Sea Region Strategies (figure 1 and **Chapter 3**). In the *Limassol Declaration (2012)*, the European ministers of maritime affairs reaffirm the importance of a coherent approach to develop blue growth in Europe and to ensure the health of oceans and seas. The EU *Marine Strategy Framework Directive* (MSFD, *2008/56/EC*) addresses the environmental aspects of the *IMP*, and provides a joint framework and goals for the protection and conservation of the marine environment (see Chapter 2 - theme **Nature and environment**, and **Chapter 3**).

The European strategy for marine and maritime research (*COM (2008) 534*) was drafted within the *IMP* and following the *Aberdeen Declaration (2007)* [229005] (see above and figure 1). Its aim is to provide policy makers with the necessary scientific information in support of:

- The socio-economic importance of the maritime economy;
- The increasing pressures on the marine environment as a result of human activities and climate change;
- The increasing competition for marine space.

The strategy also aims at an Integrated Marine and Maritime Research Area (*DG Research & Innovation*).

Marine Knowledge 2020 (*COM (2010) 461*) is considered by the EC as an important component within the *IMP* for centralising marine data from different sources. The aim is to:

- Reduce operational costs for data users;
- Provide wider access to quality-checked marine data to industries, policy makers and scientists in an efficient way so they can develop new or improved products and services;
- Reduce uncertainty in our knowledge of the oceans and the seas as a sound basis for managing future changes.

At the heart of Marine Knowledge 2020 is the European Marine Observation and Data network (*EMODnet*) which integrates marine data, data products and metadata from different sources in a uniform way through a web portal.

Besides the *IMP*, there are a number of sectoral (marine and maritime) policy instruments that provide guidance for marine research in a European context. Evident examples are the *Common Fisheries Policy* (*CFP*, *Regulation 2371/2002*) and its reform, and the implementation of the *Water Framework Directive* (*WFD*, *2000/60/EC*), the *Habitats Directive* (*92/43/EEC*), and the *Birds Directive* (*2009/147/EC*) in marine areas and coastal zones. Information systems in support of these policy instruments include the Shared Environmental Information System (*SEIS*), the Water Information System for Europe (*WISE*) and WISE-marine, the Biodiversity Information System for Europe (*BISE*), the European Climate Adaptation Platform (*CLIMATE-ADAPT*), the Data Collection Framework for the *CFP* (*Regulation 1343/2007*), and *My Ocean*, the marine component of the Global Monitoring for Environment and Security Initiative (GMES). The research-policy interface within the framework of these policy instruments is discussed in more detail in **Chapter 3** of the Compendium for Coast and Sea.

REGIONAL SEA – NORTH SEA

A number of policy instruments and entities are specifically focused on the level of regional seas, e.g. the North East Atlantic Region and/or the North Sea. Recently (May 2013), the EC drafted an Action Plan for a Maritime Strategy in the Atlantic region. Similar to the Europe 2020 strategy, the Action Plan focuses on establishing smart, sustainable and inclusive economic growth (*COM (2013) 279*). This plan refers to the developments in marine research that are necessary for a sustainable growth of the economic activity in the Atlantic region and discusses insights into processes that determine the climate in the Atlantic Ocean. As the first step in a series of regional research strategies, '*A draft Marine Research Plan for the European Atlantic Sea Basin - Discussion Document (2011)* [229244]' was developed by the SEAS-ERA project (FP7).

Conventions at the level of regional seas exist e.g. for the Baltic Sea (*Helsinki Convention* (HELCOM)), the Mediterranean Sea (*Barcelona Convention* (UNEP-MAP)) and the Black Sea (*Bucharest Convention*). The *BONUS programme* for research and development is designed to meet the specificities of the Baltic Sea.

The *Convention for the Protection of the Marine Environment of the North-East Atlantic* (*OSPAR*) offers a framework for addressing pollution and protection of the marine environment in the North East Atlantic Region, with specific measures for the North Sea (OSPAR Region II). Within this scope, the *Ministerial North Sea Conferences and Declarations* played an important role in the proposal of measures to reduce marine pollution of the North Sea from rivers, estuaries and the atmosphere.

An extensive overview of the relevant entities and legal instruments for the Belgian part of the North Sea (BNS) is given in **Chapter 3**.

EU FINANCIAL INSTRUMENTS FOR MARINE RESEARCH

Overview and history of EU financial instruments for research

The EU offers several instruments for financing research, depending on the goals, partnerships, structural embedding, budget requirements, etc. Currently the five most important financial mechanisms include (*New practical guide to EU funding opportunities for research and innovation 2012* [229007]):

- The Seventh Framework Programme for Research and Technological Development (*FP7*, 2007-2013) and its precursors MAST and FP5 and FP6 (figure 2). FP7 is followed by *Horizon 2020* (2014-2020);
- The Competitiveness and Innovation Framework Programme (*CIP*), continued under the Programme for the Competitiveness of enterprises and SMEs (COSME) (2014-2020);

- The *Structural Funds*, including the European Regional Development Fund (*ERDF*) that finances the INTERREG programme (III, IV, 2 Seas);
- The European Agricultural Fund for Rural Development (*EAFRD*);
- The European Fisheries Fund (*EFF*) (2007-2013), continued as from 2014 as the European Maritime affairs and Fisheries Fund (*EMFF*) (2014-2020) to support the *CFP* and *IMP*.

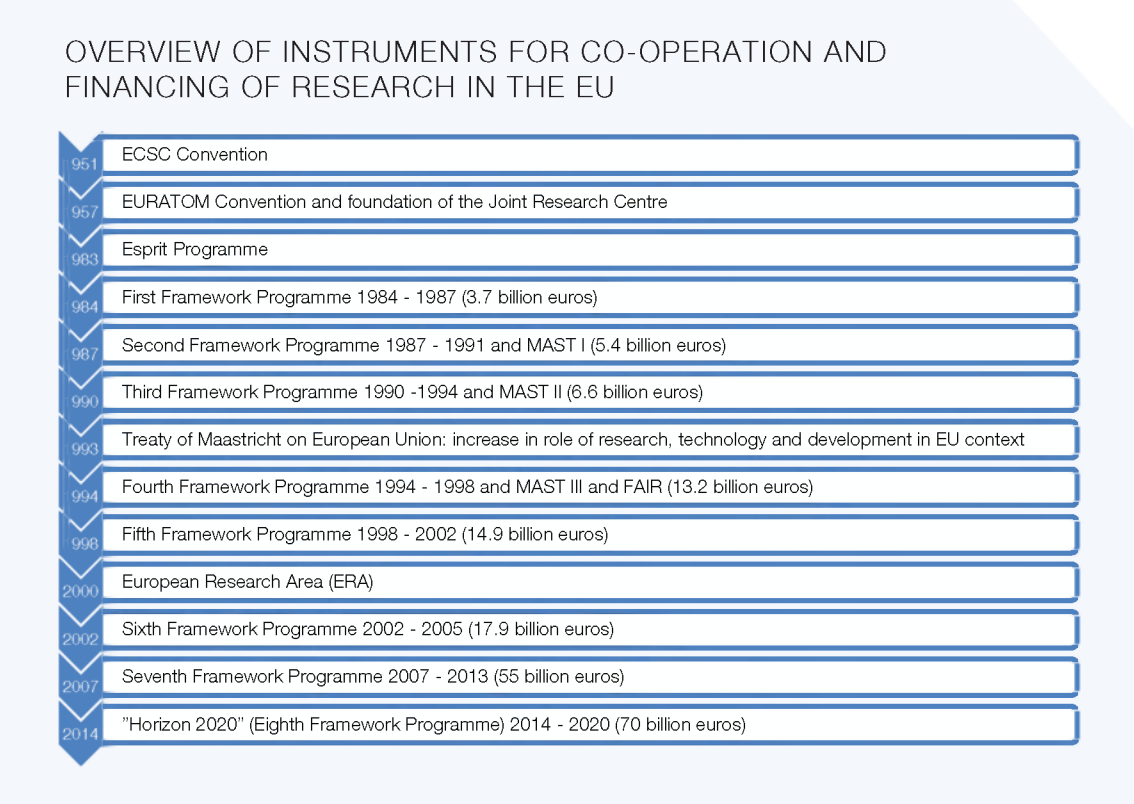

Figure 2. Chronological overview of instruments for cooperation and financing of research in the EU, with an indication of the available budget (source: DG Research & Innovation).

Besides the aforementioned financial instruments, there are other mechanisms within the community programmes (*Marco Polo II*, Financial Instrument for the Environment (*LIFE+*), Trans-European Transport Networks (*TEN-T*), Trans-European Energy Networks (*TEN-E*), etc.), and other instruments for external support (Development aid), regional support and support for maritime affairs and fisheries. Also worth mentioning are the *EUREKA network*, *EUROCORES* and the European Co-operation in Science and Technology (*COST*), and Regions of Knowledge. An overview of the European financial instruments and mechanisms is available on the website: *www.eutrainingsite.com/eu_funds.php*.

Europe and the EC have always conducted an active policy for international co-operation in research. After the Treaty establishing the European Coal and Steel Community (ECSC) in 1951, the precursor of the European Union we know today, the Joint Research Centre (*JRC*) was established under the *EURATOM Convention* in 1957. This basis for co-operation can be found in article 130 of the Treaty for the European Union (*http://europa.eu/abc/treaties/index_en.htm*) that calls for a reinforcement of science and technology as one of the foundations of the European industry. The following FPs (figure 2, from 1984) were in fact implemented according to the founding principles of the Treaty, as they were aimed at increased competitiveness at the international level and highlighted the need for research to underpin other EU policy goals.

An analysis of the EU *DG Research & Innovation* shows that since FP1 in 1984, the available EU budgets for research (FPs and other EU-financed programmes e.g. CERN, COST, ESF, ESO, EUREKA, etc.) have gradually increased, also in comparison with dedicated resources from Member States for research and development at a national level (DG Research 2005). The first three FPs had an average annual budget of approximately 1 billion euros, rising gradually from FP4 onwards to 4 billion euros per year during FP6, and again to 7.8 billion euros during FP7 (figure 2).

The numbers also show that in the 1980s the FP budgets made up about 2% of the dedicated national budgets for research and development of Member States. Together with other EU-financed programmes, the EU financial resources added up to an average of 8% in comparison to the national budgets. In the 2002-2005 period, the EU share in financing research slowly increased to an average of 15.3% compared to national research budgets (*Acheson et al. 2012* [229008]).

FP7 had a budget of over 50 billion euros in the timeframe 2007-2013. The forthcoming financial instrument '*Horizon 2020*' (*COM (2011) 808*) runs from 2014 to 2020 with an approved budget of 70 billion euros.

Relative importance of the European financial instruments for marine research

Depending on their research objectives, marine researchers can apply for different funding sources for the financing of their research projects and network activities. Although the FPs are the best known funding instruments, they do not necessarily have dedicated budget lines for marine research. It was not until FP2 that the first dedicated 'Marine Science and Technology Programme (MAST) I' was established which continued in MAST II under FP3, and subsequently in MAST III and FAIR (Agriculture and Fisheries) under FP4, with dedicated 'marine' budget lines. FP5, FP6 and FP7 – except for Ocean of Tomorrow – did not include specific budgets for marine research. Dedicated efforts to inventory marine research projects, however, allow quantifying the budgets spent on marine research (EUROCEAN Marine Knowledge Gate). *Ocean of Tomorrow* (total budget of 134 million euros) is a special programme within FP7 in which multidisciplinary projects addressing great challenges for marine research are financed. Horizon 2020 will address marine research as a crosscutting activity (Source: *EUROCEAN Marine Knowledge Gate*, *Santos et al. 2007* [229000], Jagot et al. 2012 [216054]).

The EU-wide inventory of marine knowledge output, *EUROCEAN Marine Knowledge Gate*, provides an overview of marine research projects by programme and by budget size (figure 3).

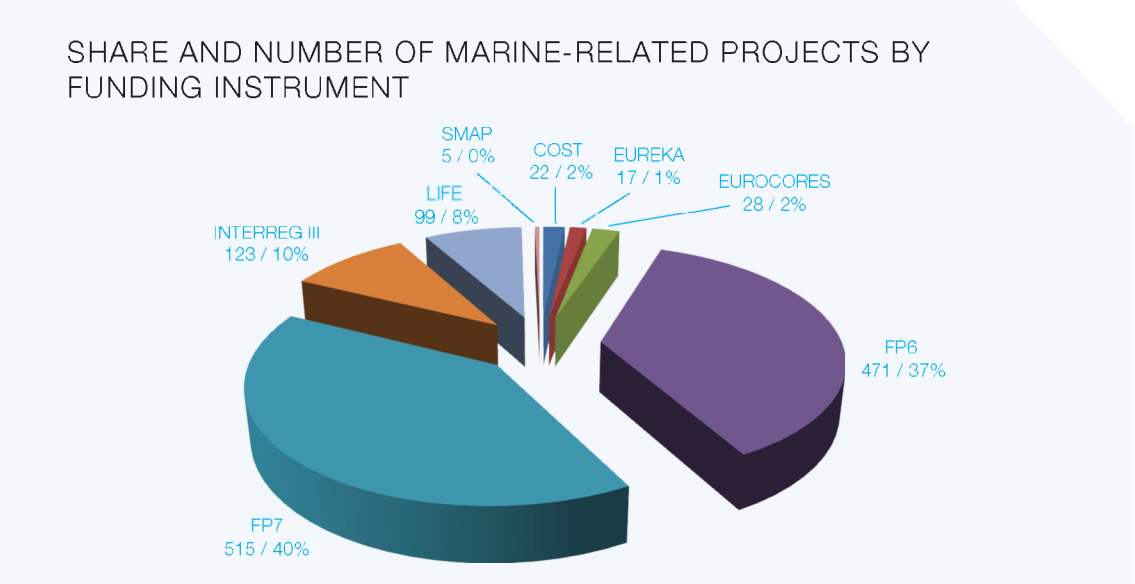

Figure 3. Share and number of marine-related projects by funding instrument, relative to the total inventoried marine-related projects (1.280) in the *EUROCEAN Marine Knowledge Gate*.

The *EUROCEAN* data also show an increase in the share of the total FP budgets assigned to financing marine-related projects, in comparison with the total budget available in the FPs: this 'marine share' increased from 1% at the start of the FPs (1987-1991) to 4.9% during FP6 (2002-2006). Preliminary data (31/10/2012) for FP7 (2007-2013) yield a share of 3.5%. These preliminary numbers do not include the budgets for the last calls of FP7 (Source: data 31/10/2012 2012 *EurOcean Marine Knowledge Gate*) (figure 4).

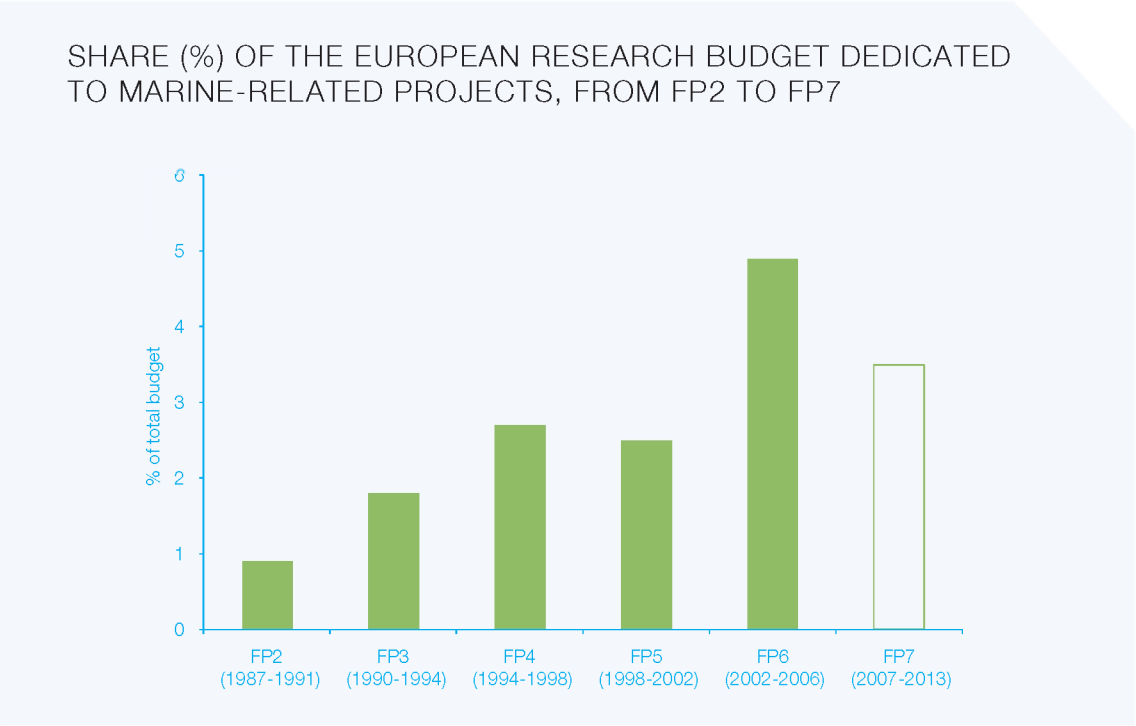

Figure 4. Share (%) of the European research budget dedicated to marine-related projects, from FP2 to FP7 (source: EUROCEAN 2006, completed with provisional figures of EUROCEAN (31/10/2012)).

Financing of data collection and data management

In the context of the initiative Marine Knowledge 2020 (*COM (2010) 461*), it is estimated that the total cost of the collection of marine data by public institutes of the EU Member States is more than 1 billion euros annually. Besides financing marine/maritime components and initiatives in the European research programmes, an additional amount of 40 million euros is provided each year for the data collection programmes in fisheries management (DCF) and 70 million euros for spatial research. A specific additional annual effort of 18.5 million euros in the period 2011-2013 focuses on data collection and data integration at the scale of regional seas, in support of the requirements of the *MSFD*. The efforts related to the initial assessment required by the *MSFD* in the 22 coastal Member States and Croatia amounted to 45-55 million euros, with another estimated 45-52 million euros for the annual cost of assembling data from existing monitoring programmes. The annual cost of new monitoring programmes for the *MSFD* in these coastal states is estimated at approximately 20 million euros (*COWI; Ernst&Young 2013* [229367]).

2 Marine research in Flanders/Belgium

2.1 Policy context for scientific research in Flanders/Belgium

DIVISION OF COMPETENCES

The division of competences for scientific research and innovation in Belgium is stipulated in the *Special law of 8 August 1980* on Institutional Reforms. Article 6bis of this law establishes that the federal government, the Communities and the Regions are responsible for scientific research, including research within the framework of the execution of international or supranational conventions and treaties. The Communities carry the responsibility for scientific research, mainly through universities (Article 127 of the Belgian constitution), while the Regions are responsible for research in the fields of economy, energy, public works, environment, transport etc., including technological and industrial fundamental research and technological innovation. Moreover, the federal government is responsible for the implementation and organisation of the exchange of data between scientific institutes at national and international level, the space research in the framework of international or supranational institutes, agreements or instruments,

the federal scientific and cultural institutes, programmes and actions that require a homogeneous implementation at national or international level and for keeping a permanent inventory of the scientific potential of the country. Co-operation between these different policy levels is coordinated through the Interministerial Conference for Science Policy (*IMCWB*) (figure 5).

There is an effort throughout the different policy levels in Belgium to systematically increase the public budgets for research and technological development (R&D) as a basis for economic growth, echoing the Barcelona goals of spending 3% of the gross domestic product (GDP) on R&D in 2010 (*COM (2002) 499*). Although the public R&D

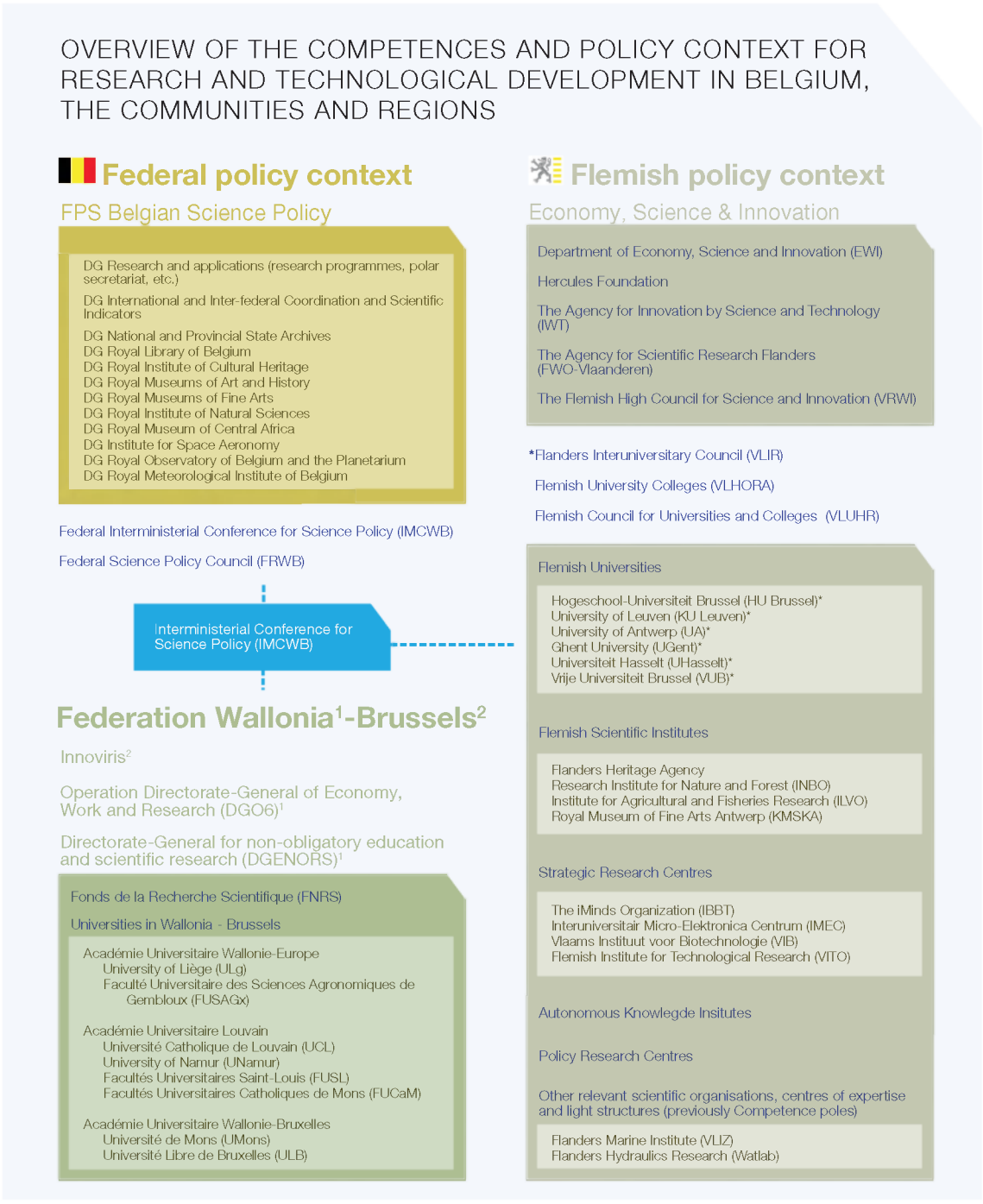

Figure 5. Overview of the competences and the policy context for research and technological development (R&D) in Belgium, the Communities and the Regions (non-exhaustive overview).

investments increased from 0.55% to 0.67% of the GDP in the period 2000-2010, the total share of the R&D budgets remained the same (1.99%). Private investments decreased from 1.42% to 1.32% of the GDP in this timeframe (*EU Research Country Profile 2013* [229191]).

FEDERAL SCIENCE POLICY

The Federal Public Planning Service Belgian Science Policy (*BELSPO*) is responsible for the science policy of the federal government (figure 5).

BELSPO manages the *research programmes* in support of the policy with regard to sustainable development, actions to address climate change, biodiversity, energy, health, mobility and the information of society. Of particular importance for the marine research field is the Science and Sustainable Development programme (*SSD*) which includes the *Belgian Federal North Sea Research Programme*. Furthermore, marine research is financed by the thematic programmes on climate, biodiversity, transport, the Belgian Polar Platform (Antarctic) and the STEREO programme. The SSD programme recently finished. Marine research will be financed by means of the new programme 'Belgian Research Action through Interdisciplinary Networks' (*BRAIN-be*). In addition, marine research is financed by multidisciplinary programmes such as the Interuniversitary Attraction poles (*IAP*). The implementation of IAP and SSD is based on a cooperation agreement between the federal state and the Communities.

In the field of biodiversity, BELSPO coordinates the services with regard to the collection of biological cultures used in scientific research (see website Belgian Coordinated Collections of Micro-organisms, *BCMM*). The *Belgian Biodiversity Platform* is the information and communication platform for scientific research on biodiversity in Belgium.

BELSPO is also responsible for the Belgian contribution to the European Space Agency (ESA). The department consists of 10 federal scientific institutes, of which the Royal Belgian Institute for Natural Sciences (*RBINS*) and the Royal Museum for Central Africa (*RMCA*) are of particular importance with regard to marine research (figure 5).

More detail is provided on the Belgian Portal for Research and Innovation (*BRSITI*). An overview of research funded by BELSPO is available from the *FEDRA database*. The *INVENT database* keeps a permanent inventory of the Belgian research capacity (research units, research projects, and research staff).

The national research network, *BELNET*, offers fast internet access to Belgian universities, colleges, research centres and government departments. The Scientific and Technical Information Service (*STIS*) provides support for information exchange to the scientific community, the socio-economic sectors and government departments. BELSPO is also responsible for coordinating research efforts of all governments of the country, and ensuring that Belgian researchers can participate in international research networks.

SCIENCE POLICY IN THE WALLONIA-BRUSSELS FEDERATION

In Wallonia and the Wallonia-Brussels Federation (formerly the 'French Community of Belgium'), the preparation and implementation of the science policy is regulated by the Directorate for Scientific Research (*Direction de la Recherche Scientifique*) of the Directorate-General for Non-Obligatory Education and Scientific Research (Direction Générale de l'Enseignement Non Obligatoire et de la Recherche Scientifique (DGENORS)), which itself is part of the General Administration for Education and Scientific Research (Administration Générale de l'Enseignement et de la Recherche Scientifique (AGERS)) of the Federation. This directorate is responsible for financing universities, financing non-targeted scientific research (Fonds de la Recherche Scientifique (FNRS) and associated funds), and special funds for research in universities. It also coordinates co-operation in science policies at the regional, federal and international level. The *FNRS* is the entity that provides funding for research programmes, infrastructure and activities in the French-speaking research community. The board of directors of FNRS is *inter alia* composed of representatives from the French-speaking universities as well as the permanent secretaries of the Royal Academy for Science, Literature and Fine Arts, and the Belgian Royal Academy of Medicine.

Since 2007-2008, the French-speaking Universities in Belgium have merged into three 'Académies universitaires' (university academies) in response to changes in the subsidy regulations of the French Community: the Académie Universitaire Wallonie-Europe (ULg, FUSAGx), the Académie Universitaire Louvain (UCL, UNamur, FUSL and FUCaM) and the Académie Universitaire Wallonie-Bruxelles (UMons and ULB) (figure 5).

The Walloon government body *Direction Générale Opérationnelle de l'Économie, de l'Emploi et de la Recherche* (Operational Directorate-General for Economy, Employment and Research) ensures the support of research centres within the scope of (applied) research and technological development in collaboration with the agency *Agence de Stimulation Technologique* (AST). To this end they put grants at the disposal of companies, universities, colleges and research centres.

THE FLEMISH POLICY FRAMEWORK FOR RESEARCH AND INNOVATION

The Flemish Science policy is *inter alia* established by law in the *Decree of 30 April 2009* on the organisation and financing of the science and innovation policy. Several entities in the policy domain of Economy, Science and Innovation (*EWI*) are involved in preparing, implementing and evaluating science policy:

- The department of Economy, Science and Innovation (*EWI*) is responsible for the preparation, follow-up and evaluation of concrete action plans, policy research and regulations in the policy fields of economy, science and innovation;
- The Agency for Innovation by Science and Technology (*IWT*) stimulates innovation with an added economic and societal value in Flanders through the provision of financial support, advice and coordination to companies, research institutes, the government and other entities;
- The task of the Agency for Scientific Research Flanders (*FWO-Vlaanderen*) is to stimulate and support fundamental scientific research at the universities of the Flemish Community, including partnerships between Flemish universities and other research institutes;
- The *Hercules Foundation* was established by the Flemish government as the agency for financing medium-scale and large-scale infrastructure for fundamental and strategic research;
- The Flemish High Council for Science and Innovation (*VRWI*) is a strategic advisory board for science and innovation policies.

The Information Guide for Entrepreneurship and Innovation (*Van der Weken et al. 2013* [229266]) provides an overview of the total budget for science and innovation in Flanders. In 2013, the budget amounted to 1.979 billion euros, 1.271 billion euros of which is spent on research and development in the thirteen policy domains of the Flemish government. An overview of all actors in the Flemish research landscape is available on the *website of the department EWI.*

The research is conducted in the first place by the universities (*Hogeschool-Universiteit Brussel*, *University of Leuven*, *University of Antwerp*, *Ghent University*, *Universiteit Hasselt*, *Vrije Universiteit Brussel*), the *Flemish Scientific Institutes* (*INBO*, *ILVO*, *KMSK*, *Flanders Heritage Agency*), the Strategic Research Centres (*SOC*), (*VITO*, *IMEC*, *VIB*, *IBBT*) and other research institutes (*ITG*, *KMDA*, *Botanic Garden*, managementschools, university associations) (figure 5). The Flanders Marine Institute (*VLIZ*) is the coordination and information platform for marine research in Flanders. Flanders Hydraulics Research (*WatLab*) is a division of the Technical Support Services of the Mobility and Public Works Department of the Flemish Government. An overview of the policies and authorities involved in the policy with regard to the coast and sea is available in **Chapter 3**.

The Flemish Interuniversity Council (*VLIR*) is an autonomous advisory platform aiming to improve the communication and co-operation between the Flemish universities. The Flemish university colleges are also organised under the umbrella organisation of the Flemish University Colleges (*VLHORA*). Moreover, there is communication between all actors in the Flemish higher education (VLIR, VLHORA, university associations, etc.) through the Flemish Council for Universities and Colleges (*VLUHR*) (see below, **Financing**).

MARINE RESEARCH IN FLANDERS AND BELGIUM: GENERAL POLICY CONTEXT

Marine research in Flanders and Belgium is mainly guided and financed within the framework of the science policy of the Communities and the federal and regional governments (see **Policy context for scientific research in Flanders/ Belgium**). Because of the growing importance of science in response to the increasing societal challenges, research is extended to a greater number of policy domains and several applications, as support is raised for the authorities involved. The responsible governmental entities and the division of competences in the coastal zone, marine waters and adjacent estuaries are described in **Chapter 3** of the Compendium for Coast and Sea.

Traditionally, sectoral legislation and policy instruments that play an important role in fundamental research as well as in applied and policy-oriented marine research include fisheries and aquaculture, sand and gravel extraction, dredging and dumping, shipping and ports. Over the past years, offshore energy production has also gained importance as a

research field. The societal challenges also result in a greater demand for research on conservation and management of nature and environment as well as heritage and culture. A detailed overview of all user functions is provided in **Chapter 2** of the Compendium for Coast and Sea.

2.2 History of marine research in Flanders/Belgium

PIONEERS AND GROUNDBREAKING RESEARCHERS

Belgium has a long standing tradition in marine sciences (*Charlier & Leloup 1968* [112914], *Houvenaghel 1980* [212187], *Godeaux & Voss 1985* [13127], *Godeaux 1990* [205736], *Decleir et al. 1990* [208476], *Charlier 2004* [70905], *Seys et al. 2009* [141810]). Prior to the introduction of a more systematic approach to marine research in the early 20th century, research was conducted by scientists individually. Notwithstanding the small size of its marine territory, Belgium has a long and productive history in the field of marine research. Besides those who acquired international fame because of their groundbreaking achievements in the field of marine sciences prior to the 18th century such as the cartographer *Gerardus Mercator* [214583] (Rupelmonde, 1512-1594) and the mathematician and natural scientist *Simon Stevin* [206535] (Bruges, 1548-1620), there are the pioneers of marine research such as 'abbé' *Théodore-Augustin Mann* [217283] (1735-1809) and Jean-Baptiste de Beunie (1717-1793). These pioneers in marine sciences already provided advice to their governments on issues such as overfishing, mussel poisoning, tides and meteorology through studies for the Royal Academy. Later on, their work was adopted by trailblazers such as *Pierre-Joseph Van Beneden* [142447] (1809-1894), his son *Edouard Van Beneden* [206606] (1846-1910), *Alphonse Renard* [206536] (1842-1903) and *Gustave Gilson* [206537] (1859-1944). The merits of marine researchers and experts such as Louis Verhaeghe (1811-1870), Auguste Stessels (1826-1875), *August de Maere-Limnander* [126613] (1826-1900), Charles Van Bambeke (1829-1918), *Philippe Dautzenberg* [142477] (1849-1935), Julius Mac Leod (1849-1935), *Alphonse Meunier* [126612] (1857-1918), *Paul Pelseneer* [207296] (1863–1945), Auguste Lameere (1864-1942), *Jean Massart* [142479] (1865-1925), Désiré Damas (1877-1959), Louis Stappers (1883-1916) and many others are essential in the further evolution of marine sciences in Belgium. The second half of the 19th century was marked by fast developments in science and technology, especially influenced by two milestones: the start of multidisciplinary oceanographic research with the Challenger expedition (1872 – 1876) and the publication of 'On the Origin of Species' (1859) by Charles Darwin. The life and work of these pioneers and groundbreaking marine scientists can be explored on the website '*wetenschatten*' ('Science Treasures', a series of informative fact sheets called 'Historical personalities in marine research', VLIZ).

A FIRST MARINE STATION IN OSTEND

Pierre-Joseph Van Beneden [142447] (1809-1894), professor at the Catholic University of Leuven, built a modest laboratory on the east bank of the Ostend harbour in 1843 with his own means (*Breyne et al. 2010* [198423]). In the following decades, marine biological research was conducted in this '*Laboratoire des Dunes*' ('Dune Laboratory'), installed at the oyster farm of Valcke-De Knuyt, and Van Beneden received visits from famous local and foreign scientists (*Decleir 1989* [205409]). This marine station in Ostend was operational in the years prior to the foundation of renowned European marine stations such as Concarneau (1859), Roscoff (1872), Naples (1872), Wimereux (1875) and Den Helder (1876/1890, *Van Bennekom 2001* [21340]) which only appeared in the 2nd half of the 19th century. His son *Edouard Van Beneden* [206606] (1846-1910), who gained a reputation as the discoverer of meiosis, followed in his father's footsteps and became the driving force behind oceanographic research at the University of Liège. He founded his own research centre in Ostend (1883), close to his father's.

THE START OF SYSTEMATIC MARINE RESEARCH WITH AN INTERNATIONAL DIMENSION

In 1897, *Adrien de Gerlache* [220867] (1866-1934) set sail for Antarctica with the RV Belgica to conduct multidisciplinary research, supported by an international team of scientists. The attention for the expedition stimulated renewed interest in marine research and highlighted the importance of multidisciplinary research in Belgium. Between 1898 and 1913 - and also after WWI - *Gustave Gilson* [206537] who was professor at KULeuven, director of the Royal Natural History Museum (the current Royal Belgian Institute for Natural Sciences, RBINS, *Vivé & Versailles 1996* [30060]) and successor of *Edouard Van Beneden* [206606], undertook a number of campaigns in the southern North Sea. These campaigns led to a collection of more than 14,000 samples which are still used as reference material for present research in the BNS.

In 1927, the Marine Research Institute (*Zeewetenschappelijk Instituut* (ZWI)) was founded on the initiative of Gustave Gilson, with Gilson as its first director. In 1937 ZWI became an 'institution of public utility'. The institute's research focus was mainly on fisheries, inventorying the fauna and flora of coastal waters, and statistical data collection of sea fisheries. The latter was taken over by the Experimental Station for Sea Fisheries (*Proefstation voor de Zeevisserij*) in 1963, later known as the National Station for Sea Fisheries (*Rijksstation voor Zeevisserij*), now part of the Institute for Agricultural and Fisheries Research (*Instituut voor Landbouw en Zeevisserij* (*ILVO*)) of the Flemish government. Gilson was also the driving force behind the 'First International Congress of the Sea' which took place in Ostend in 1936 and was organised again in 1939, 1946 and 1951. Together with his assistant Charles Gillis, he played a role in the foundation of the international programme for data collection on sea fisheries in the Northern Atlantic Region and the North Sea, through the International Council for the Exploration of the Sea (*ICES*).

The infrastructure of ZWI was intensively used by researchers from the Flemish universities. After WWII, marine research in Flanders took a new start with Eugene Leloup (1902 – 1981) as director of ZWI. Under his direction, hydrographic reference stations were surveyed *inter alia* aboard the Westhinder, with an important scientific input from the Belgian universities. ZWI was closed in 1967 due to a lack of financial resources (*Decleir 1989* [205409], *Seys et al. 2009* [141810]).

While the French-speaking universities focused on marine research in the Mediterranean Sea, the main study areas for Flemish institutes were the BNS and the southern North Sea. This led to the foundation of a number of dedicated marine research groups at the State University of Ghent. For internships and practical fieldwork, however, researchers were still depending on foreign marine research stations (e.g. Wimereux and Roscoff).

In October 1970, the Institute for Marine Research (*Instituut voor Zeewetenschappelijk Onderzoek* (IZWO)) was founded by the Flemish universities, the Province of West Flanders and private initiatives involved in marine research activities. Under the leadership of E. Jaspers (°1941) IZWO supported co-operation between several marine research disciplines and the management of laboratory facilities at the Ostend Sluice Dock, a pool of brackish water systematically used for research by university groups since the 1940s (*Leloup & Miller 1940* [5288]). When IZWO was dissolved in 2000, its tasks, staff and infrastructure were taken over by the current Flanders Marine Institute (*Vlaams Instituut voor de Zee* (VLIZ)) (*IZWO 1991* [25578], *IZWO 1993* [65962], *Seys et al. 2009* [141810]). VLIZ is a platform for marine and coastal research in Flanders, coordinating the scientific programme and the ship time of the research vessel of the Flemish government, RV Simon Stevin, and manages its research equipment. Flanders Marine Institute is also part of several projects and networks, and supports and promotes the international appeal of Flemish marine research and international marine education.

RESEARCH PROGRAMMES FOR THE NORTH SEA

In 1970, the Belgian government initiated 'Project Sea' within the scope of the research programme Environment/ Water. This was the *first phase of the programmatic research of the North Sea* (the former Department for Programmatic Science Policy (DPWB), later DWTC, now BELSPO). The goal of 'Project Sea' was the collection of scientific data and the development of modelling techniques to simulate the impact of natural phenomena and anthropogenic effects on the marine environment in both a qualitative and a quantitative way. Between 1971 and 1976, 200 researchers

Table 1. Period and budget of the various phases of the research programme for the North Sea.

PHASE	NAME	PERIOD	BUDGET
I	*Project Sea*	1971 – 1976	4.4 million euros
II	*Concerted Research Action Oceanology*	1977 – 1981	3.4 million euros
III	*Concerted Interuniversitary Research Action North Sea*	1982 – 1993	5.3 million euros
IV	*Impulse programme Marine Sciences*	1992 – 1996	4.6 million euros
V	*Sustainable Management of the North Sea (SPSD I)*	1997 – 2003	10.3 million euros
VI	*Sustainable Management of the North Sea (SPSD-II)*	2002 – 2006	10.9 million euros
VII	*North Sea Research (SSD)*	2006 – 2010	8.3 million euros
VIII	*Marine Research (BRAIN-be)*	2012 - 2017	

from 40 university laboratories and scientific institutes and from multiple disciplines cooperated in the project. At the end of Project Sea, a unit was founded to manage the Mathematical Model of the North Sea and the Scheldt Estuary (*MUMM*), which today exists under the Direction Natural Environment of the RBINS.

Since Project Sea there have been 7 consecutive phases in the research programme for the North Sea (table 1). A new phase was recently initiated in the framework of the research programme: BRAIN-be. The goals of these programmes include:

- The development and consolidation of the scientific expertise with regard to the ecosystem of the North Sea;
- Scientific support for policy makers in matters of the North Sea;
- The promotion of multidisciplinary research (in natural and social sciences);
- The encouragement of interactions between scientists, policy makers and other involved parties at the national, European and international level;
- The stimulation of participation of scientists in international research and international programmes.

RESEARCH VESSELS

At the start of the 20th century, *Gustave Gilson* [206537] used several vessels for his sampling campaigns in the North Sea: the *Sleper nr. 1*, the *Ville d'Anvers* (a vessel for surveillance of fisheries) and the *Narval* (a steamship). As early as 1914, Gilson highlighted the importance of a national oceanographic research vessel (*Noël 1994* [66271]).

In the 1970s, sampling campaigns at sea were conducted with converted minesweepers of the Belgian Navy, such as the *Mechelen* (*France et al. 1992* [79289], *Noël 1994* [66271]). It was not until 1984 that the Belgian scientific community finally had its own vessel: the *RV Belgica*. The RV Belgica is owned by the Belgian State and falls under the responsibility of *BELSPO*. The Direction Natural Environment (RBINS) is responsible for the management of the ship and its scientific equipment, as well as the planning and organisation of the scientific campaigns at sea. The Belgian Navy provides the crew, the operation and the dock in Zeebrugge, the home port of the Belgica (*website MUMM*).

In 2000, the Flemish government provided the RV Zeeleeuw, a converted pilot boat, in support of the marine research community. In 2012 the RV Zeeleeuw was replaced by a new research ship: the RV Simon Stevin, which is mainly used for coastal oceanographic research in the Southern Bight of the North Sea and the eastern part of the Channel (*website VLIZ*). The operation and crew are provided by *VLOOT*, the shipowner of the Flemish government. VLIZ coordinates the scientific programme and manages ship time as well as the research infrastructure and equipment (*website VLIZ*).

2.3 Marine research in Flanders and Belgium: inventory of the research landscape

METHODOLOGY

The inventory of marine research in Flanders/Belgium intends to map the marine research landscape in an objective and coherent way. This first inventory effort addresses the 2008 – 2012 period. In the future, the inventory will be updated annually. Within this scope, objective definitions, preconditions and replicable methods are necessary in order to compare and monitor evolutions in the long term (table 2). These are discussed more thoroughly below.

Research domain, research discipline and marine expertise

To enable a comparison of the inventory on an international level, the definition of research domains and disciplines was based on the international FRASCATI-model (Revised field of science and technology (FOS) classification in the Frascati manual, version 2006). The division of the research disciplines was adapted to marine research based on the division used by the Australian Bureau of Statistics (table 3). The content of the research disciplines is defined by a third hierarchical level, using specific marine expertise (key words, thesauri, 'Aquatic Sciences and Fisheries Abstracts' (ASFA) terminology, etc.). While the first two levels follow the international standards, the third level allows a more flexible and more specific approach to the description of marine research in Belgium. This division in research domains and disciplines is used for the actual description of marine research (**Qualitative description**).

Table 2. Overview of the terminology and definitions which were used for the inventory of the marine research landscape in Flanders and Belgium.

TERM	DEFINITION
Marine research group (MRG)	An MRG has to meet all 4 criteria listed below: • The research group is established in Flanders or in Belgium • The research group periodically receives government funding or subsidies embedded in policy agreements, covenants, or other legal agreements. • Groups which do not belong to a university are included in the list of institutes recognised for scientific research, as established in the *Royal Decree of 22 August 2006* and the subsequent modifications of this royal decree. • The research group focuses on marine research, or research which is relevant for the aforesaid research. In case of doubt, the measurable marine research output of the group over the last 5 years is checked. This output is defined as 'more than one peer-reviewed or VABB publication (**definitions of peer-reviewed and VABB publications**) the first author of which is affiliated to the research group'.
Types of scientific institutes	4 types of scientific institutes are distinguished in this inventory: • Flemish universities • Universities of the Wallonia – Brussels Federation • Flemish scientific institutes • Federal scientific institutes
The Belgian Marine Bibliography (BMB)	The BMB is the reference list of all publications on the Flemish coast and the Belgian part of the North Sea (BNS), and of all other marine, estuarine and coastal publications of Belgian authors and scientists and of foreign scientists affiliated to a Flemish/Belgian institute. The BMB includes: • Books • Reports • Proceedings and Abstracts • Theses • Articles, including peer-reviewed publications • Atlases and maps • Multimedia
Peer-reviewed publications	Marine publications included in the BMB which belong to one of the following categories: • A1: Publications included in one of the ISI Web of Science databases: 'Science Citation Index', 'Social Science Citation Index' or 'Arts and Humanities Citation Index'. Limited to publications of the type: article, review, letter, note, proceedings paper. • A2: Publications in an international scientific journal with peer review, not included in (A1) • A3: Publications in a national journal with peer review, not included in (A1) • P1: Proceedings included in one of the ISI Web of Science databases: 'Conference Proceedings Citation Index - Science' or 'Conference Proceedings Citation Index - Social Science and Humanities'. Limited to publications of the type: article, review, letter, note, proceedings paper, except for publications of the type (A1)
VABB publications	A publication included in the list of the Flemish Academic Bibliographic Database for Social Sciences and Humanities (*VABB-SHW*) (includes both peer-reviewed and non-peer-reviewed publications (**definition of peer-reviewed publications**)).
Marine publication (MPub)	A publication included in the BMB (**definition of BMB**).
Peer-reviewed Marine Publication (MPub_pr)	A marine publication published in a peer-reviewed journal (**definition of peer-reviewed publication**) and included in the BMB
Non peer-reviewed Marine Publication (MPub_non-pr)	A marine publication included in the BMB, except for those published in a peer-reviewed journal
Marine researcher	A person affiliated to an MRG (**definition of MRG**) who is a (co)author of one or more marine publications (**definition of MPub**).
Specialised personnel	A person affiliated to an MRG (**definition of MRG**) who contributes to the development and support of marine research, but without measurable output as publications in the BMB (**definition of BMB**).

Process

VLIZ is responsible for the mapping of the marine research landscape, as commissioned by the Flemish government (EWI dept.). Based on the daily operations of VLIZ, research groups at universities and scientific institutes with a marine research focus are identified as a so-called MRG (**definition of MRG**). Moreover, additional systematic efforts have been carried out to identify additional MRGs which have not yet been identified through the regular channels used by VLIZ.

Table 3. Overview of the research domains and disciplines which are used in the inventory and description of the marine scientific landscape in Flanders and Belgium.

RESEARCH DOMAIN	RESEARCH DISCIPLINE
Agricultural and veterinary sciences	Fisheries and aquaculture sciences
	Veterinary sciences
	Other Agricultural and veterinary sciences
Engineering and technology	Civil engineering
	Electrical and electronic engineering
	Mechanical engineering
	Information and computer sciences
	Geomatics
	Biotechnology
	Other Engineering and technology
Humanities	History and archaeology
	Other humanities
Medical and health sciences	Medical and health sciences
Natural sciences	Mathematics
	Physical sciences
	Chemical sciences
	Earth sciences
	Biological sciences
Social sciences	Economics and business
	Sociology
	Law and legal studies
	Political sciences and policy
	Communication and media
	Other Social sciences

The process to inventory the marine research landscape is based on the regular operation of VLIZ, complemented with an annual systematic survey of literature databases. In the inventory of 2013 these databases are 'Web of Science' (through the ISI-Web or Knowledge) and the Flemish Academic Bibliographic Database for the Social Sciences and Humanities (*VABB-SHW*). The surveys are based on marine keywords in publications as well as journals (figure 6; methods and files in online annex). This selection of publications is subsequently checked on its marine focus and affiliation with a Belgian research group. Next, the publications are added to the Belgian Marine Bibliography (**definition of BMB**) in the integrated marine information system (*IMIS*, VLIZ), in which a link is made between the author(s), the institute and the publication. Based on these links, new or additional MRGs (**definition of MRG**) are identified, provided they have more than one marine peer-reviewed or VABB publication as a first author in the past 5 years.

The completeness of the inventoried marine publications is verified for all MRGs (**definition of MRG**) from at least 2008 onwards. The links between marine publications, author(s) and institutes in the database serve as a basis to count the number of marine publications and authors of the MRGs. The inventory of the staff of the MRGs (marine researchers and specialised personnel, definitions) is based on a survey of the MRGs and their information products (brochures, websites). This survey was performed by VLIZ in 2012-2013 (example file will be provided on *www.compendiumcoastandsea.be*).

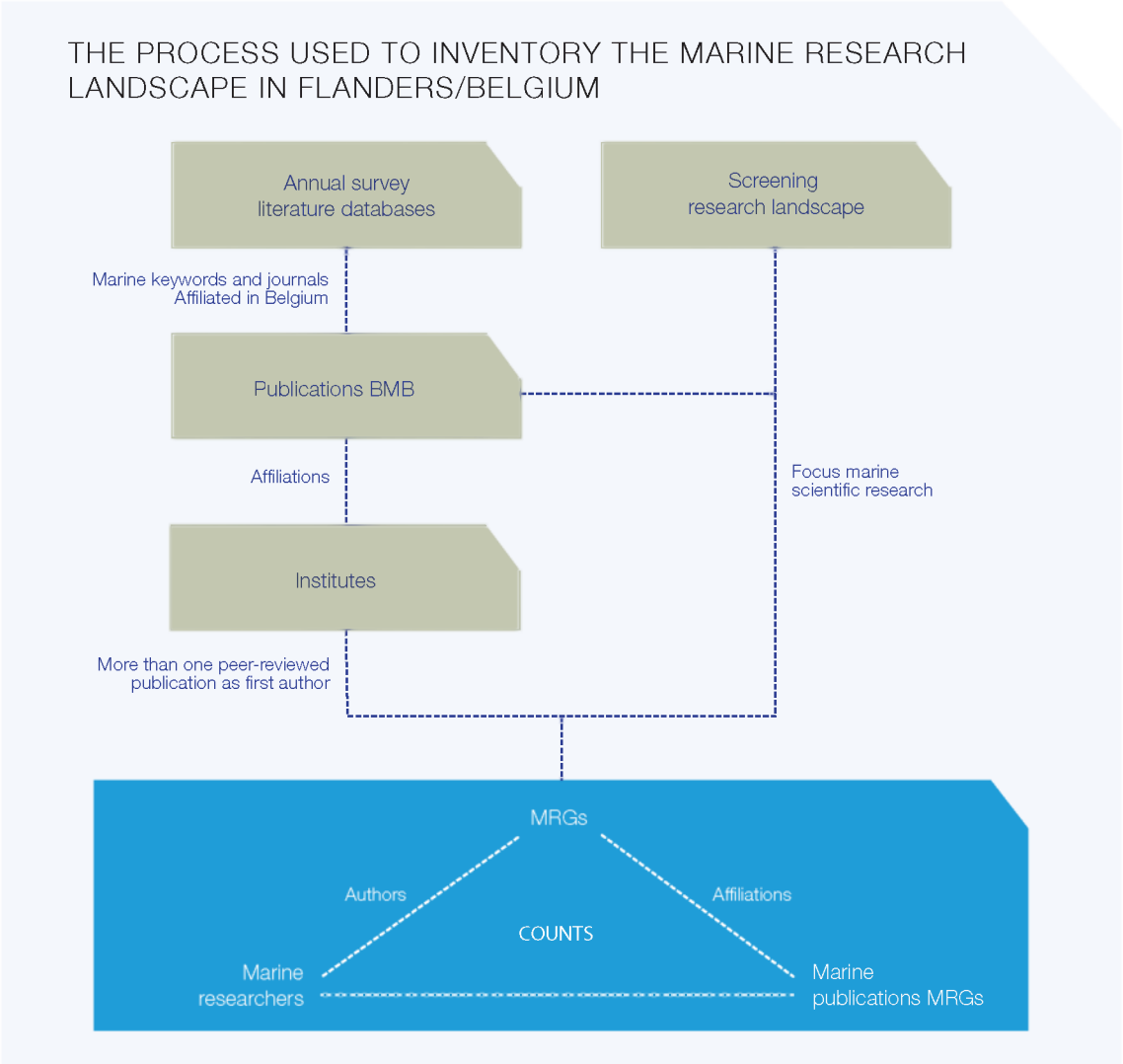

Figure 6. The process used to inventory the marine research landscape in Flanders/Belgium.

From 2013 onwards, the counts and the survey of literature databases will be annually performed by VLIZ for the preceding five years, with a benchmark in July. The benchmark for the present inventory was 19 July 2013.

Consequences and limitations of the definitions and methodology used

The current inventory addresses MRGs at universities and scientific institutes in Flanders and Belgium. Marine research not performed at universities or scientific institutes is not included in the present inventory. This may concern administrations, public and private non-profit organisations, companies, consultancies, port and fish market operators, museums and organisations with educational goals. The marine research results of these bodies are discussed in **Chapter 2** (Use of the Sea) of the Compendium for Coast and Sea.

In this first version of the inventory of marine research in Flanders and Belgium, the objective counts are focused on peer-reviewed publications and publications included in the Flemish Academic Bibliographic Database for the Social Sciences and Humanities (*VABB-SHW*). A significant part of the scientific output is available in types of publications which are not included in the counts of the current inventory (e.g. theses, books, scientific advice, project reports, etc.) (figure 7). The collection of publications included in the inventory is to some extent determined by the surveyed databases (Web of Science and *VABB-SHW*), in which certain fields of science, such as engineering sciences, are less represented. This implies a potential incompleteness or underestimation of the scientific output of the MRGs.

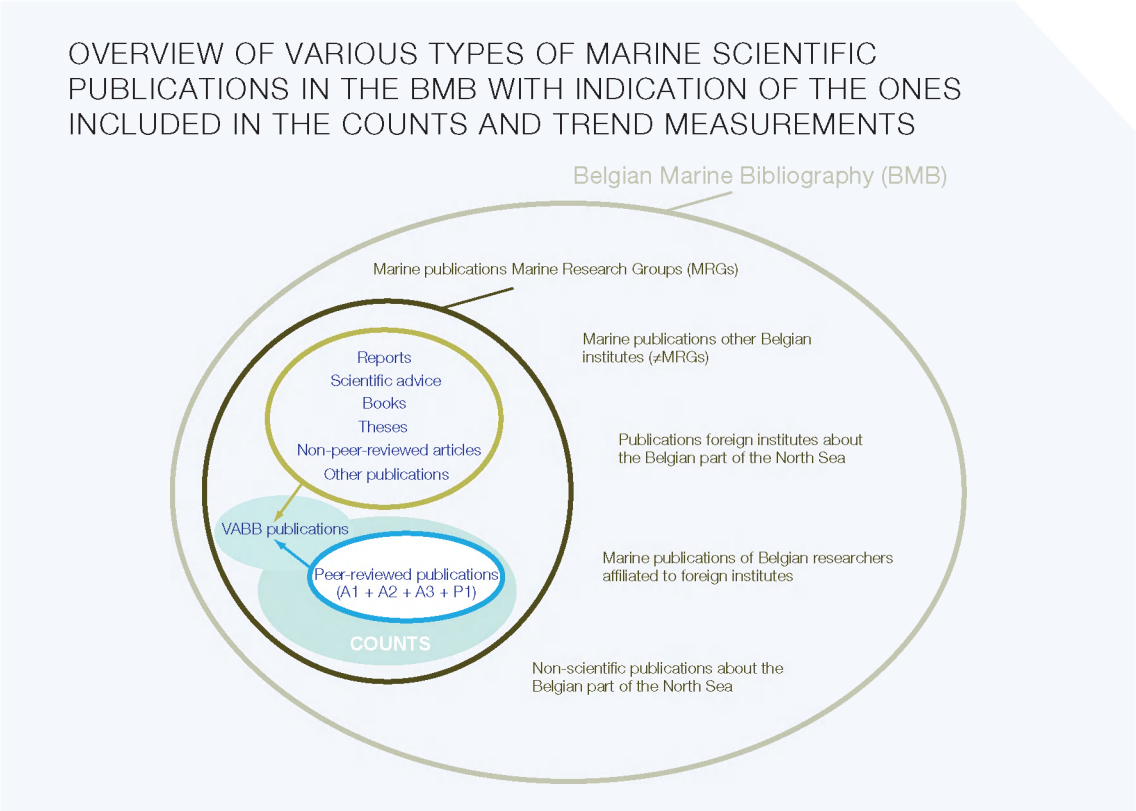

Figure 7. Overview of various types of marine scientific publications in the BMB with indication of the publications included in the counts and trend measurements (VLIZ, 2013).

This limitation is a direct consequence of the specific character of the available information sources. Nevertheless, the survey can be expanded to new and/or more complete information sources such as the *INSPEC* database (focus on engineering and technology) when available. In addition, important developments occur in the field of citability of data sets and other scientific knowledge output (projects, datasets, maps, models, etc.), which will receive the appropriate attention in this inventory in the future.

The methodology used, aims to exhaustively inventory the MRGs and their publications. This may lead to a degree of incompleteness which is hard to quantify. In the following years, the inventory will be completed further, which may result in small changes to the current figures.

Given that the affiliation of the authors is used to link institutes, authors and publications, it may be that the inventory counts do not include publications with an incomplete or incorrect affiliation (e.g. 'Ghent University' instead of 'Marine Biology Section').

In literature databases, new publications are included and described with a certain delay, meaning that the statistics for publications in 2012 in the current inventory are incomplete for the Web of Science database while they are not yet available for the *VABB-SHW*. More reliable figures for 2012 will be available in the next edition of the inventory.

MARINE RESEARCH GROUPS AND RESEARCH CAPACITY

A total of 82 marine research groups (MRGs) had been identified on the benchmark date of 19 July 2013. Scientific institutes are counted on an institute level (e.g. Research Institute for Nature and Forest, INBO) whereas university groups are counted on a laboratory, unit, or research group level (e.g. Ecosystems management Research Group) (figure 8). A list of all MRGs on the date of the count is available in the annex.

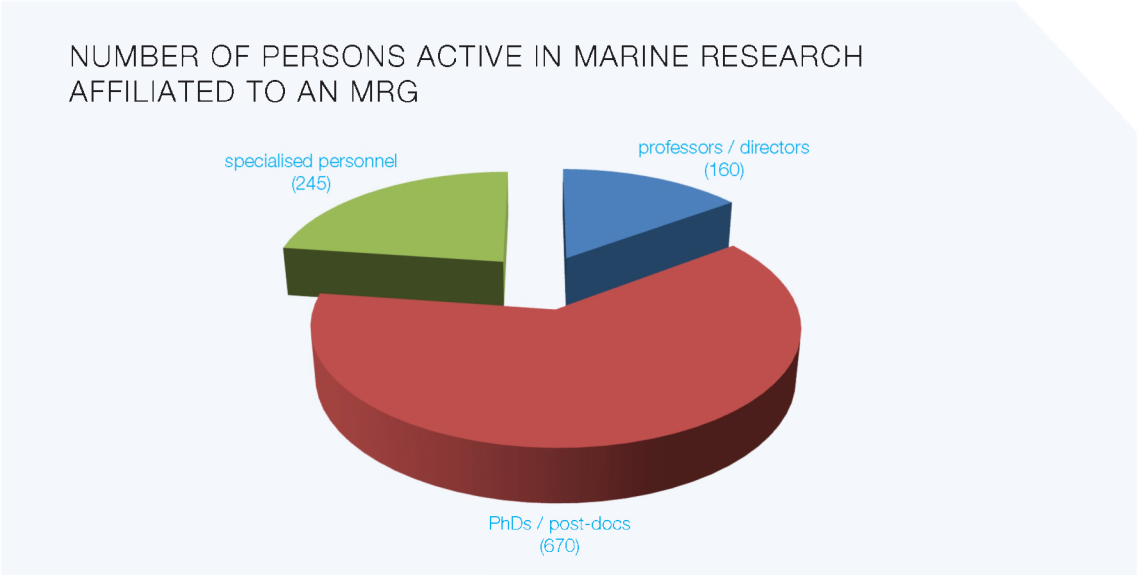

Figure 8. Number of persons active in marine research which were affiliated to an MRG on 19 July 2013 (Source: VLIZ survey 2012-2013).

A total of 1,075 persons active in the field of marine research were counted in these MRGs. This corresponds to 1.7% of the total staff in the Research and Development (R&D) sector in Belgium and 3.9% of the R&D staff in higher education and the government (source: Commissie Federale Samenwerking, Overleggroep CFS/STAT; calculations Federal Science Policy (BELSPO)).

The Flemish MRGs account for 67% of the marine research staff in Belgium (725 out of 1,075). R&D indicators (*Debackere & Veugelers 2011* [228757]) show that 15,500 people worked full-time in the non-profit segment of the R&D sector (government and higher education) in 2009. This means that the marine research potential at the MRGs in Flanders accounts for an estimated 4.7% of the total non-profit R&D sector in Flanders.

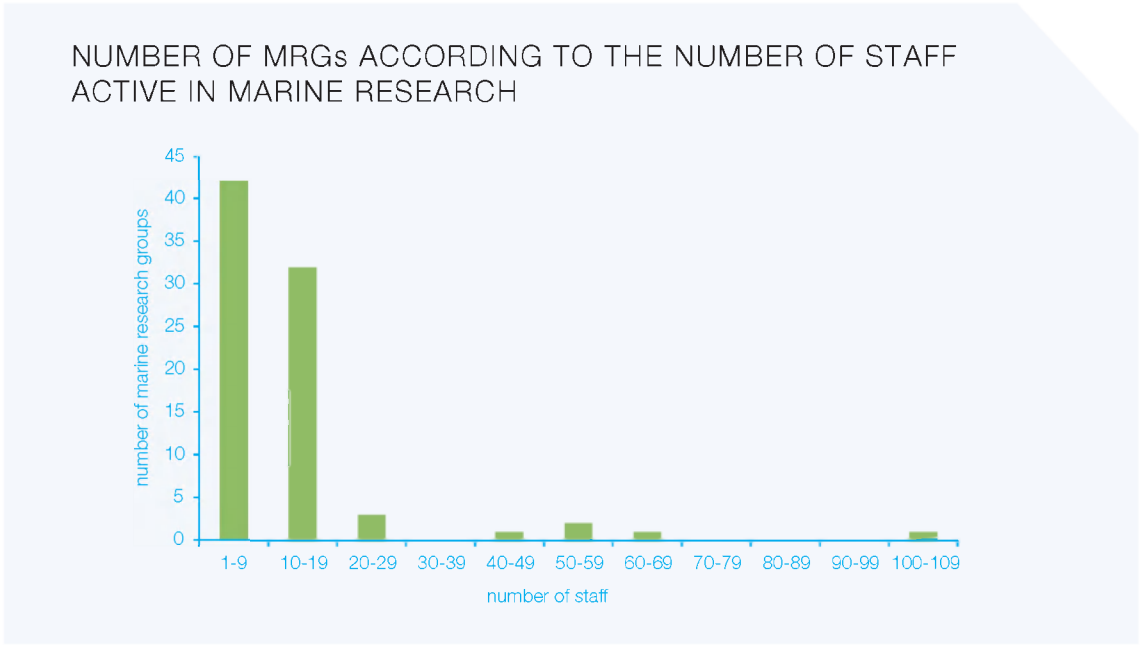

Figure 9. Number of MRGs based on 'the number of staff active in marine research (marine researchers and specialised personnel, definitions)' (Source: VLIZ survey 2012-2013).

The staff of the MRGs can be further categorised into professors, heads of department and directors of research groups and institutes (160 persons); researchers in a PhD programme or continued research (670 persons); and specialised personnel in marine research (245 people). It should be mentioned that not all marine researchers and specialised personnel work full-time on marine topics.

The number of staff per research group is rather limited, with a median of 9 people active in marine research per MRG (figure 9). Only 5 out of 82 groups have more than 30 staff members active in marine research. In 4 out of 5 cases it concerns a scientific institute.

Research capacity by type of institute

The Flemish universities and the universities of the Wallonia – Brussels Federation account for 48 and 26 MRGs respectively. There are 6 MRGs in the Flemish scientific institutes and 2 in the federal scientific institutes.

The number of staff active in marine research provides a better view on the actual research capacity of the different types of institutes, showing that the Flemish universities employ about half of the marine researchers and specialised personnel (521 persons), followed by the universities of the Wallonia – Brussels Federation (238 marine staff members), the Flemish scientific institutes (204 marine staff members), and the federal scientific institutes (112 marine staff members) (figure 10).

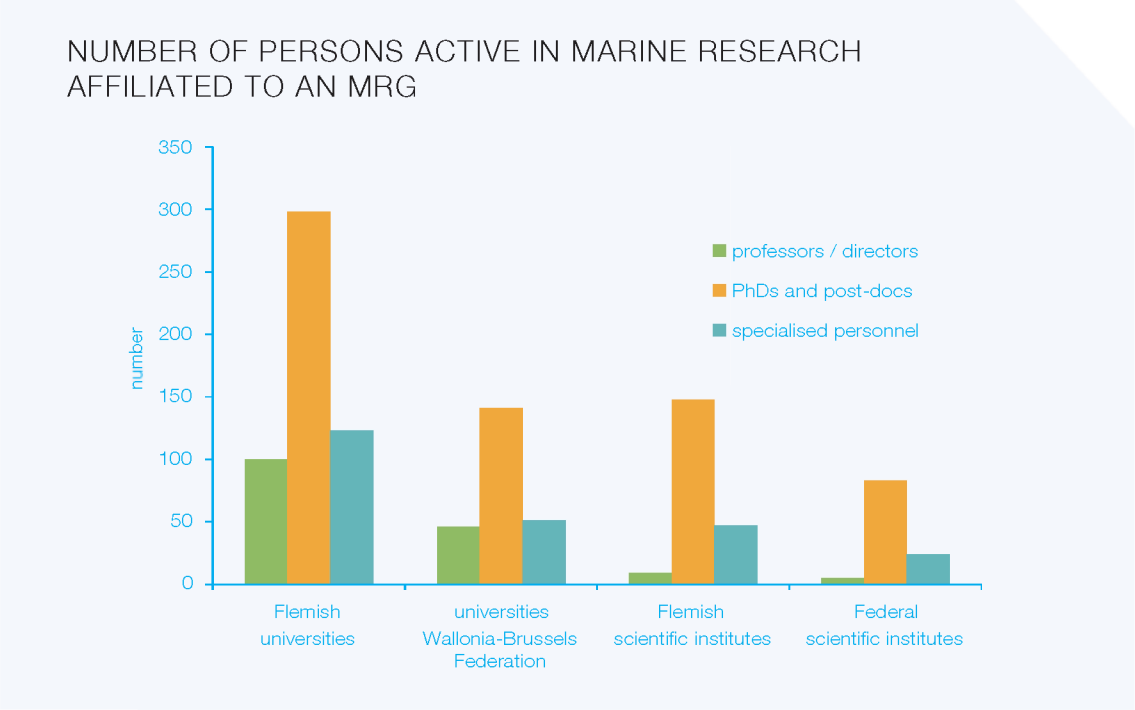

Figure 10. Number of persons active in marine research affiliated to an MRG on 19 July 2013, by type of institute (Source: VLIZ survey 2012-2013).

Research capacity by research domain and discipline

The bulk of marine research at the MRGs is carried out within the research domain of Natural Sciences with 57 MRGs (out of the 82 inventoried MRGS) and 826 marine staff members (out of a total of 1,075; source: VLIZ survey 2012-2013). In addition, the MRGs have a considerable research capacity in the domain of engineering and technology (16 MRGs; 285 staff members), agricultural and veterinary sciences (9 MRGs; 134 staff members) and social sciences (7 MRGs; 111 staff members). The human sciences and the medical and health sciences are represented by four MRGs / 24 staff members and two MRGs / 11 staff members respectively (figure 11).

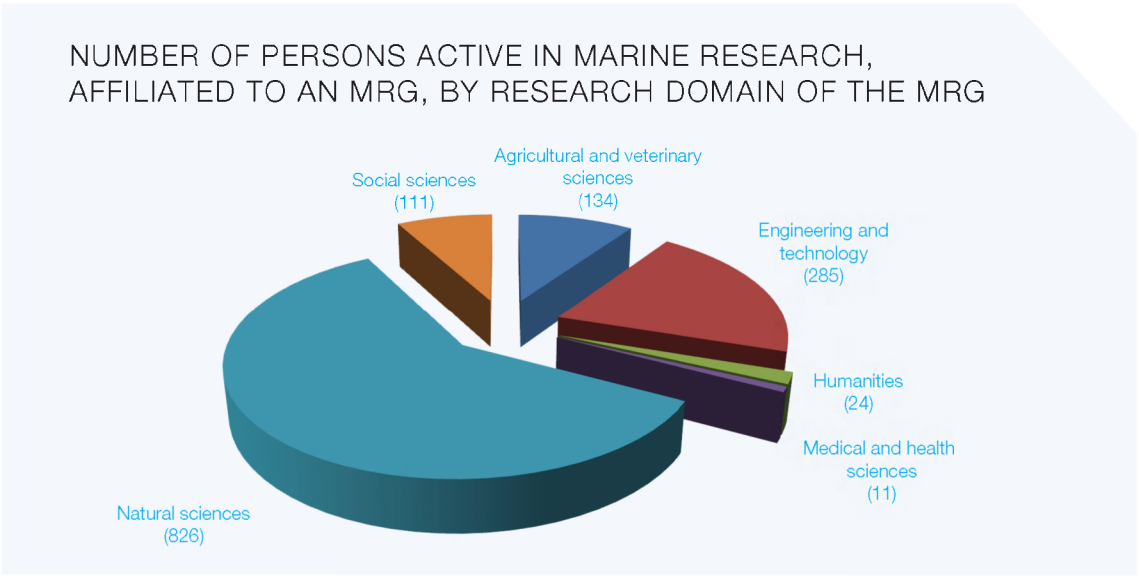

Figure 11. Number of persons active in marine research who were affiliated to an MRG on 19 July 2013, by research domain of the MRG. Research groups (and the associated staff) can be allocated to several research domains and disciplines (Source: VLIZ survey 2012-2013).

The research domains can be subdivided into several research disciplines, in which the biological sciences (33 MRGs; 524 marine staff members) and earth sciences (24 MRGs; 347 marine staff members) account for the majority of the research capacity (figure 12). Additionally, research groups belong to a number of research disciplines ranging from fisheries and aquaculture sciences, civil engineering, history and archaeology to law and legal studies. This diversity is also demonstrated by the qualitative description of the research topics of the MRGs (see **Qualitative analysis**).

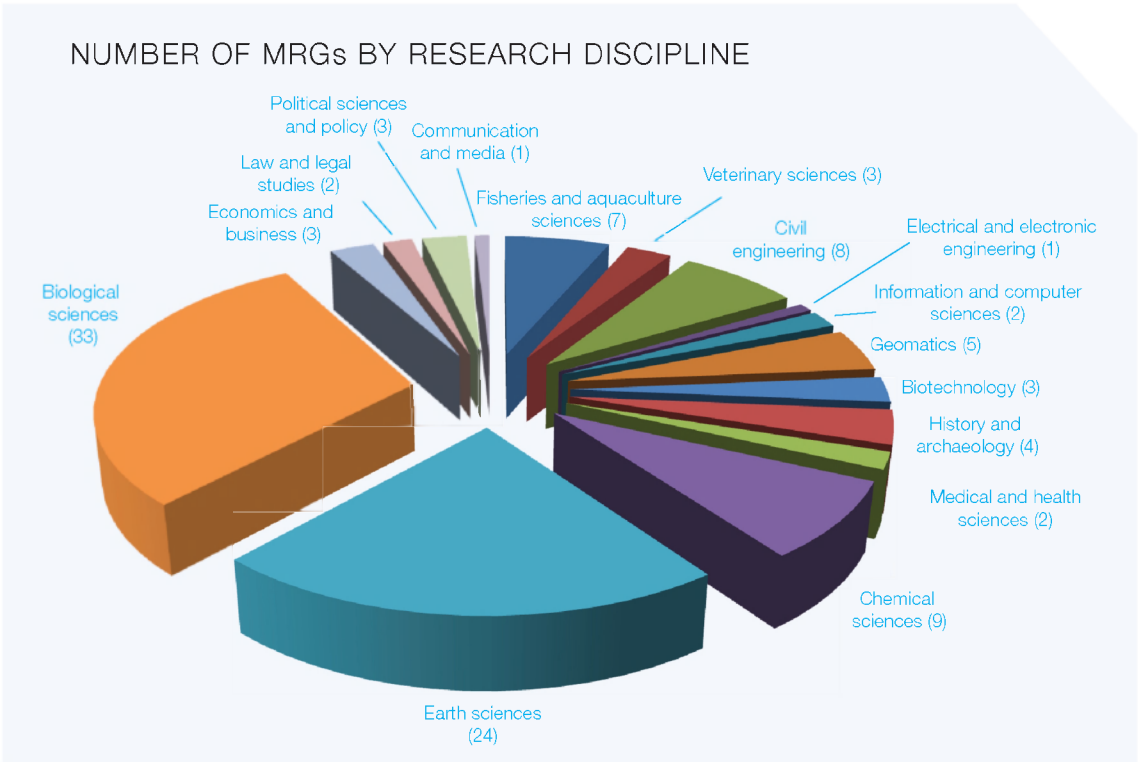

Figure 12. Number of MRGs by research discipline on 19 July 2013. MRGs (and the associated staff) can be allocated to several research domains and disciplines (Source: VLIZ survey 2012-2013).

SCIENTIFIC OUTPUT

The scientific output of the MRGs is diverse and includes peer-reviewed publications, books, (project) reports, proceedings, scientific advice, theses, etc. In the following, only the output of peer-reviewed and VABB publications is taken into account (definitions and figure 6). It is not the intention to value different types of publications in this context. The methodology and its consequences and limitations are explained more thoroughly in the methodology section.

Peer-reviewed publication

Between 2008 and 2011, the 82 MRGs published an average of 372 marine peer-reviewed publications every year (figure 13). As explained in the methodology section, this number is a minimum estimate. The marine output of the MRGs constitutes approximately 1.5% of the peer-reviewed publications of institutes located in Belgium (Belgian research groups but also European institutes such as JRC, etc.) in 'Web of Science' (25,154 peer-reviewed publications: articles, proceedings, reviews, meeting abstracts, etc. in 2012). Besides, approximately hundred marine peer-reviewed publications of institutes not recognised as an MRG are annually included in the BMB (figure 13). These are publications by Belgian researchers affiliated to foreign institutes, publications of Belgian institutes which do not meet the definition of an MRG, and publications on the BNS by foreign research institutes.

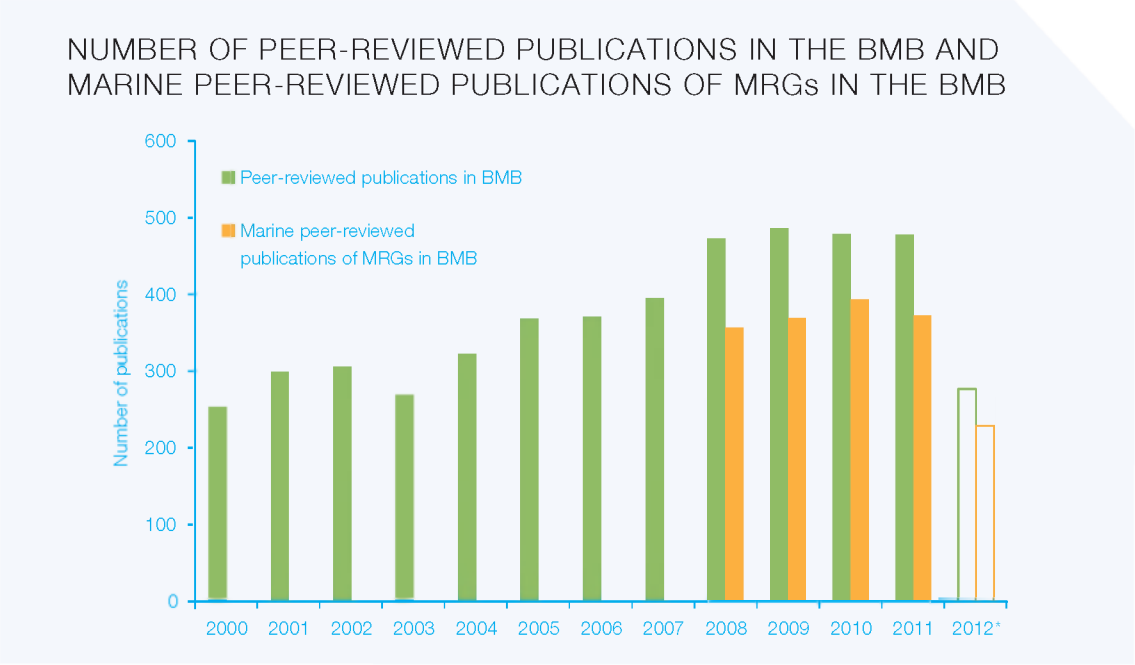

Figure 13. Number of peer-reviewed publications in the BMB and marine peer-reviewed publications of MRGs in the BMB. **The figures for 2012 are less complete, (see Methodology; source: IMIS, VLIZ 2013).*

In line with the research capacity, the majority of marine peer-reviewed publications was published by Flemish universities and universities of the Wallonia – Brussels Federation, with an annual average of 248 and 105 marine peer-reviewed publications respectively in the 2008-2011 period (figure 14). The Flemish scientific institutes publish an average of 27 marine peer-reviewed publications and the federal scientific institutions an average of 55 marine peer-reviewed publications per year. It is important to mention that scientific institutes mainly focus on knowledge output such as scientific advice, project reports, monitoring and evaluation of policy goals, etc., which are often not suitable for publication in peer-reviewed journals.

The majority of marine peer-reviewed publications is published by MRGs active in the research domain of natural sciences, with an annual average of 328 publications in the 2008-2011 period (figure 15). This is in line with the aforementioned research capacity, but is also a consequence of the nature of the database surveyed (Web of Science, see **Methodology**) and of the tradition in the domain of natural sciences to publish in peer-reviewed journals. The prevalence of natural sciences in the peer-reviewed output also shows in the list of journals in which MRGs publish

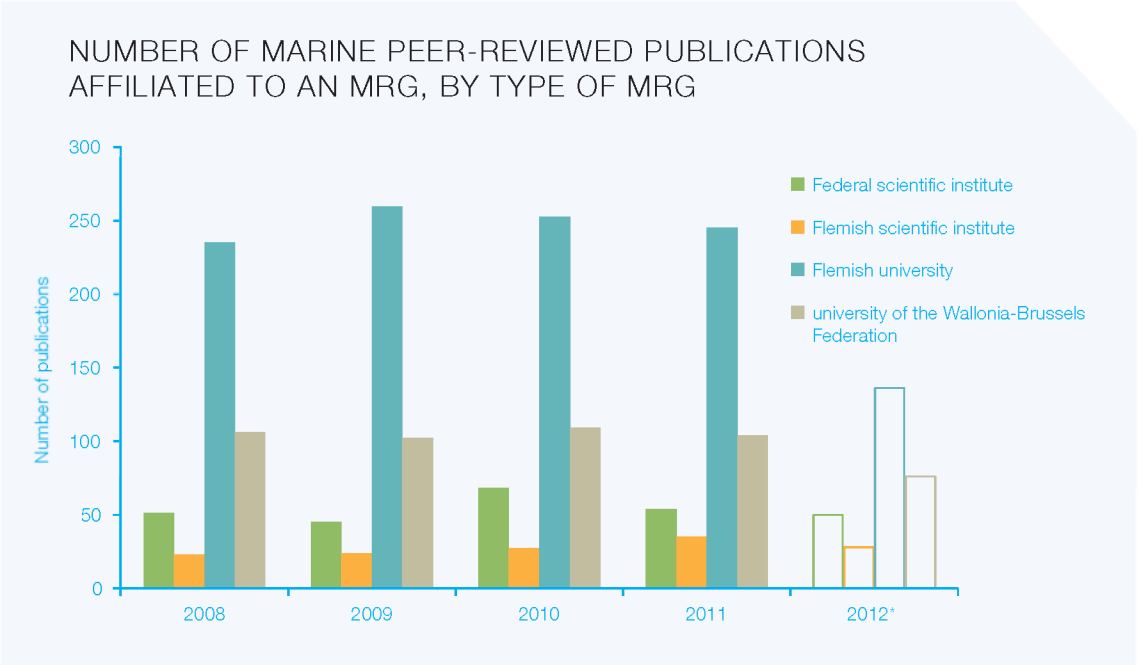

Figure 14. Number of marine peer-reviewed publications affiliated to an MRG, by type of MRG. In case of cooperation between several institutes, a publication can be allocated to more than one type of institute. **The figures for 2012 are less complete (see Methodology; source: IMIS, VLIZ 2013).*

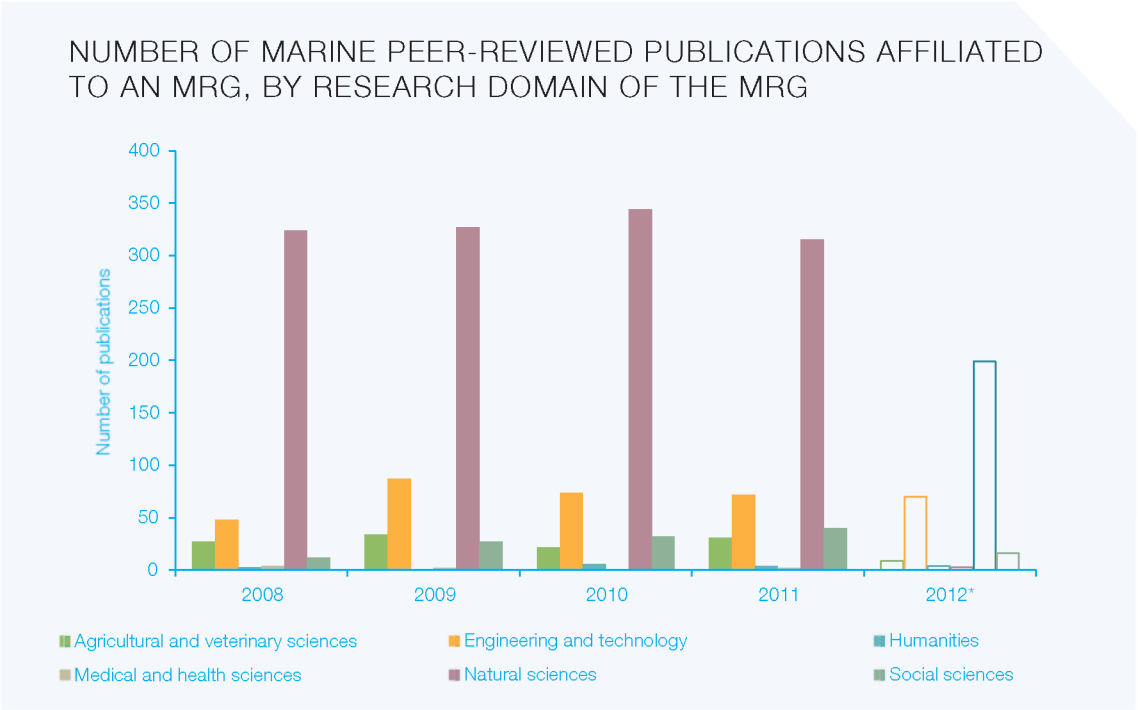

Figure 15. Number of marine peer-reviewed publications affiliated to an MRG, by research domain of the MRG. In case of cooperation and multidisciplinary research, a publication can be attributed to several research domains. **The figures for 2012 are less complete (see Methodology; source: IMIS, VLIZ 2013).*

most often (table 4). On the other hand, the fact that publications were published in 499 different peer-reviewed journals between 2008 and 2011, gives an indication of the diversity of the research conducted by the MRGs. The research domain engineering and technology accounts for an average of 70 peer-reviewed publications per year (2008-2011), followed by agricultural and veterinary sciences (yearly average of 29 peer-reviewed publications) and social sciences (yearly average of 28 peer-reviewed publications). As scientific output is often published outside of the peer-reviewed publications system in certain research domains such as human and social sciences, marine publications which are included in the *VABB-SHW* have also been taken into account (see below, **VABB publications**).

Table 4. Overview of the number of marine peer-reviewed publications affiliated to an MRG, on the basis of the journals in which MRGs most frequently publish (2008-2012).

	NUMBER OF PUBLICATIONS (2008-2012)	JOURNAL
1	75	Geophysical Research Abstracts. Copernicus: Katlenburg-Lindau. ISSN 1029-7006
2	64	Marine Ecology Progress Series. Inter-Research: Oldendorf. ISSN 0171-8630
3	57	Estuarine, Coastal and Shelf Science. Academic Press/Elsevier: Amsterdam. ISSN 0272-7714
4	37	Marine Geology. Elsevier: Amsterdam. ISSN 0025-3227
	37	Deep-Sea Research, Part II. Topical Studies in Oceanography. Pergamon: Oxford. ISSN 0967-0645
6	32	Marine Pollution Bulletin. Macmillan: Oxford. ISSN 0025-326X
	32	Ocean Dynamics. Springer-Verlag: Berlin. ISSN 1616-7341
8	29	Belgian Journal of Zoology. Koninklijke Belgische Vereniging voor Dierkunde = Société royale zoologique de Belgique: Gent. ISSN 0777-6276
9	28	Marine Biology. Springer: Berlin. ISSN 0025-3162
10	26	PLoS One. Public Library of Science: San Francisco. ISSN 1932-6203
11	23	Coastal Engineering: An International Journal for Coastal, Harbour and Offshore Engineers. Elsevier: Amsterdam. ISSN 0378-3839
	23	Continental Shelf Research. Pergamon Press: Oxford. ISSN 0278-4343
	23	Geologica Belgica. Geologica Belgica: Brussel. ISSN 1374-8505
	23	Journal of Marine Systems. Elsevier: Amsterdam. ISSN 0924-7963
15	22	Aquaculture. Elsevier: Amsterdam. ISSN 0044-8486
16	21	Geochimica et Cosmochimica Acta. Elsevier: Oxford. ISSN 0016-7037
	21	Journal of Coastal Research. Coastal Education and Research Foundation: Fort Lauderdale. ISSN 0749-0208
18	20	Hydrobiologia. Springer: Berlin. ISSN 0018-8158
	20	Journal of Experimental Marine Biology and Ecology. Elsevier: Amsterdam. ISSN 0022-0981
20	19	Bulletin van het Koninklijk Belgisch Instituut voor Natuurwetenschappen. Aardwetenschappen = Bulletin de l'Institut Royal des Sciences Naturelles de Belgique. Sciences de la Terre. KBIN: Brussel. ISSN 0374-6291
	19	Journal of Geophysical Research. American Geophysical Union: Washington DC. ISSN 0148-0227
	19	Marine Ecology (Berlin). Blackwell: Berlin. ISSN 0173-9565
23	18	Aquatic Botany. Elsevier Science: Amsterdam. ISSN 0304-3770
	18	Journal of the Marine Biological Association of the United Kingdom. Cambridge University Press/Marine Biological Association of the United Kingdom: Plymouth. ISSN 0025-3154
	18	Ocean Modelling. Elsevier: Amsterdam. ISSN 1463-5003
26	17	Gattuso, J.P.; Kesselmeier, J. (Ed.) Biogeosciences. Copernicus Publications: Katlenburg-Lindau. ISSN 1726-4170
	17	Zootaxa. Magnolia Press: Auckland. ISSN 1175-5326
28	16	Eos, Transactions, American Geophysical Union. American Geophysical Union: Washington DC. ISSN 0096-3941
29	15	Maritime Policy and Management. Taylor & Francis: London. ISSN 0308-8839
30	13	Journal of Experimental Biology. Cambridge University Press: London. ISSN 0022-0949
	13	Marine Policy. Pergamon: Amsterdam. ISSN 0308-597X
	13	Palaeogeography, Palaeoclimatology, Palaeoecology. Elsevier: Amsterdam. ISSN 0031-0182

On the benchmark date of 19 July 2013, the integrated marine information system (*IMIS*, database of VLIZ) contained 674 marine peer-reviewed publications affiliated to an MRG (2008-2012) with a Web of Science (WoS) code. This code was inserted during the survey of the WoS database and can be used to analyse the number of citations in the WoS database. These 674 marine peer-reviewed publications (2008 – 2012) with a WoS code constitute a representative sample of the total peer-reviewed output of the MRGs to analyse the number of citations. The total annual average of citations of the analysed publications is 1.86 citations each year (figure 16). It should be mentioned that the annual average number of citations of a publication increases as the publication is included in the WoS database for a longer period of time. Eleven publications have an average of more than 10 citations per year.

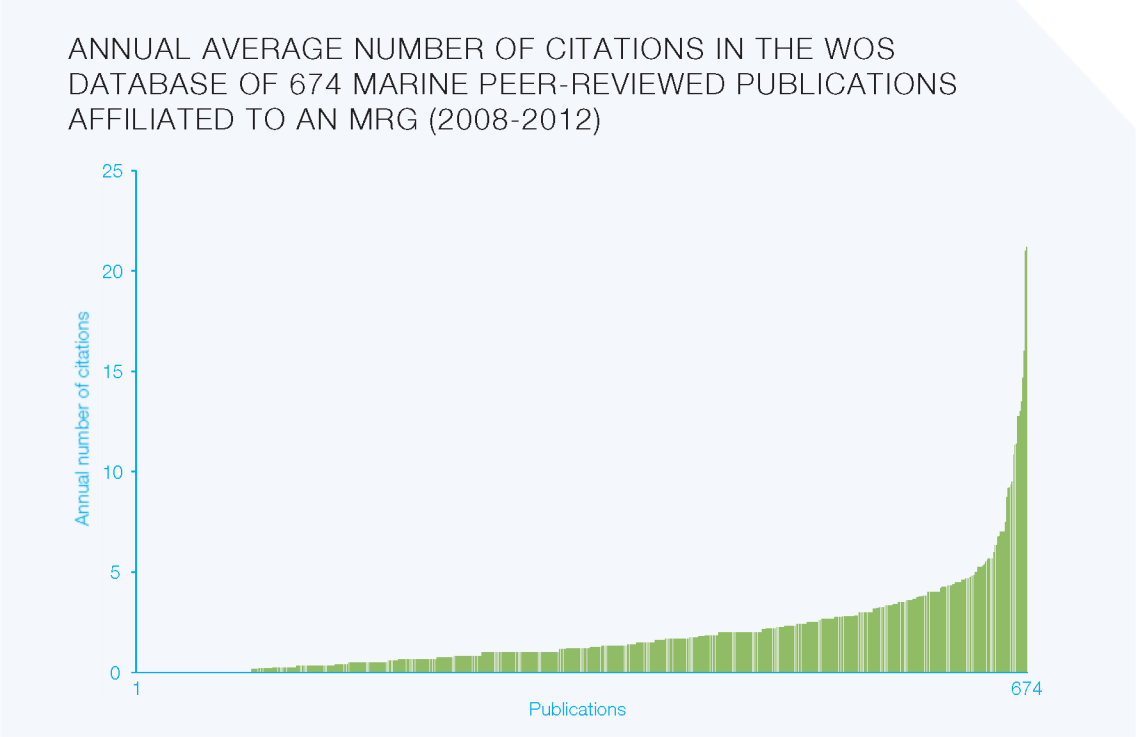

Figure 16. Annual average number of citations in the WoS database of 674 marine peer-reviewed publications affiliated to an MRG (2008-2012) (Source: Web of Science, survey VLIZ July 2013).

VABB publications

For a more complete view of the scientific output of MRGs in research domains which often publish outside of peer-reviewed journals (e.g. human and social sciences), *VABB-SHW* has been surveyed as well. This database was established to better assess the output in this kind of research domains and contains books, (peer-reviewed) journals, proceedings, abstracts, etc. The conditions a publication needs to meet to be included in the VABB are elaborated on the website *http://www.ecoom.be/en/vabb*. It should be mentioned that this database focuses on Flemish universities, and that the output of other types of institutes is less well represented.

Table 5. Number of marine VABB publications affiliated to an MRG on the basis of the journals in which MRGs most frequently publish (2008-2011).

	NUMBER OF PUBLICATIONS (2008-2011)	JOURNAL
1	11	Maritime Policy and Management. Taylor & Francis: London. ISSN 0308-8839
2	6	Maritime Economics & Logistics. Palgrave Macmillan: Basingstoke. ISSN 1479-2931
3	5	Journal of Transport Geography. Butterworth-Heinemann: Oxford. ISSN 0966-6923
4	3	Marine Policy. Pergamon: Amsterdam. ISSN 0308-597X
	3	Nieuw Juridisch Weekblad. Kluwer: Mechelen. ISSN 1378-8914

On average, 31 marine publications of MRGs are included in the VABB database every year (2008-2011) (figure 17). Given the specific character of the database, it is not surprising that the marine VABB publications are mainly published by Flemish universities (an annual average of 31 publications between 2008 and 2011) and in the domain of social sciences (an annual average of 20 publications between 2008 and 2011). This last fact is also apparent in the list of journals in which MRGs publish most often (table 5).

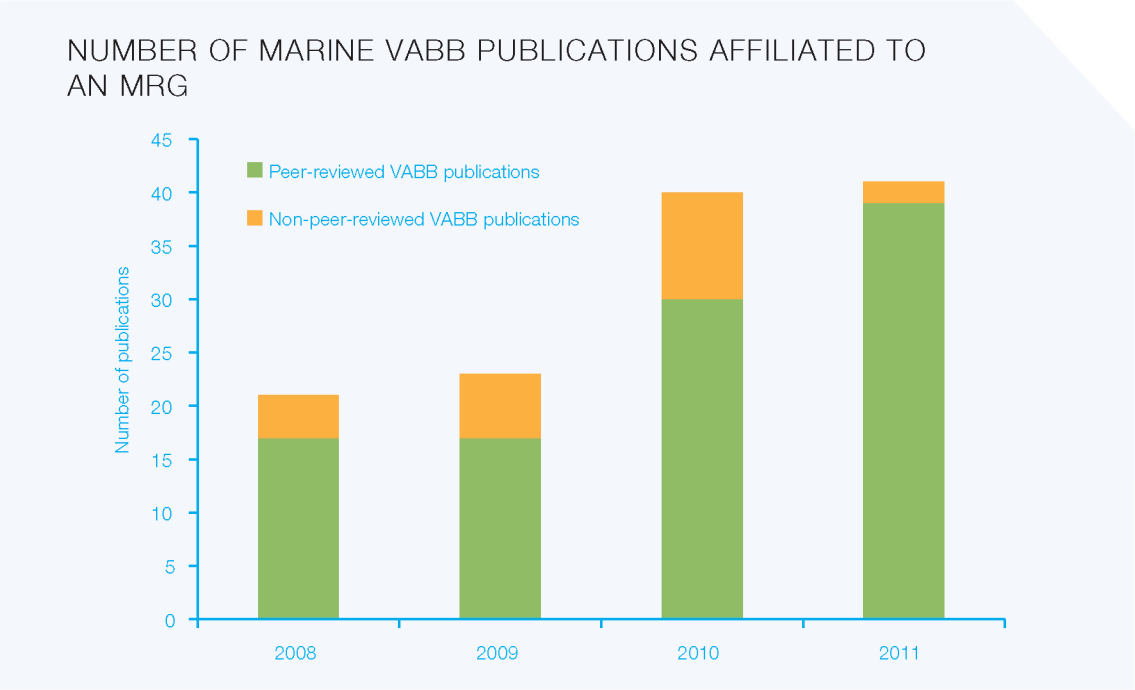

Figure 17. Number of marine VABB publications affiliated to an MRG (2008-2011) (Source: VABB and IMIS, VLIZ 2013).

Authors

In the 2008-2012 period, a total of 1,089 unique persons affiliated to an MRG were (co)author of a marine peer-reviewed or VABB publication. The yearly average amounts to 466 unique authors (2008-2011) (figure 18). In line with the research capacity, most authors are affiliated to MRGs of Flemish universities (648 unique authors) and of universities of the Wallonia – Brussels Federation (270 unique authors). Additionally, 114 unique authors of a peer-reviewed or VABB publication were affiliated to a Flemish scientific institute, and 119 to a federal scientific institute (2008-2012).

922 unique authors of marine peer-reviewed or VABB publications are affiliated to an MRG in the research domain of natural sciences. In addition, the research fields of engineering and technology (218 unique authors), agricultural and veterinary sciences (110 unique authors) and social sciences (58 unique authors) account for a considerable number of authors as well (figure 19). Given that this count encompasses a period of 5 years (2008-2012), a number of these authors may be no longer affiliated to an MRG at the time of the count. The current situation with regard to staff composition is discussed in the section about the research capacity of the MRGs.

STUDY AREAS OF THE MRGs

An analysis of the location of the study areas was conducted on the basis of the inventoried marine peer-reviewed and VABB publications of the MRGs of 2010. In the case 144 publications, a study area could not be determined. Examples of these kinds of publications are conceptual modelling studies and experimental studies in laboratories. Of the remaining publications, 78 can be categorised as 'regional research' (29% of publications with a study area). This concerns studies with a study area in the River Scheldt, the Flemish coastal zone or the Southern Bight of the North Sea (figure 20). Within the study area of the Southern Bight of the North Sea, a further selection is made

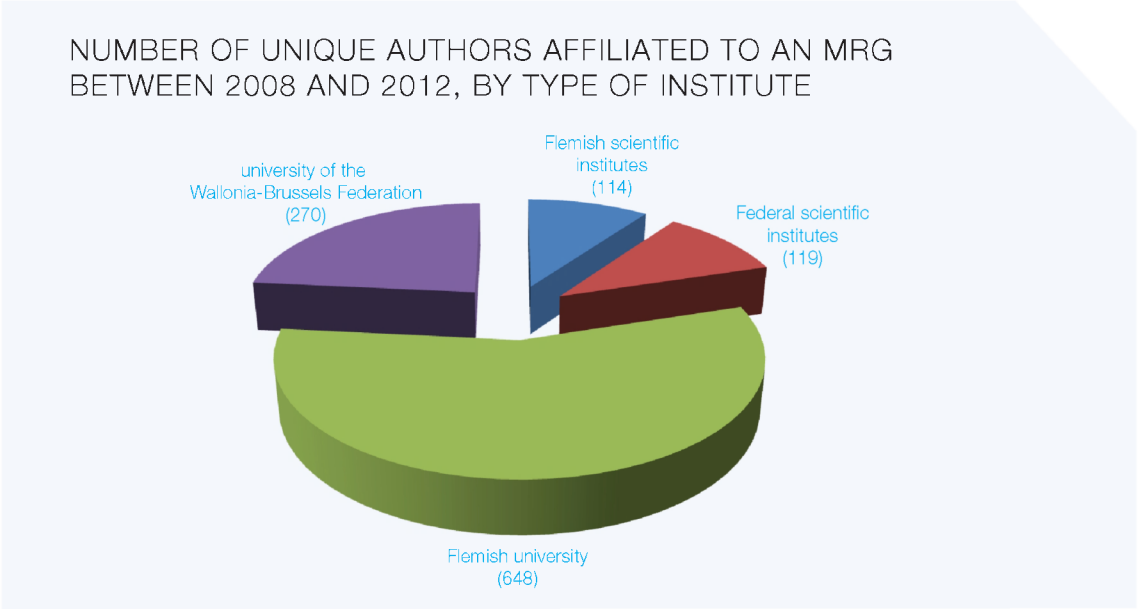

Figure 18. Number of unique authors of marine peer-reviewed or VABB publications affiliated to an MRG between 2008 and 2012, by type of institute. An author can be affiliated to several types of institutes (Source: IMIS, VLIZ 2013).

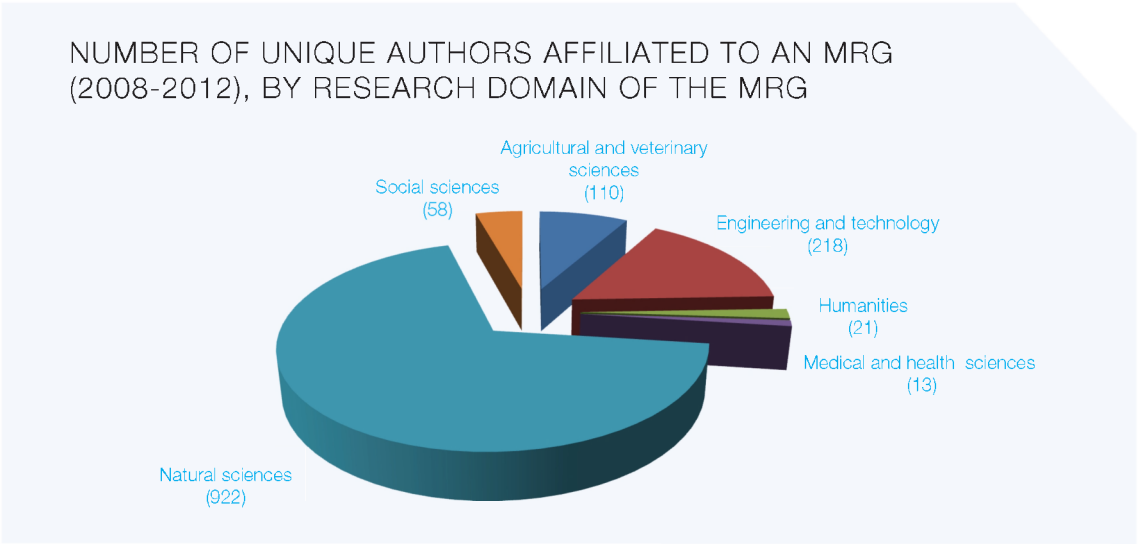

Figure 19. Number of unique authors of marine peer-reviewed and VABB publications affiliated to an MRG (2008-2012), by research domain of the MRG. The authors may belong to several research domains (Source: IMIS, VLIZ 2013).

for research conducted exclusively in the Belgian part of the North Sea. Studies located in Flanders which also include measurements in the coastal zone are classified as 'Flanders'. Within regional research, the River Scheldt (27 publications) and the Belgian part of the North Sea (24 publications) are the most important study areas. The other 190 publications (71% of publications with a study area) are categorised as international research. This international research can be divided into the following regions: Arctic Region, Atlantic Region, North Sea and Baltic Sea, Mediterranean and Black Sea, Pacific Region, Antarctic Region, Indian Ocean, Global, and European Seas and Oceans (measurements in all European seas and oceans, usually for European policy purposes). The most frequently studied areas are the Atlantic Region (56 publications), the Pacific Region (35 publications) and the Mediterranean and Black Sea Region (22 publications) (figure 20).

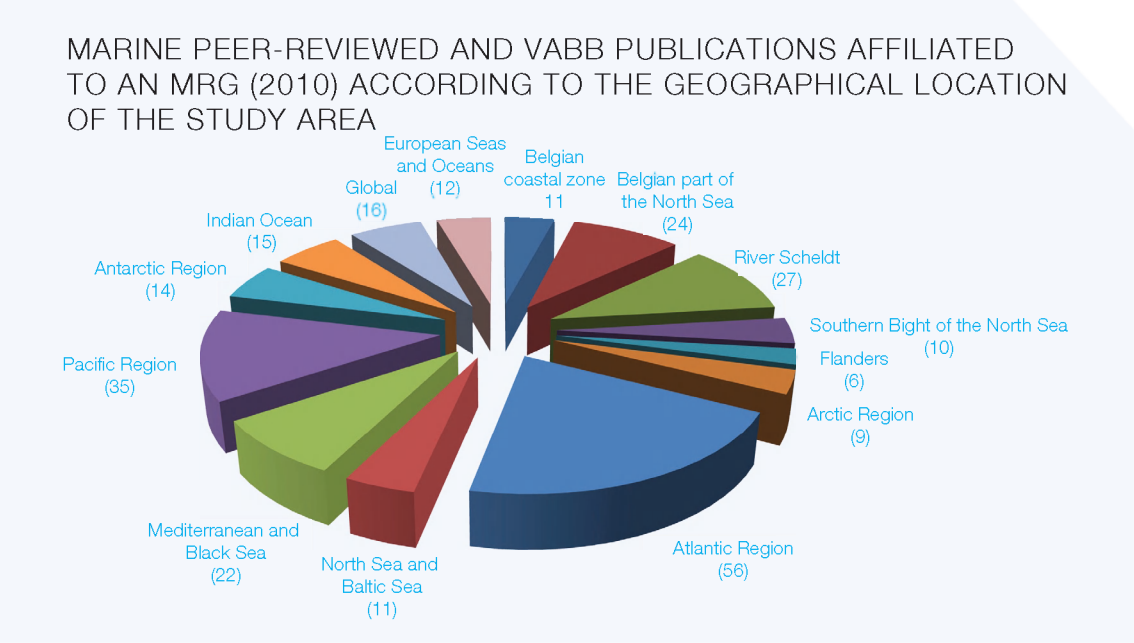

Figure 20. Marine peer-reviewed and VABB publications affiliated to an MRG (2010) on the basis of the geographical location of the study area. A publication is always attributed to one specific geographical area, except if several areas are explicitly mentioned (source: IMIS, VLIZ 2013).

A similar analysis for the year 2008 confirms the international character of the research conducted by the MRGs. In 2008, 27% of the publications with a study area indication (64 publications) were classified as regional research, while 73% (173 publications) were classified as international research.

COLLABORATION

Collaboration between MRGs

In the 2008-2012 period, 523 peer-reviewed and VABB publications resulted from collaboration between at least two MRGs (figure 21), which corresponds to 30% of the total number of inventoried marine peer-reviewed and VABB publications affiliated to an MRG. This number is indicative for the level of collaboration between the MRGs. In addition, there are also a range of partnerships in projects, education, etc., which do not necessarily result in a joint publication.

The collaboration between the different MRGs with regard to marine peer-reviewed and VABB publications between 2008 and 2012 mainly occurred through cooperation of different MRGs within the Flemish universities (184 publications) and universities of the Wallonia – Brussels Federation (88 publications), as well as through cooperation of MRGs from the universities in Flanders and Wallonia and Brussels (93 publications). There is also a considerable number of publications resulting from the collaboration between MRGs from Flemish universities and federal (106 publications) or Flemish scientific institutes (83 publications). With respect to the research domains, joint publications of MRGs mainly occurred within the domain of natural sciences (421 publications) and between MRGs of the domain of natural sciences on the one hand and MRGs of the domain of engineering and technology on the other (172 publications) (2008 and 2012). A total of 53 marine peer-reviewed and VABB publications resulted from cooperation between MRGs in the domain of agricultural and veterinary sciences and MRGs in the domain of natural sciences. The aforementioned numbers are to a large extent a consequence of the research capacities in the different types of institutes and research domains.

International collaboration

An analysis of the affiliations of (co)authors of the inventoried marine peer-reviewed and VABB publications of the MRGs in 2010 revealed that 264 of the 388 (68 %) publications analysed have at least one foreign (co)author. A total

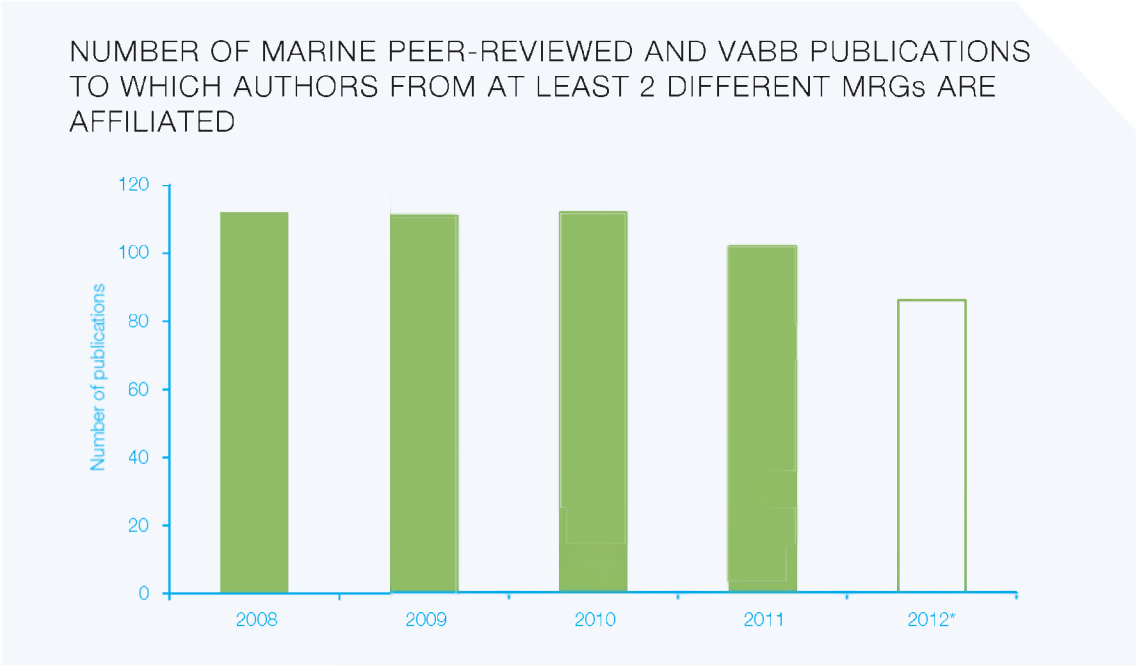

Figure 21. Number of marine peer-reviewed and VABB publications to which authors from at least 2 different MRGs are affiliated (2008-2012). **The figures for 2012 are less complete, (see Methodology, source: IMIS, VLIZ 2013).*

of 57 different nationalities were present (excluding Belgium). Collaboration mainly occurred with the neighbouring countries of France (70 publications), Germany (62 publications) and The Netherlands (59 publications), as well as with the USA (53 publications) and the UK (46 publications) (figure 22). A researcher of a Belgian research group acts as first author in 267 of the 388 publications analysed. A marine researcher affiliated to an MRG is listed as the first author in more than half of the publications (54%) with at least one foreign co-author (143 publications). Foreign first authors come from 29 different countries. The majority of the foreign first authors are found in Germany (18 publications), the USA (14 publications), France (12 publications) and the UK (10 publications).

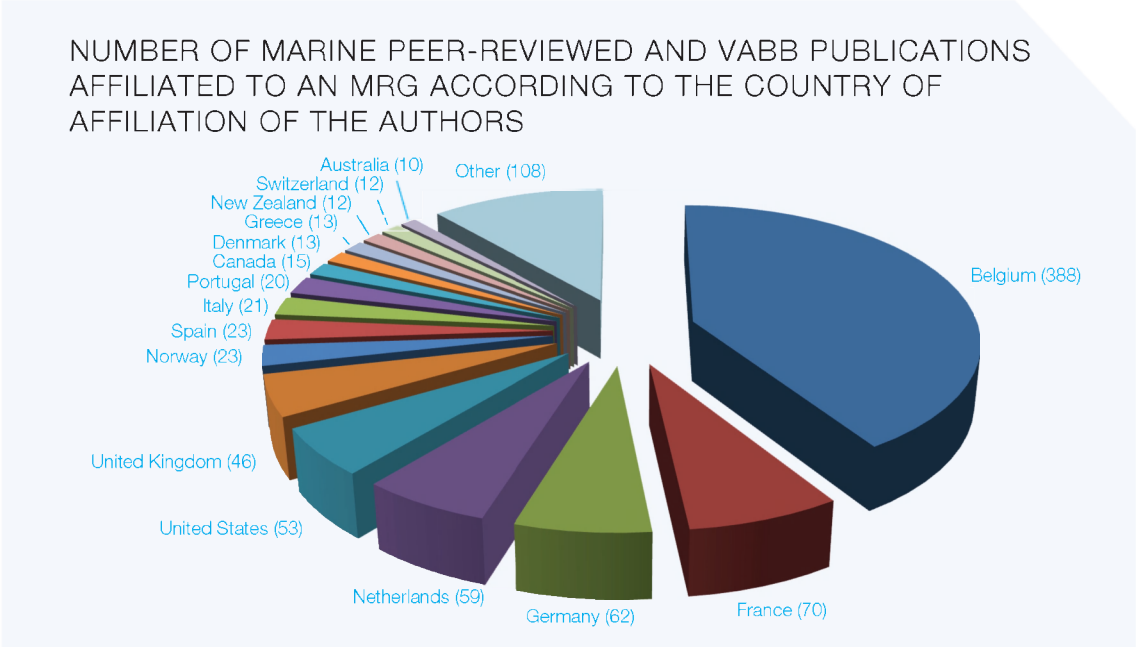

Figure 22. Number of marine peer-reviewed and VABB publications affiliated to an MRG on the basis of the country of affiliation (research institute) of the authors (2010). A country is only counted once per publication (Source: IMIS, VLIZ 2013).

RESEARCH VESSELS

The marine peer-reviewed and VABB publications of the MRGs in 2010 (403 publications) were screened on the use/mention of a research vessel. In 140 publications (35%), a research vessel was used for sampling or for data collection; 67 of these publications specifically mentioned the name of the ship whereas 73 publications do not refer to any ship(s). These publications constitute the sea-going research of the MRGs (figure 23). The other publications (263) mainly concern coastal and estuarine research, modelling studies, experimental studies in laboratories, social and economic studies, etc. However, many of the aforementioned studies directly rely on sea-going research (e.g. for the validation of models or experiments).

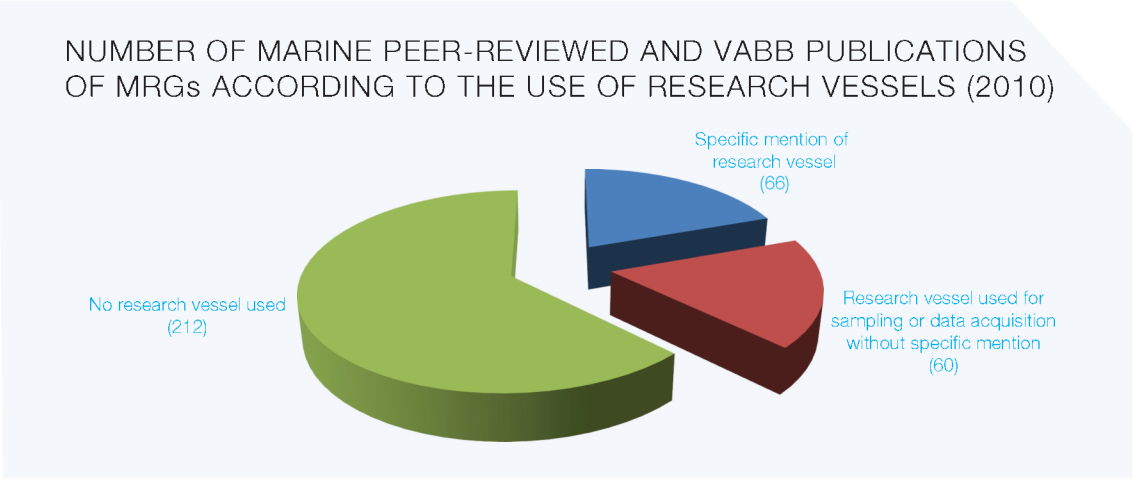

Figure 23. Number of marine peer-reviewed and VABB publications of MRGs on the basis of the use of research vessels for the year 2010 (Source: IMIS, VLIZ 2013).

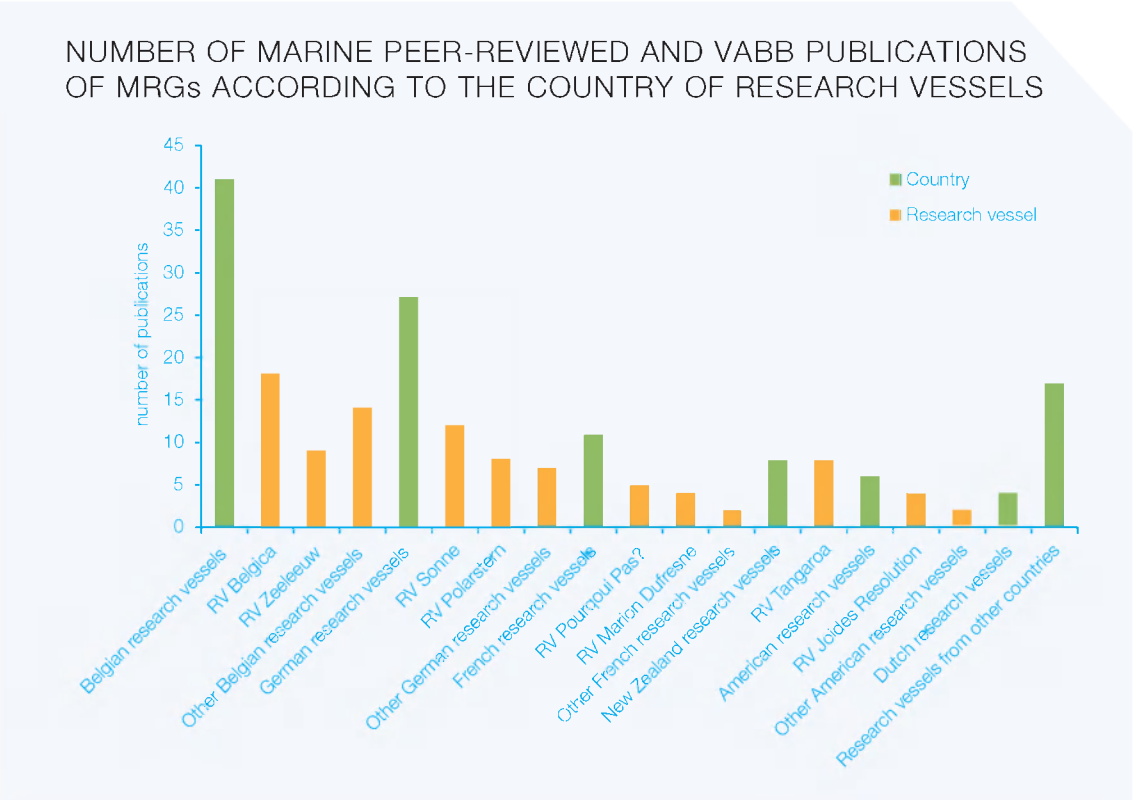

Figure 24. Number of marine peer-reviewed and VABB publications of MRGs on the basis of the research vessel and its country (2010). Several research vessels may be mentioned in one publication (Source: IMIS, VLIZ 2013).

A total of 41 different research vessels from 15 different countries are mentioned in the peer-reviewed and VABB publications of MRGs in 2010. The majority is from Belgium (41 publications), Germany (27 publications), France (11 publications) and New Zeeland (8 publications) (figure 24).

RV Belgica (18 publications), RV Sonne (12 publications), RV Zeeleeuw (9 publications), RV Tangaroa (8 publications) and RV Polarstern (8 publications) are the ships which are most often mentioned. The relatively high number of publications which mention the RV Sonne and the RV Tangaroa is due to an international research project on methane sources on the Hikurangi Margin off the coast of New Zealand, in which an MRG participated. The scientific cruises within the scope of this project also explain the intensified cooperation with authors from New Zealand (International Collaboration) and contribute to the relatively high share of the Pacific Region in the study areas of the MRGs (**Study areas of the MRGs**). The scientific results of these cruises are measurable over several years in different publications.

FUNDING

In order to finance their research, the different research institutes and universities in Flanders have several mechanisms and funds at their disposal in addition to the fixed working budgets which also finance higher education. Depending on the type and objectives of the research, several resources can be addressed (table 6). A definition and division of the different types of research are provided in the following publication: *Soete (2012)* [229190].

Apart from some exceptions, the present funding instruments do not include a specific budget for marine research. Financial information sources are incomplete and scattered, and overlap occurs in the reported numbers as a result of the different types of information gathering. The current effort to quantify the funding of marine research in Flanders and Belgium will be completed further in a later phase. Together with other European Member States, Belgium addresses this challenge with an eye on an efficient use of research funds in the context of the current and future (science) policy.

Table 6. Overview of the research funding and the most important funding resources for marine research (International, federal and Flemish).

Funding by Universities • *Bijzonder Onderzoeksfonds* (*BOF*), for the funding of fundamental scientific research • Industrial Research Fund (*IOF*) for linking strategic fundamental research, technological innovation and industrial co-operation	**International-European** • European Framework Programmes *FPs* and *Horizon2020* • Programmes of the Directorates-General of the European Commission: *EMFF*, ERDF, EUREKA, etc. • Flanders-UNESCO Science Trust Fund (*FUST*) • International Foundation for Science (*IFS*)
Flanders • Research Foundation Flanders (*FWO*) • Agency for Innovation by Science and Technology (*IWT*) • The *Hercules Foundation* for funding research infrastructure • The *Policy Research Centres* - Flanders • Institutional resources of the Flemish scientific institutes • Department of Economy, Science and Innovation (*EWI*) • The *RV Simon Stevin* (VLOOT)	**Federal** • Belgian Science Policy (*BELSPO*) • Research programmes (SSD, BRAIN-be, STEREO, Interuniveristary Attraction Poles (*IAP*)) • The *RV Belgica* (BELSPO) • Other funding by the federal government
Financing through Sustainable Development Aid	**'Science and Society'** Societal valorisation of scientific research and communication
Science awards • The *FWO Science Awards* • Edouard *Delcroix Award* • The *North Sea Awards*	**Foundations** • University Foundation • Francqui Foundation • Biotechnology Funds (FBBF) Research Awards • Royal Flemish Academy of Belgium for Science and the Arts (KVAB) • King Baudouin Foundation • Foundation against Cancer (*Stichting tegen Kanker*)

Funding instruments for marine research (Flanders and Belgium)

Bijzonder Onderzoeksfonds (*BOF*) is an important funding source for academic research in Flanders. BOF resources include calls for mandates, fellowships, scholarships and initiatives such as 'Methusalem', which are granted according to the regulations stipulated by EWI (Flemish Government). The allocation of BOF resources is based on scholarly results and the academic publication output. From 2003 onwards, part of the BOF resources have been attributed on the basis of the publication and citation output (with a weighing factor of up to 35%) aiming at a qualitative policy. The new BOF resolution (1 January 2013) stipulates a number of conditions on strategic policy, good governance, science communication and diversity. Since 2013, the Flemish Government has provided a total of at least 150 million euros to Flemish universities through BOF, which is a sevenfold increase over a period of 20 years (21.1 million euros in 1995). There are currently no specific numbers available for the funding of marine research with BOF resources.

Research Foundation Flanders (*FWO-Vlaanderen*) finances fundamental scientific research at universities through PhD fellowships, post-PhD research, temporary and fixed mandates, individual research grants, research projects, participations in congresses and symposia, knowledge exchange networks, and excellence programmes (such as the Methusalem and Odysseus programmes). FWO is mainly financed by the Flemish Community as well as by the Federal Government, companies and foundations. The annual investment of the Flemish Government in FWO amounts to 172 million euros (2012). A first estimation, based upon the numbers (mandates, scholarships, stays, congresses) indicates an annual average of 1.9 million euros in funding for marine research since 2000 (source: database FWO, processed by the VLIZ, 2010). An *inventory* of finished and ongoing research projects is available on the website of FWO.

The agency for Innovation by Science and Technology (*IWT*) focuses on specialised scholarships and on projects in the Strategic Basic Research (*SBO*). The average annual funding of scholarships for marine researchers is estimated at 0.5 million euros (source: database IWT, processed by the VLIZ, 2010).

The *Hercules Foundation* is a structural funding channel of the Flemish government for investments in medium-scale and large-scale research infrastructure for fundamental and strategic reseach in all scientific disciplines. An *inventory* of all financed projects since the start of the programme (2007) is available online.

Part of the institutional funding granted to the Flemish scientific institutes and strategic research centres (figure 5; **The Flemish policy framework for research and innovation**) is reserved for personnel and means for marine research and monitoring. The scientific institutes complement their resources for marine research with external local/regional and European funding.

The policy fields of Economy, Science and Innovation (EWI), Environment, Nature and Energy (LNE), Mobility and Public Works (MOW), Foreign Affairs (IV), Agriculture and Fisheries (LV), etc. provide resources for (policy) research and monitoring, for which the MRGs of universities and research institutes can apply.

A number of funding instruments are focused on research valorisation and are also used by (marine) research groups at universities. The Industrial Research Fund (*IOF*) finances research mandates and projects focused on the valorisation of academic knowledge in the form of community and/or commercial applications. In addition, IWT manages the *TETRA fund* for technological research at colleges and the SOC fund for the spin-off policy of the Strategic Research Centres. IWT also participates in the Flemish Innovation Network (VIN), which is structured around the Flemish Cooperative Innovation Networks (VIS) and the innovation centres, which are under provincial control.
Development aid projects can be funded by sources at different levels: the Flemish Interuniversity Council (*VLIR*), the Flemish Department of Foreign Affairs (*DIV*), the Directorate-General for Development Cooperation, the Belgian Development Agency, and international cooperation (UNESCO, UN).

The Centre for Research & Development Monitoring (*ECOOM*) is an interuniversity consortium in which all Flemish universities participate. ECOOM supports the Flemish Government by mapping the innovation and R&D efforts in Flanders. No specific numbers for marine research are available.

The Belgian Science Policy (*BELSPO*) provides the institutional resources of the Direction Natural Environment – RBINS. Furthermore, BELSPO is an important actor in the field of marine research project funding with *inter alia* the North Sea Research Programme. A new phase in these programmes was initiated recently, in the framework of the BRAIN-be programme. The earth observation programme STEREO II also finances marine projects. Between

2005 and 2012, approximately 6 million euros were annually invested in marine programmes through SSD and other BELSPO programmes. About half of the amount was granted to Flemish universities and scientific institutes (source: BELSPO, 2013). The Interuniversity Attraction Poles (IAP) programme provides support to networks of excelling research teams performing fundamental research at universities and scientific institutes in Belgium. The current phase (VII) runs from 2012 to 2017 and has a budget of 156 million euros.

The federal government also provides additional resources for research and monitoring through federal government departments. An important aspect in this regard is research funding in support of the policy field of the FPS Public Health, Food Chain Safety and Environment, and more specifically the marine research assignments of the Marine Environment Department (DMM). The procurements of this department accounted for an annual average of 0.1 million euros (source: DMM, processed by VLIZ, 2010).

Support of marine research

In addition to the direct funding of marine research, an important part of the resources is provided by the systematic support of this research. Resources in support of the operation of research vessels are crucial in this regard (see **Research vessels**). The Flemish Government (VLOOT) annually spends 0.9 million on the operation of RV Zeeleeuw and its successor RV Simon Stevin. RV Simon Stevin entered into service in May 2012. The cost amounted to 11.5 million euros (including taxes), and 1 million euros were spent on scientific equipment. The federal agency BELSPO takes care of RV Belgica, with an annual operational budget of approximately 2 million euros (source: BELSPO). Both ships are annually deployed for 200 sailing days to support research, monitoring, and educational objectives.

VLIZ annually receives 1.7 million euros in subsidies (2012) from the Flemish government to support marine research and science education. The organisation receives an additional 0.9 million euros for international assignments of the Flemish government in the field of marine research and data management (IODE Project Office IOC-UNESCO, EMODNET Project Office and JPI-Oceans). The Province of West Flanders supports marine research with an annual allowance of 0.15 million euros as a partner in VLIZ (*Mees et al. 2013* [225678]).

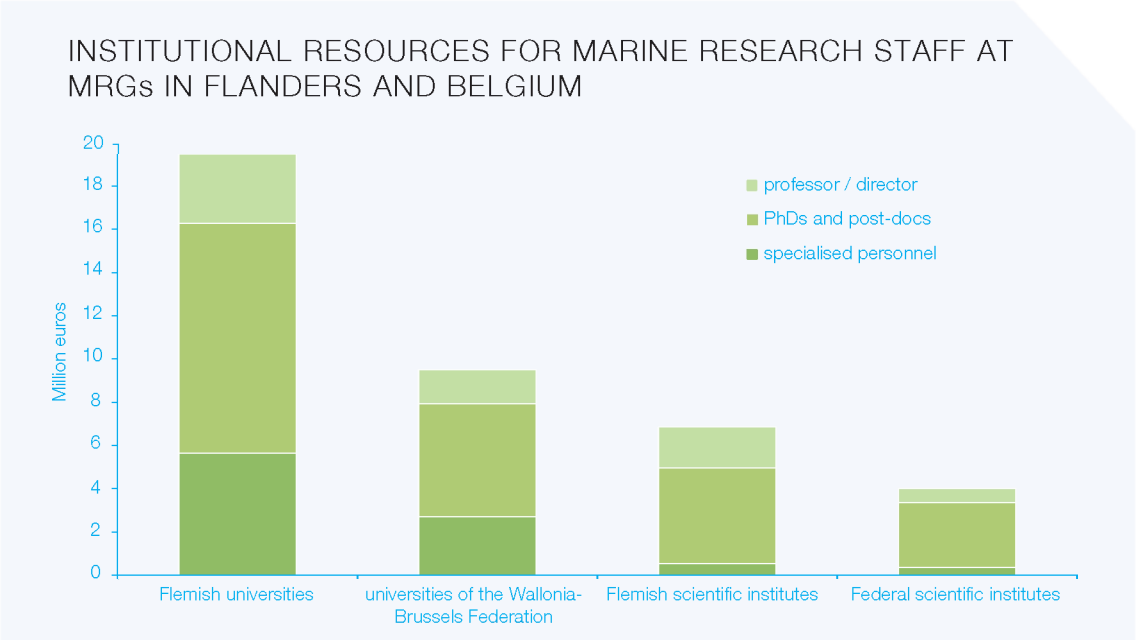

Figure 25. Institutional resources for marine research staff at MRGs in Flanders and Belgium. The estimation is based on the inventory of the number of employees and a differential salary scale. These numbers do not include investments and operational costs (Source: VLIZ survey 2012 – 2013).

Marine research staff

Given the incompleteness of the financial information sources, an indirect estimation of the financial resources for marine research staff was made, taking into account both fixed institutional resources and national and European competitive resources. This estimation was based on the inventory of the marine research capacity at the MRGs in Flanders and Belgium (survey of VLIZ 2012-2013; Inventory of Marine Research). A different salary scale was used for heads of department, (post-)doctoral employees and specialised personnel (figure 25). This estimation did not take into account investments, administrative support and operational costs; consequently, it does not provide an accurate representation of the total resources for marine research.

Based on this indirect approach, the MRGs in Flanders and Belgium had a budget of approximately 40 million euros at their disposal for funding marine research staff in 2012. 19.5 million euros went to staff affiliated to MRGs of Flemish universities, 9.5 million to universities of the Wallonia – Brussels Federation. The Flemish and federal scientific institutes complete the personnel budget with 6.8 and 4 million euros respectively. These results are directly related to the result of the inventory of marine personnel, and are also influenced by the definitions used (**Inventory of Marine Research**).

European projects

Although marine research in Flanders and Belgium is mainly funded by fixed and competitive resources on a national level (Flemish, Walloon, federal and provincial government resources, see **Policy context for scientific research in Flanders/Belgium**), an increasing part of the funding comes from international and European funding mechanisms. Europe is an important actor in guiding and enabling marine research. A variety of programmes exists, such as the 6th and 7th Framework Programme for Research and Technological development of the European Directorate-General for Research and Innovation, the European CO-operation in Science and Technology (*COST*), *LIFE* (European instrument supporting environmental and nature projects), EUREKA (a Europe-wide network for industrial research and development) and INTERREG (strengthening of regional cooperation through projects). Information on the framework programmes (*DG Research & Innovation*) is available through the Community Research & Development Information Service (*CORDIS website*). An overview of the European funding instruments, including the programmes of the directorates-general of the EC, is available on *http://www.eutrainingsite.com/eu_funds.php* (**European financing instruments**).

An overview from the EUROCEAN database (*Knowledge Gate*, EUROCEAN) indicates that 130 European marine projects in which at least one scientific institute from Flanders/Belgium participated received European funding prior to FP7 (FP6, COST, EUREKA, EUROCORES, INTERREG III, LIFE, SMAP). Approximately one hundred of these projects were funded by FP6. This is a significant increase compared to the previous period, during which the Belgian participation in European marine research and innovation projects accounted for 31 projects, mainly MAST III and specific programmes of *DG Environment*.

During FP5 and FP6, Belgium took part in 3 of the largest European marine research projects: DAMOCLES, aimed at developing arctic modeling and observing capabilities for long-term environmental studies (16 million euros); ENSEMBLES, aimed at predicting of climate change and its effects (15 million euros); and HERMES, aimed at deep-sea ecosystems in the European Seas (15 million euros). During FP6, a total of 600 million euros was spent on marine research themes (DG Research and Innovation, 2012). One of the requirements of FP6 is transnational co-operation in project consortia. Belgium participated in 101 projects during FP6, of which 21 were coordinated by Belgian partners (source: EUROCEAN 2012), managing 32.19 million euros. In comparison, the UK accounted for the highest number of participations during FP6 with 282 projects, and France managed the highest amount of money, namely 166.29 million euros (EUROCEAN 2012). For the COST, EUREKA, LIFE, INERREG III and SMAP programmes there are no specific analyses available with regard to marine research.

Belgian participation in marine FP7 projects

During FP7, Belgian partners participated in 178 projects with a total budget of 38 million euros. MRGs accounted for 79 of these project participations, with a total budget of 20 million euros. In the majority of the cases it concerned an MRG affiliated to a university (50 projects and a total budget of 15 million euros) (table 7. Source: EWI 2013, processed by VLIZ. Figures for 2007-2012).

Table 7. Overview of the Belgian participation in marine FP7 projects (EWI 2013, processed by VLIZ).

PROJECT PARTNERS	Number of FP7 projects	FP7 budget (in euros)	Average budget per partner (in euros)
Organisations located in Belgium	178	38,363,485	215,525
Belgian Marine Research Groups	79	19,922,230	252,180
MRG affiliated to a university	50	14,940,498	298,810
Flemish universities	30	10,076,921	335,897
Universities of the Wallonia – Brussels Federation	20	4,863,577	243,179
Flemish scientific institutes (MRGs)	19	3,197,641	168,297
Federal scientific institutes (MRGs)	10	1,784,090	178,409

Participation of Flemish MRGs in marine FP7 projects

The MRGs of the Flemish scientific institutes and universities participated in 49 projects with a total project partner budget of 13 million euros. This is a significant increase compared to FP5, when the number of participations was 13 and the total partner budget amounted to 1.8 million euros (table 8, figure 26).

Table 8. Overview of the Flemish participation in marine projects from FP5 until FP7 (EWI 2013, processed by VLIZ).

Flemish scientific institutes and universities	NUMBER OF PARTICIPATIONS	BUDGET OF THE PROJECTS (IN EUROS)	AVERAGE BUDGET PER PARTNER (IN EUROS)
FP5	13	1,778,901	136,838
FP6	18	5,767,766	320,431
FP7	49	13,274,562	270,909

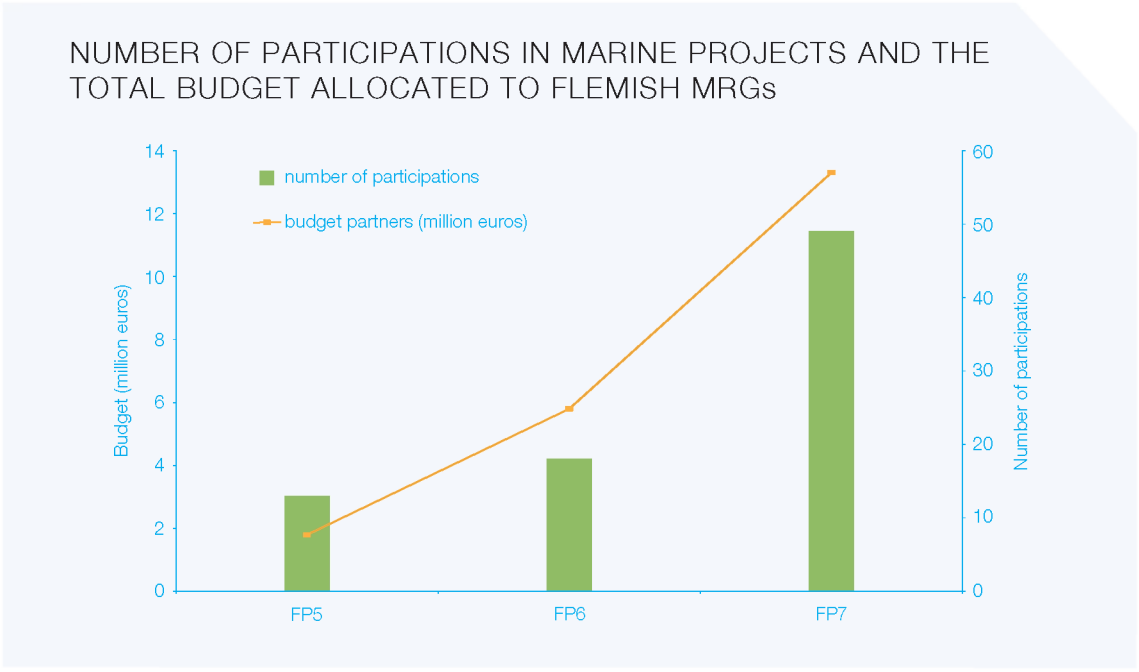

Figure 26. Number of participations in marine projects and the total budget allocated to Flemish MRGs, from FP5 to FP7 (Source: EWI 2013, processed by VLIZ).

Additionally, an annual average of 0.35 million euros over the past 10 years from competitive resources from European financing instruments for regional development (INTERREG) was spent on marine research with societal relevance. Between 2011 and 2013, total funding from the *European Fisheries Fund – Axis 4* for the sustainable development of Belgian fisheries areas amounted to about 4 million euros. Axis 4 is focused on a broad range of project objectives ranging from promotion, education, development of new economic carriers to applied fisheries research.

Other institutes involved in the funding of marine research

During policy preparation, implementation and evaluation, the competent government instances and administrations also conduct applied research that is directly or indirectly related to marine waters and coastal zones. In the case of Flanders, these policy areas are Economy, Science and Innovation (EWI), Environment, Nature and Energy (LNE), Agriculture and Fisheries (LV), Mobility and Public Works (MOW), Spatial Planning, Housing Policy and Immovable Heritage (RWO), Work and Social Economy (WSE), Foreign Affairs (IV), and Welfare, Public Health and Family (WVG). On the federal level, the major competent government instances are the FPS Public Health, Food Chain Safety and Environment, FPS Economy, SMEs, Self-Employed and Energy, FPS Mobility and Transport, FPS Finances, FPS Internal Affairs, PPS Science Policy, the Ministry of Defence and the Federal Police. An overview of the competent bodies of the Flemish and federal government with regard to the coast and sea is available in **Chapter 3** – Division of Competences.

COMPANIES AND EDUCATION

Flanders in Action (ViA), the programme of the Flemish government, stipulates that Flanders will spend 3% of its GDP on research and development in 2014. The marine sector also promotes this exchange between knowledge-generating research and its commercialisation in the business world. *'Flanders Maritime Cluster'* vzw, which represents the Flemish marine and maritime scientific institutes and companies, plays a facilitating role in the sustainable growth of the Flemish knowledge-based economy. This cluster represents companies in maritime transport (42%), research and development such as consultancies (26%), services for the maritime sector (26%) and dredging and extraction (20%).

A list of companies in the marine - maritime sector is available in the *business catalogue – maritime industry in Flanders* [223848] and on the website of *Flanders Maritime Cluster*.

There is also a broad offer of marine and maritime education in secondary and higher education at universities, university colleges and secondary schools.

Table 9. Overview of maritime technical (TSO) and vocational (BSO) education in secondary education.

DIPLOMA	SCHOOL	STAGE
TSO Maritime education - Deck TSO Maritime education - Engine Room	*Koninklijk Werk* IBIS Bredene	2nd stage and 3rd stage
TSO Maritime education - Deck TSO Maritime education – Engine room BSO Rhine and Inland Navigation Shortsea Shipping	KTA Zwijndrecht - Cenflumarin	2nd stage and 3rd stage, as well as a specialisation year
TSO Maritime Education - Deck TSO Maritime Education – Engine room BSO Fisheries BSO Shipmaster - Engine Room	Maritime Institute 'Mercator' Ostend	2nd stage and 3rd stage, as well as a specialisation year

The publication '*Koers naar Zee*' provides an overview of educational tools and activities at the coast on the themes of nature, environment, science and technology (*Copejans et al. 2011* [209709]). Last but no least, Flanders boasts 26 maritime museums, centres, study groups and non-governmental organisations which fulfil important socio-economic functions in addition to their work with regard to seas and coasts.

Table 10. Overview of the most important marine-related master degrees in higher education.

MASTER DEGREE	UNIVERSITY	DURATION	LANGUAGE
Marine and Lacustrine Science and Management, 'Oceans and Lakes'	Ghent University, University of Antwerp, Vrije Universiteit Brussel	2 years	English
Nautical Sciences	Antwerp Maritime Academy	1 year	Dutch / English
Marine Biodiversity and Conservation, Erasmus Mundus	Ghent University and 5 European partners	2 years	English
Maritime Sciences (interuniversity programme)	Ghent University University of Antwerp	1 year	Dutch / English
Océanographie	University of Liège	2 years	French / English
Aquaculture (international)	Ghent University	2 years	English
Master of Science in Electromechanical Engineering (Maritime Engineering)	Ghent University	2 years	Dutch / English

2.4 Marine research in Flanders and Belgium: a qualitative analysis

Based on a survey of the 82 Marine Research Groups (MRGs), the diversity of the current marine, coastal and estuarine research was mapped and described qualitatively for the different research domains. Figure 27 provides

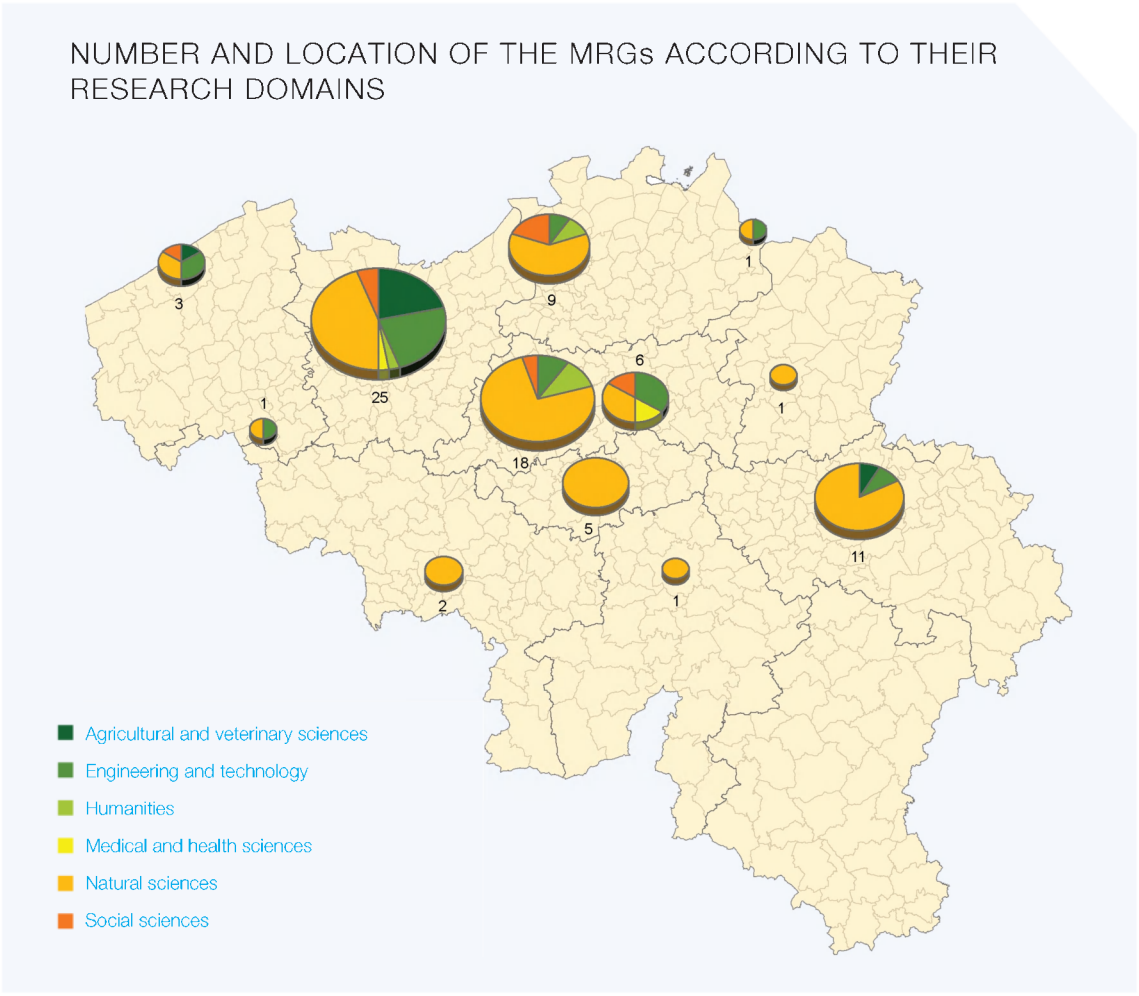

Figure 27. Number and location of the MRGs according to their research domains.

an overview of the geographic distribution of the expertise of the MRGs. Comparable to the inventory of the research capacity (Inventory of Marine Research), the qualitative description demonstrates the diversity of the research conducted by the MRGs. The description below also indicates that the MRGs have extensive expertise in research fields put forward by the (European) scientific community as challenges for future research (cf. *Navigating the Future IV (European Marine Board, 2013)* [226874] and the communication on a European strategy for marine and maritime research (*COM (2008) 534*)).

The division below is somewhat artificial, which can lead to overlap between the different research domains. The research domain natural sciences is further divided into disciplines (biological, chemical and earth sciences).

RESEARCH DOMAIN AGRICULTURAL AND VETERINARY SCIENCES

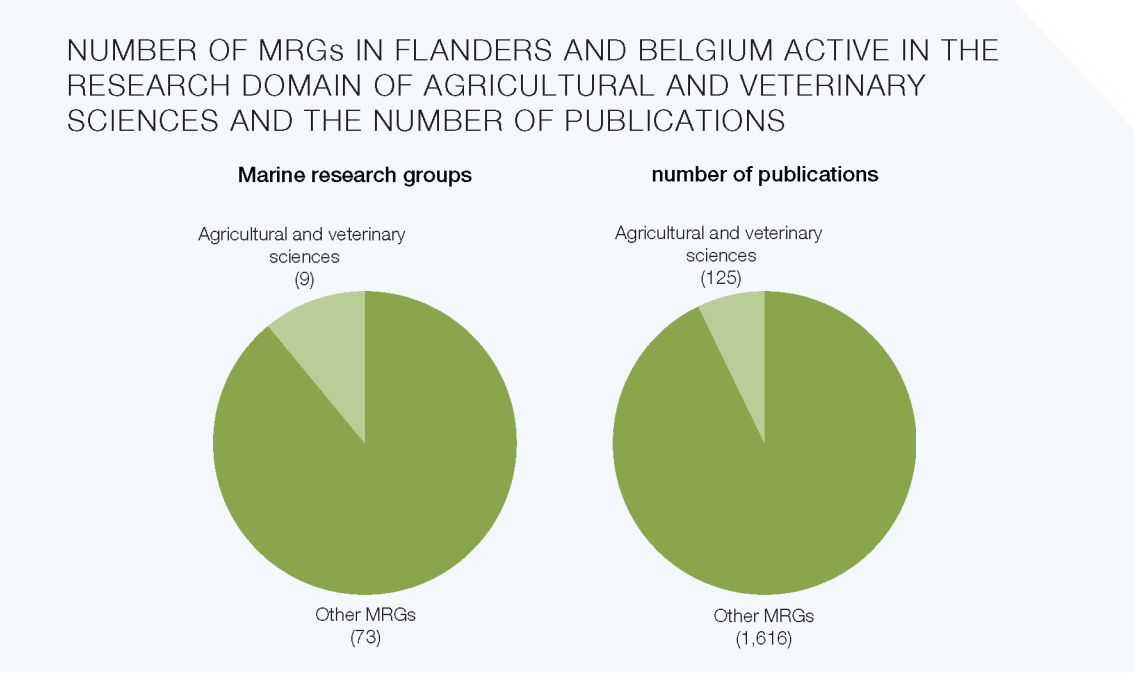

Figure 28. Number of MRGs in Flanders and Belgium active in the research domain of agricultural and veterinary sciences as well as the number of publications (peer-reviewed and VABB) published between 2008 and 2012 in this research domain (Source: IMIS, VLIZ 2013).

Within the research domain of agricultural and veterinary sciences, the MRGs (9, figure 28) conduct research on several aspects of fisheries, aquaculture, aquatic veterinary medicine, food safety and consumption of fish and shellfish. The fisheries research supports a fisheries management based on scientific information about fish stocks and their position in the ecosystem, a thorough knowledge of the efficiency and effects of different fishing methods, and insight in the socio-economic aspects of the fisheries sector. The aquaculture sector is currently the fastest growing producer of animal nutrition (*COM (2012) 494*). Scientific information on environmental effects, the different aquaculture techniques and breeding species, and the quality and safety of the products is necessary to achieve a sustainable aquaculture (*COM (2009) 162*). In *Navigating the Future IV (European Marine Board, 2013)* [226874], sustainable fisheries and aquaculture are identified as key points for future marine research (Chapter 2, themes **Fisheries** and **Aquaculture**)

The fisheries research of the MRGs covers a range of aspects. The **biological** aspects of **fisheries research** are mainly focused on the collection of biological and ecosystem data, fish stock evaluations and catch predictions to support the European *Common Fisheries Policy* (CFP) and environmental impact assessments (EIAs). In this regard, the impact of fishing activities on the marine environment is studied extensively. Research is conducted on sustainable fishing techniques so as to reduce the environmental impact and optimise the catch. This primarily encompasses adaptations of existing fishing techniques such as beam trawling, but also includes research on alternative fishing techniques such as handline fishing, gillnetting, Scottish seining and electrotrawling ('Hovercran').

There is also research on **social, economic and historical aspects** of the fisheries sector. Evidently, fisheries research has a certain overlap with biological research conducted in the research domain of natural sciences, but it also has links to research domains in the social sciences (fisheries policy and legislation), and human sciences (history and archeological research).

In the field of **aquaculture**, MRGs address biological, ecological (cf. research discipline biological sciences) and technical aspects. This does not only concern aquaculture on land, but also mariculture with offshore farms and mussel culture, and the application of **integrated multi-trophic aquaculture systems** (IMTA). An important aspect concerns the study of the **impact** of aquaculture activities on the (marine) environment. Research is furthermore conducted on **different breeding** species such as sea bass, turbot, bream, halibut, cod, black tiger shrimp, mussels, etc. The immunological aspects of this research are addressed as well and have a strong link with veterinary research (see below). The **food sources** for aquaculture such as Artemia species (brine shrimp), micro-algae and rotifers constitute a research subject of their own: biological cultures, natural occurrence, production techniques, strain-typing, nutritional value and enrichment, the impact of a diet on the breeding species, etc. Technical aquaculture research on new integrated water systems supports the development of research and industry in this field.

Besides fisheries and aquaculture, there is also research on **food safety** and **consumption** of **fish and shellfish** as well as on the quality and freshness of fish products. Research is performed on chemical contaminants in the sediment, in suspended material and in biota, and on the biological effects of these chemical contaminants on marine organisms (link with veterinary, biological and chemical sciences). Additionally, microbial ecology and viruses in fish products are studied with a view to food safety, and strategies for preservation and intelligent packaging are developed further. The toxicological risks associated with the consumption of fish products are addressed in the research domain of medical and health sciences. Finally, some research groups study consumer behaviour and the marketing of fish products.

Veterinary research conducted by the MRGs is closely related to research on fisheries and aquaculture, as well as to biological and chemical (toxicological) research in the research field of natural sciences. This research *inter alia* addresses the diagnosis of diseases and mortality and the influence of pollutants on marine organisms and on marine mammals in particular. Research is furthermore performed on the interaction between micro-organisms with a probiotic function and their hosts (larvae of marine fish species (sea bass/sole) and nauplii of brine shrimps). Finally, the potential injuries and physiological consequences of electric pulse fishing and other forms of anthropogenic stress on marine organisms are studied.

RESEARCH DOMAIN OF ENGINEERING AND TECHNOLOGY

The MRGs (16, figure 29) with expertise in the field of engineering and technology are active in research concerning: coastal protection and the construction of ports; ship design and hydrodynamics; offshore energy systems; management of research vessels and their equipment, data and information management; research on remote sensing; and marine biotechnology. At the European level, the societal relevance of this research is highly valued. The economic value and importance of research on several offshore energy technologies, blue biotechnology, maritime transport and ship construction is specifically highlighted in the communication on blue growth (*COM (2012) 494*) and the communication on a European strategy for marine and maritime research (*COM (2008) 461*). This last communication also emphasises the importance of specialised marine research facilities. These facilities encompass, *inter alia*, research vessels and their equipment (*EU-FP7 project Eurofleets*), satellites, buoys, deep sea observatories, and data and information systems (*COM (2010) 461*). *Navigating the Future IV (European Marine Board, 2013)* [226874] further discusses the importance of research on new and existing forms of energy production from seas and oceans, blue technology and ocean observation.

In the field of **coastal protection**, the research of the MRGs mainly focuses on innovative coastal protection systems, fundamental research on coastal protection works for sandy beaches, and hydraulic aspects of the design of hydrological structures (locks, weirs, bank and seabed protection, etc.). The interaction between coastal protection and port structures on the one hand and the marine environment on the other is also studied closely. Both the hydrodynamic and the sedimentological field are addressed by the MRGs in this regard. Given the frequent use of hydrodynamic and sediment transport models in this research, domain overlap occurs with the morphological and modelling studies conducted in the research discipline of earth sciences.

Notwithstanding the fact that no major shipyards remain in Belgium, there is still research on certain facets of **ship-building** and the **hydrodynamic aspects of ships**. An integrated software package for ship-building is being

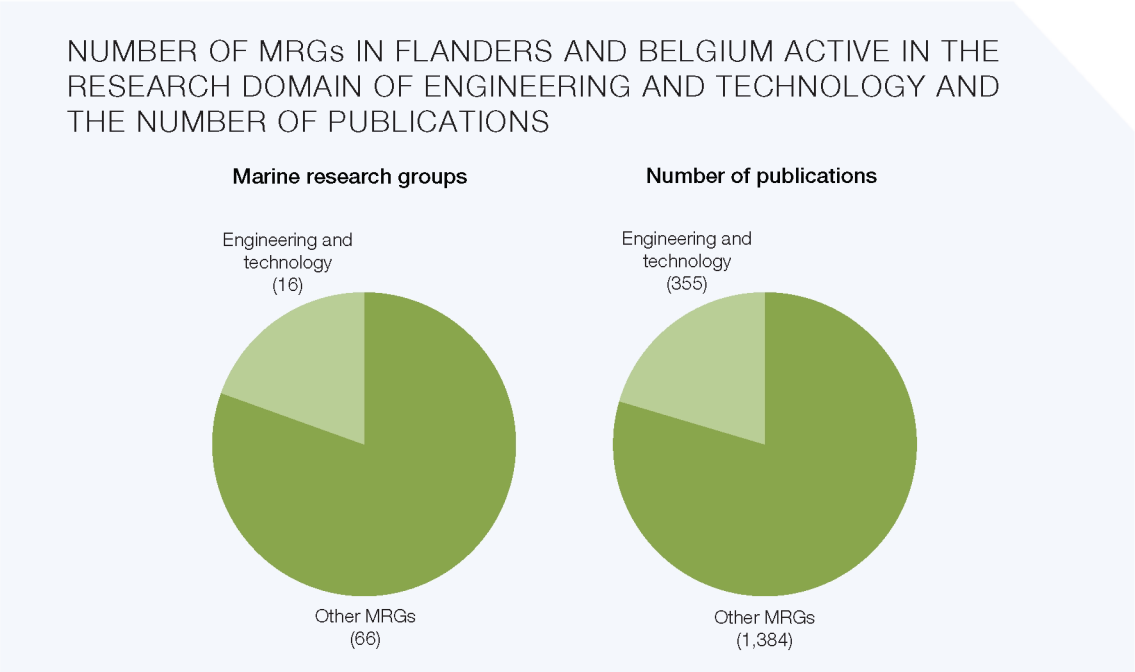

Figure 29. Number of Marine Research Groups (MRGs) in Flanders and Belgium active in the research domain of engineering and technology as well as the number of publications (peer-reviewed and VABB) published between 2008 and 2012 in this research domain (Source: IMIS, VLIZ 2013).

developed, and research is being conducted on the influence of wave forces, the corrosion of ballast tanks, and the phenomenon of brittle fracture in the steel structure of ships. Additionally, several MRGs study the behaviour of ships in shallow waters, such as ship-ship interactions, bank effects and the nautical bottom. Studies related to ship-building address the presence of toxic fumes aboard chemical tankers, electronic navigation devices for ships, acoustic submarine communication, and the financial aspects of shipping (cf. research domain social sciences) (Chapter 2, theme **Maritime transport, shipping and ports**).

The MRGs in Belgium have broad expertise in the field of offshore energy systems. Several groups are conducting research on the technical aspects and economic feasibility of different offshore technologies for renewable energy, energy storage and energy transport. Research themes such as wind and wave conditions and protection against erosion of offshore wind turbines are discussed. Modelling studies and techniques from the earth sciences discipline are used within this scope. Specific research is being conducted on wave energy conversion systems: optimisation of point absorber systems, farm modeling of wave energy convertors, and overtopping wave energy convertors. The materials for wind turbines and the behaviour of the construction, as well as management and maintenance of offshore turbines are also studied. Within the research disciplines of earth sciences and biological sciences, research is being performed on the effects of offshore wind turbines on marine ecosystems (Chapter 2, theme **Energy (including cables and pipelines)**).

Marine biotechnology is the application of science and technology to living organisms, as well as parts, products and models thereof, to alter living or non-living materials for the production of knowledge, goods and services (definition of the Organisation for Economic Co-operation and Development, *OECD*). Marine biotechnology is a research field with a strong multidisciplinary character. In Belgium, there are research groups in several disciplines (biological sciences, medical and health sciences, biotechnology, fisheries and aquaculture sciences, veterinary sciences, chemical sciences, etc.) whose expertise covers different aspects of marine biotechnology. The expertise of these groups is addressed in more detail in the relevant research fields. A number of these MRGs collaborate in the framework of *the Flemish Marine Biotechnology Platform*.

In the context of logistic and operational activities (a broader scope than engineering and technology), Belgium puts 2 seagoing research vessels at the disposal of the marine scientific community: RV Belgica and RV Simon Stevin. The Royal Belgian Institute of Natural Sciences (RBINS, *Direction Natural Environment*) is responsible for the coordination and management of the oceanographic research vessel Belgica. This encompasses the preparation of

scientific programmes, budget control and the management of scientific instrumentation (purchase, operation and data supervision). The Flanders Marine Institute (*VLIZ*) is responsible for the coordination of ship time for RV Simon Stevin and manages a pool of common research equipment and infrastructure.

There are two marine data centres in Belgium: the Belgian Marine Data Centre (*BMDC*, RBINS), and the Flanders Marine Data and Information Centre (*FMDC*, VLIZ). These data centres provide a wide range of data (physical, chemical, taxonomical, biogeographical, ecological, geological, hydrometeorological, toxicological, etc.) to a broad group of experts on a national, European and international level. In addition, these groups are involved in the development of international standards for the management and exchange of data and information and for the integration in international networks. The *VLIZ-library* is specifically dedicated to marine, estuarine and coastal scientific literature and multimedia.

Remote sensing through satellites and (unmanned) planes allows to study certain parameters, processes and phenomena on a larger spatial scale. The MRGs use these observations for different goals, ranging from the monitoring of human activity at sea (fisheries, pollution, etc.) over the studying of certain parameters (chlorophyll-a, SPM) to spatial environmental aspects (water quality, eutrophication, etc.). These observations are closely related to the research conducted in other scientific disciplines, such as earth sciences and biological sciences. Remote sensing is often combined with models and *in situ* measurements.

RESEARCH DOMAIN HUMANITIES

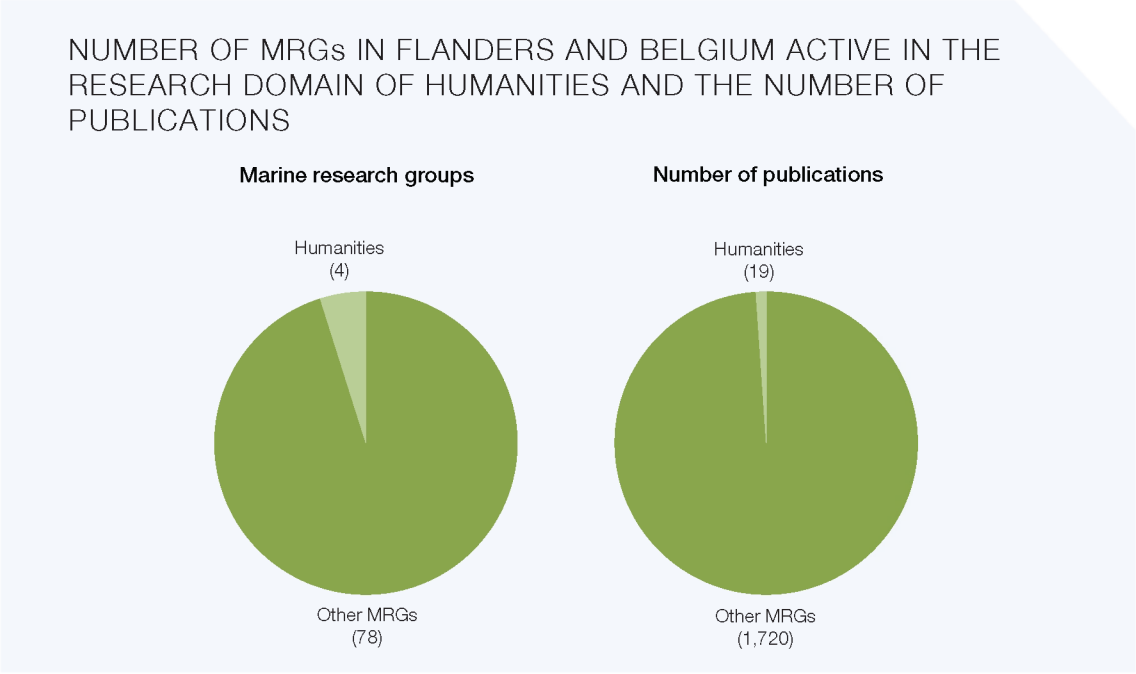

Figure 30. Number of MRGs in Flanders and Belgium active in the research domain of humanities as well as the number of publications (peer-reviewed and VABB) published between 2008 and 2012 in this research domain (Source: IMIS, VLIZ 2013).

Humankind has undeniably influenced the development of the coastal landscape. Hunting and agriculture already occurred in the coastal zone in the Neolithic. In the Middle Ages, the impact of humankind increased as a result of dike construction, dune fixation and increasing agricultural activity, which increasingly determined the landscape. The coastal zone was also where important economic activities such as fishery, shipping and ports as well as military activities took place. Hence, it is not surprising that research is carried out on different aspects of these historical human activities in the coastal zone. This research is not only conducted on land. As a result of the *Convention on the Protection of the Underwater Cultural Heritage* (UNESCO, 2001), there has been an increased interest in submerged landscapes on and under the seabed in recent years.

The historical and archaeological research of the MRGs (4, figure 30) is principally concentrated on the Middle Ages, studying different aspects: research on rural society, demographic research, research on water management and floods in the coastal plain and neighbouring estuaries, research on the development of the medieval coastal and polder landscape (historical geography), research on fishing settlements, research on medieval cogs, etc. Furthermore, there is archeological research in the Belgian part of the North Sea. This encompasses both surveys for new information as well as the inventory of archaeological finds. Aspects of conservation and preservation are also considered in the research on maritime heritage and maritime archaeology. The historical maritime research addresses the history of **maritime economy** (importance of ports, trading relations, etc.) and **maritime migrations**. Last but not least, **naval heritage** is also studied. This includes the inventory of naval heritage, information on ships and their history, and research on the history of shipyards. Some of the aforementioned research themes have a strong relation with other research disciplines, such as earth sciences (e.g. geological development of coastal zones) and biological sciences (e.g. identification of fish remains from archaeological sites).

RESEARCH DOMAIN OF MEDICAL AND HEALTH SCIENCES

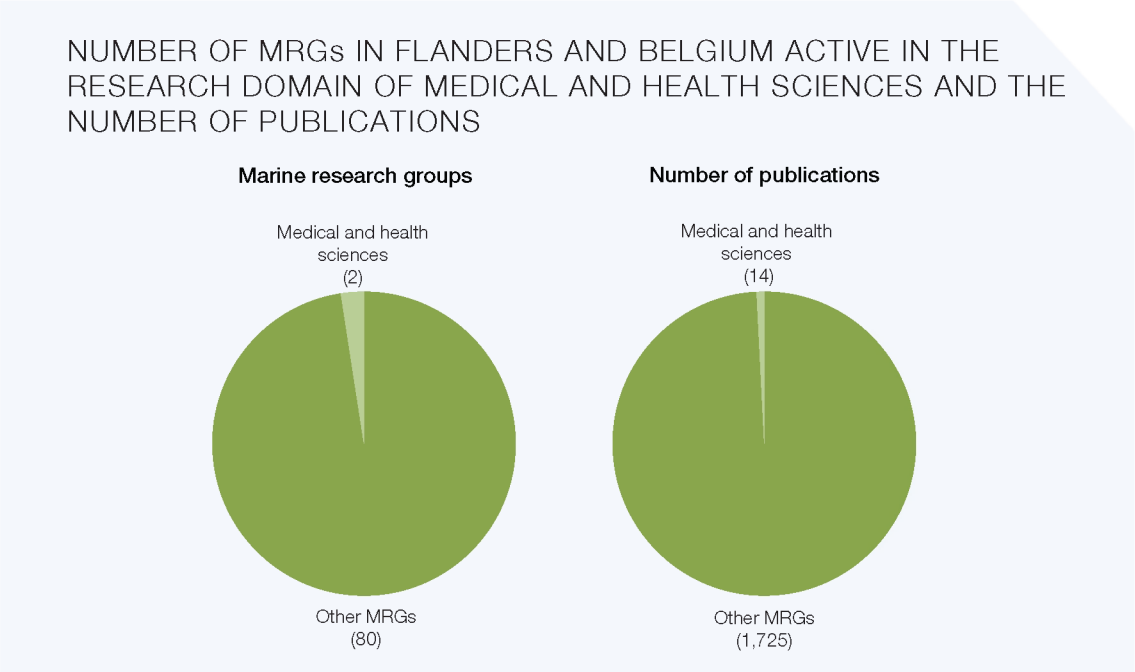

Figure 31. Number of MRGs in Flanders and Belgium active in the research domain of medical and health sciences as well as the number of publications (peer-reviewed and VABB) published between 2008 and 2012 in this research domain (Source: IMIS, VLIZ 2013).

The research domain of medical and health sciences includes several aspects ranging from research on the influence of toxic substances in the marine environment on human health (toxins in marine organisms, marine pollution, toxic algal blooms, etc.) over research on the effects of the sea on human well-being and health ('the blue gym'), to the extraction of medicine from marine organisms. On a European level, the potential of medicine of marine origins is emphasised in the communication on blue growth (*COM (2012) 494*). According to *Navigating the Future IV (European Marine Board, 2013)* [226874], a further elucidation of the relationship between human health and the oceans (the risks as well as the remedies) constitutes one of the great challenges for future marine research.

The research of the MRGs (2, figure 31) in this domain is on the one hand focused on the discovery and characterisation of **bioactive** substances (toxins), in, *inter alia*, jellyfish, sea anemones and cone snails. This research is strongly connected to marine biotechnology, in the research domain of engineering and technology. On the other hand, research is performed on **fish and shellfish** as a nutrition source for omega-3 fatty acids and the **toxicological risks** related to the consumption of fish. This research is strongly linked to ecotoxicological research conducted within the research disciplines of biological sciences and fisheries and aquaculture (e.g. food packaging and food safety).

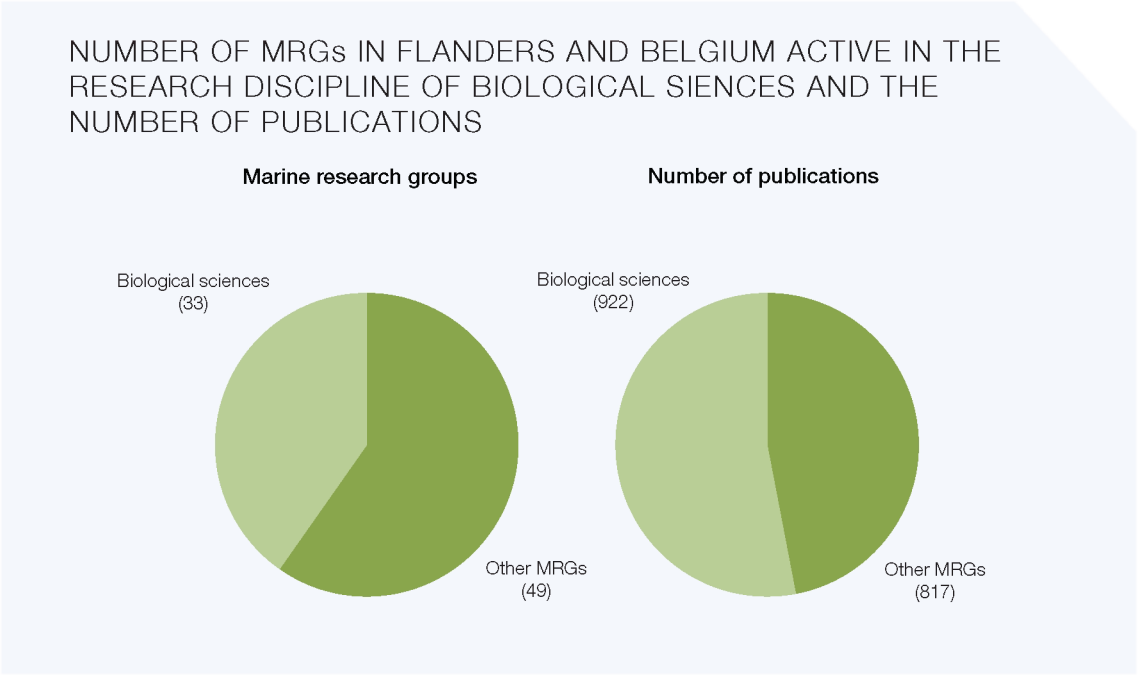

Figure 32. Number of MRGs in Flanders and Belgium active in the research domain of natural sciences – research discipline biological sciences, as well as the number of publications (peer-reviewed and VABB) published between 2008 and 2012 in this research discipline (Source: IMIS, VLIZ 2013).

The MRGs (33, figure 32) in Flanders and Belgium have strongly developed expertise in marine, estuarine and coastal biological research. The biological and ecotoxicological research in support of policy, primarily addresses the impact of human activities on the marine environment and marine organisms. In addition, there is research on the diversity, distribution and abundance of several marine organisms, ranging from marine mammals, seabirds, fish, and marine invertebrates to algae and micro-organisms. The interaction between these organisms and their abiotic environment is also studied in research on marine, estuarine and coastal ecosystems. The importance of present and future research on marine ecosystems and their societal benefits, resources from the deep sea, the impact of climate change, etc. is emphasised in *Navigating the Future IV (European Marine Board, 2013)* [226874].

Several MRGs conduct **policy-oriented marine biological research** with regard to the impact of human activities on marine ecosystems in the BNS. In many cases, this concerns mandatory monitoring carried out in the framework of international conventions (e.g. the *OSPAR Convention*), European directives (*Marine Strategy Framework Directive, Water Framework Directive, Birds Directive, Habitats Directive*, etc.) or national legislation. The biological impact of human activities such as the disposal of dredged material, offshore sand extraction, artificial hard substrates, construction of offshore wind farms, introduction of invasive species, fisheries, etc. is studied and monitored. Furthermore, the condition of certain populations and habitats is monitored (cf. research on marine mammals, sea and coastal birds, and ecosystems research). The research in support of the *Common Fisheries Policy* is discussed in the research domain of agricultural and veterinary sciences.

Policy-oriented research is also conducted on the beach and dune areas, such as the inventory and mapping of certain key species, scientific support for management plans, quantification of the ecological effects of beach nourishments, and development of nature conservation and repair measures (see coastal ecosystems). Finally, MRGs conduct research to support policies for the Scheldt Estuary by means of ecosystem monitoring in the context of the *Water Framework Directive* and nature regeneration projects (see estuarine ecosystems).

In **(eco-)toxicological research** the effects of certain contaminants on marine organisms or the marine environment are modelled and monitored (see also the research discipline chemical sciences). Specific research is conducted on the effects of marine (micro)litter, endocrine disruptors, trophic transfer and bio-accumulation of contaminants in food chains, heavy metals in European sea bass and dogfish, the impact of metals and organic contaminants on microbial communities in marine sediments and the influence of pollutants such as PCBs on deep sea fish.

Some MRGs perform scientific research on the occurrence of **marine mammals** in the BNS. An important aspect of this research concerns the study of stranded marine mammals. The toxicokinetics and physiological effects of organic contaminants in marine mammals (seals, sea lions etc.) are also addressed.

The MRGs conduct research on different aspects of **sea and coastal birds**. This includes the study of the evolution of populations of coastal birds, bird counts in the BNS, food ecology of terns, interaction between the pelagic component and top predators in the food chain and the impact of human activities on coastal birds and sea bird populations.

Besides fisheries-related research (cf. research field agricultural and veterinary sciences), the MRGs also conduct fundamental research on different aspects of **fish**. This includes the development of an encyclopaedia on African brackish water fish (FishBase), the study of the phylogeography and distribution ecology of marine fish of the North East Atlantic Ocean and the Southern Ocean, genetic research of fish, archaeobiological studies (cf. research domain human sciences), host-parasite interactions and cospeciation, research on fish migration and migration bottlenecks, the development of ecological parameters for fish stocks, the study of the communication and hearing of bony fish, sound studies on clownfish, bioluminescence in sharks, etc. The different MRGs also conduct **evolutionary morphological research** on fish. Within this scope, the evolution of the features and function of certain parts in marine vertebrae are studied, such as the cranial morphology of Anguilliformes (eels), the skeleton and metabolism of Syngnathids (pipefish, seahorses), opercular malformations in sea bream, morphological studies of pearlfish, the development of sea bass larvae and the carapax of Teleostei (bony fish).

The MRGs have extensive expertise with regard to marine invertebrates such as Crustaceae, Mollusca, Nematoda, Annelida, Platyhelminthes, Echinodermata, and Cnidaria. The research concerning these invertebrates is, *inter alia*, used in biodiversity studies and studies on the impact of climate change on the functioning of ecosystems. In the case of the **Crustacea**, research topics include: the distribution of exotic Crustacea in estuarine waters in Belgium; the revision and synopsis of Amphipoda in the Southern Ocean; the study of the ecology, evolution and taxonomy of Copepoda; and the taxonomy, phylogeny and zoogeography of marine and brackish Ostracoda. With regard to **Mollusca**, research is conducted on molecular systematics, taxonomy, and population genetics. The MRGs host extensive expertise with regard to **Nematoda**. Both benthic as well as free-living species are studied in different ecosystems (cf. research on marine, estuarine and coastal ecosystems). In addition, research is performed on bioluminescence in pelagic ringworms (**Annelida**). In the case of the **Platyhelminthes**, the biodiversity, phylogeny and biogeography of free-living flatworms are studied. The study of **Echinodermata** includes research on taxonomy and biodiversity (zoogeography, systematics and bio-ecology) of echinoderms such as sea urchins, starfish, sea cucumbers and brittle stars. Furthermore, there is specific research on the bioluminescence in Echinoderms and the excretion of certain substances by sea cucumbers, sea urchins and brittle stars. With regard to **Cnidaria**, research focuses on the taxonomy and biogeography of sponges. The research on corals is addressed in the study of marine ecosystems. The MRGs also perform research on the formation of skeletal parts (**biomineralisation**) in marine invertebrates.

The MRGs have an extensive expertise in the field of **algology** (brown algae, green algae and micro-algae). Research is conducted on different aspects of algae such as sexual reproduction and speciation, evolutionary dynamics and biogeography, population structure, bacteria-algae interactions, spatial and temporal analysis of communities and species variability, taxonomy, genetics, and diversity. Resistant remains of micro-algae such as diatoms and dinoflagellate cysts are frequently used in palaeo-ecological research (see also research discipline of earth sciences). A large collection of live diatoms is kept and constitutes a part of the 'Belgian Coordinated Culture collections of Microorganisms'. Finally, there is extensive research on toxic algal blooms in the marine environment.

The **microbiological research** of the MRGs *inter alia* focuses on aquatic microbial ecology (phytoplankton, protozooplankton and bacteria) and identification and classification of new marine bacteria. In addition, research is conducted on marine methanotrophes by means of the development of reactors and the study of marine ecosystems such as mud volcanoes, ecosystems in the deep sea and coral reefs. Bacteria in intertidal sediments and endosymbiotic bacteria in green algae are also studied. Last but no least, viruses and microbial ecology of fish products are studied, which is related to the food safety studies in the research domain of agricultural and veterinary sciences.

The MRGs conduct research on diverse **marine ecosystems**. This includes the modelling of ecosystems, the study of the biodiversity in marine ecosystems, the study of ecosystems on sandbanks and the study of ecosystems in the deep sea, such as submarine canyons at continental slopes, cold-water corals, communities at seeps, mud volcanoes, hydrothermal sources, habitats in polar seas and deep-sea sediments. The ecology (parasites, coral

bleaching) and evolution of tropical coral reefs are also studied. The microbial communities and skeletogenesis in corals are discussed as well within this scope (see also the research on marine invertebrates and the microbiological research).

The research on **coastal ecosystems** is focused on coastal dunes and the beaches of the Belgian coast. It concerns research on the use of spiders and insects as bio-indicators in coastal dunes (implications for nature conservation and evaluation of the impact of nature management measures), the ecology and functioning of dune ecosystems (e.g. research on the blue grasshopper, spiders, marram grass, plant-arthropod interactions, etc.) and policy-oriented biological research (impact of sand nourishments, key species, support of management plans, preparation of nature conservation and recovery measures).

The MRGs also have extensive expertise in the field of **estuarine ecosystems**. This research primarily covers ecosystems in the Scheldt Estuary such as mudflats and salt marshes (bioturbation, nursery function, mudflats as a 'source of sink' of nutrients and silica, interaction between salt marshes and the sea, etc.) in which an ecosystem model for the Scheldt is being developed. In addition, policy-oriented biological research is conducted through ecosystem monitoring in the context of the *Water Framework Directive* and nature restoration projects (water birds, macrobenthos, habitats and ecotopes, nature development, ecosystem visions, methodology of basin management plans, non-indigenous species, integrated system monitoring, fish migration, fish stocks, etc.).

In the field of estuarine and coastal ecosystems, multidisciplinary research is carried out on different aspects of **mangroves**, ranging from the functioning of the ecosystem, over ecosystem management and interaction with adjacent coral reefs to the study of insects in mangroves.

In addition to the biodiversity research of specific ecosystems, the MRGs conduct **biodiversity research** on a higher level. Use is made of marine data centres and databases such as SCAR-MarBIN (the Antarctic Marine Biodiversity Information Network) and NeMys to collect information for this purpose (see also research domain of engineering and technology). The biodiversity research addresses the study of food webs in the sea, in which the role of functional biodiversity (primary producers, biomass, predators, key species, species diversity, nutritional relations, etc.) is examined.

RESEARCH DOMAIN OF NATURAL SCIENCES: RESEARCH DISCIPLINE CHEMICAL SCIENCES

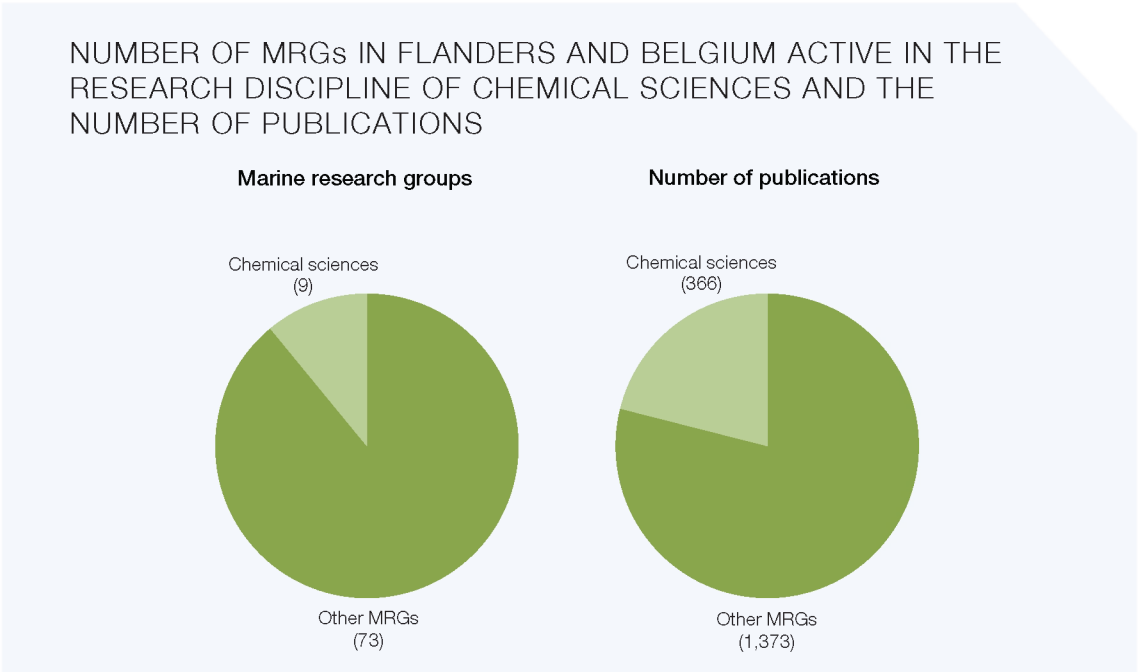

Figure 33. Number of MRGs in Flanders and Belgium active in the research domain of natural sciences - research discipline chemical sciences as well as the number of publications (peer-reviewed and VABB) published between 2008 and 2012 in this research discipline (Source: IMIS, VLIZ 2013).

The research of the MRGs (9, figure 33) in the research discipline of chemical sciences focuses on the development of chemical analysis methods, analysis of contaminants and the study of biogeochemical cycles and fluxes of certain chemical substances and chemical processes. This research discipline is important with regard to monitoring in the framework of different policy instruments and overlaps with the disciplines of earth sciences and biological sciences.

The MRGs conduct research on the **development of new analysis and evaluation methods** and the validation of the results. This research will lead to an improved knowledge of the marine environment by means of analytical chemical, physical and biochemical analyses and also contributes to certain monitoring activities in the context of the *OSPAR Convention*, the European *Water Framework Directive*, and the *Marine Strategy Framework Directive*. Reference materials for international ring tests are also being developed.

A significant part of the research discipline of chemical sciences is focused on the **analysis of chemical contaminants**. This includes the analysis of sediment, suspended material, water and biota. This research topic has applications in several areas, such as endocrine disruption in the Scheldt Estuary, analysis of micro-pollutants, food safety and authenticity/traceability of fish and shellfish (overlap with the research domain of agricultural and veterinary sciences) metabolisation and transfer of marine toxins from algae to the environment and research on persistent organic pollutants (POPs such as PCBs, OPCs, PBDEs, etc.) in fish, eels, and marine mammals.

The MRGs study **several biogeochemical cycles and fluxes** of different **chemical substances**. This includes heavy metals, of which both the biogeochemical behaviour in the Scheldt Estuary and North Sea and the influx of these metals to the sea by rivers and the atmosphere are studied. Research is also carried out on marine biogeochemical cycles in different marine areas (sea ice in polar zones, continental slopes, etc.) and (eco-)systems (mangrove ecosystems, tropical estuaries, upwelling systems, etc.). Furthermore, biogeochemical fluxes of substances such as carbon methane, nitrogen, silica and phosphor are studied. Within the scope of these studies, the MRGs also conduct research on a number of marine chemical processes, such as eutrophication, calcification, ocean acidification and (export) production in open oceans.

RESEARCH DOMAIN OF NATURAL SCIENCES: RESEARCH DISCIPLINE EARTH SCIENCES.

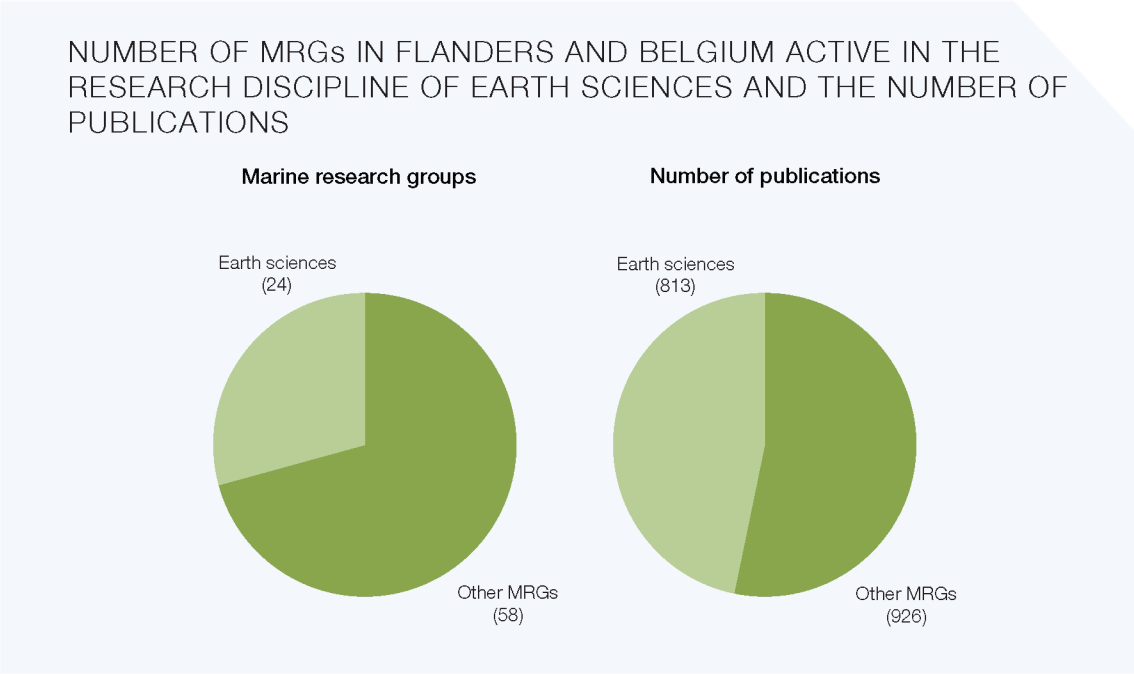

Figure 34. Number of MRGs in Flanders and Belgium active in the research domain of natural sciences – research discipline earth sciences as well as the number of publications (peer-reviewed and VABB) published between 2008 and 2012 in this research discipline (Source: IMIS, VLIZ 2013).

The research of the MRGs (24, figure 34) in the research discipline of earth sciences encompasses a broad spectrum of topics. It includes the study of hydrodynamic and sedimentary processes in the marine environment, the observation

and study of the seabed and the underlying sediments, ancient marine sediments on land, palaeontological studies and the geology of the coastal plain. Climate research is also discussed, although this is pre-eminently a multidisciplinary research field. In *Navigating the Future IV (European Marine Board, 2013)* [226874], research on changes in the oceans within a changing earth system, polar ocean science and sustainable use of (deep-)sea resources are put forward as important challenges for (future) marine research.

Several MRGs conduct research on **hydrodynamic and sedimentary processes** in the Scheldt Estuary and the BNS. In addition to *in situ* measurements, hydrodynamic and sediment transport models are being developed for a range of applications, such as the monitoring of the effects of dredging and dumping of dredged materials (mud transport), evolution and degradation of pollution and marine meteorological predictions in order to simulate water levels and currents. In this context, an important overlap occurs with the research domain of engineering and technology (coastal protection, port structures, geomatics, etc.). Additionally, hydrodynamic, biogeochemical and sedimentary processes in oceans are modelled on a larger scale, often in relation to climate studies.

An important aspect in the study of the seabed concerns **observation techniques** to explore the seafloor. Besides sampling through grabs, box cores, sediment cores, etc., MRGs also have expertise in the use of seismic surveys, multibeam imaging, side scan sonar imaging and acoustic characterisation of the seabed. There is specific research on the propagation of sound waves in aquatic environments, acoustic tomography, the processing of sonar images to map the sea floor and the development of methods for the characterisation of shallow environments (estuaries and coastal waters). This research is related to the research domain of engineering and technology.

The MRGs study different aspects of the **seabed**, in which the mapping and characterisation of the seabed are strongly linked to benthic biological research (see also research discipline biological sciences). In the BNS a broad range of research topics is addressed such as research in support of a sustainable management of natural resources, evaluation of dumping sites, and morphological and marine geoarchaeological research. In addition, there is a strong international component in which research is conducted on the geology of continental slopes and the deep sea. The geological research of the oceans is *inter alia* focused on the geodynamics, stratigraphy and palaeo-oceanography of continental slopes, methane hydrates, cold seeps and mud volcanoes, cold-water corals and carbon mounds, and the reconstruction of deep-sea currents by means of detailed sedimentological studies. The geochemistry and petrology of the oceanic crust (plumes, subduction zones, etc.) are also studied in cores which were retrieved within the scope of the Integrated Ocean Drilling Program (IODP).

Besides the study of the seabed, ancient marine deposits on land are studied as well (see also palaeontology). The MRGs conduct research on **carbonate rocks** (in which diagenesis of marine carbonates is studied in detail) and specifically on **fossil coral reefs**, mounds and atolls, of which the basin dynamics, palaeogeography, sedimentology, palaeontology and geochemistry are elucidated.

The MRGs have considerable **marine palaeontological expertise**, on both macro- and micropalaeontology. The research mainly focuses on molluscs, ostracods, brachiopods, vertebrates, Precambrian eukaryotes, and microfossils such as dinoflagellate cysts, foraminifera, chitinozoa, pollen and spores, etc. This palaeontological research encompasses all geological eras, from the Precambrian to the Quaternary (Holocene), and has an international character. The research has several applications, such as taxonomy, morphology, osteology, geosphere-biosphere interactions, palaeo-ecology, palaeoclimatology, global and regional biostratigraphy and sequence stratigraphy, anthropobiology, archaeozoology and the evolution of Precambrian eukaryotes. The research on anthropobiology and archaeozoology is strongly linked to coastal archaeological research in the research domain of human sciences and the biological sciences (e.g. the identification of fish remains).

The **geological history** of the **coastal plain** is extensively studied by the MRGs, covering both the sedimentology of deposits and the palaeogeography of the coastline (sea level changes). This research is strongly linked to archaeological research in the coastal region, in the field of human sciences. Furthermore, this research focuses on the hydrogeology of the coastal plain, such as fresh and salt water distribution, management of ground water extraction, water quality and the impact of climate change on the hydrogeological situation in the coastal plain.

The **study of the climate** is a multidisciplinary research field strongly linked to biological and chemical sciences as well as to the research domain of engineering and technology (coastal protection). Within the research discipline of earth sciences, climate studies constitute an important part of the research on the seabed and sediment records, the geology of the coastal plain and palaeontological studies. The MRGs perform research on a range of aspects related to climate. Applied research is conducted on the impact of climate change and necessary adaptations for marine activities. Sea ice, the dynamics of ice sheets and their contribution to the sea-level rise are also studied. Ocean and

ice models are developed (LIM, SLIM, CART, etc.) in order to make long-term predictions with regard to climate and sea level changes. These models can also be used to reconstruct the former climate and to evaluate human impact on climate. Another important aspect of the climate research of MRGs is the study of biogeochemical cycles in oceans (link to chemical sciences), which is crucial to elucidate the role of oceans in the global climate and to gain insight in certain effects of climate change on oceans, such as ocean acidification.

RESEARCH DOMAIN OF SOCIAL SCIENCES

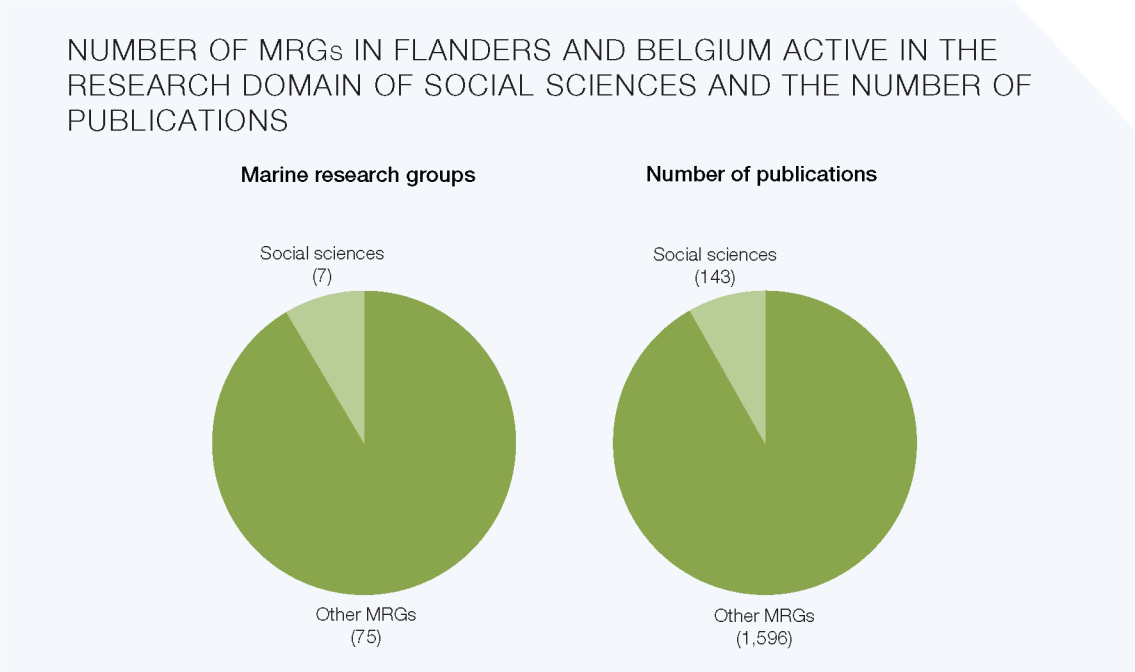

Figure 35. Number of MRGs in Flanders and Belgium active in the research domain of social sciences as well as the number of publications (peer-reviewed and VABB) published between 2008 and 2012 in this research domain (Source: IMIS, VLIZ 2013).

The research domain of social sciences includes a wide range of research topics such as economy, sociology, communication, political sciences and law. Specific research is carried out on several aspects of coastal, marine and maritime law, spatial planning at sea and in the coastal zone, and port and transport economy, as well as on specific aspects of the marine policy. Marine and coastal research is also disseminated to specific target groups. Safe and sustainable use of marine and coastal space and effective European marine science - policy interfaces are some of the crucial research topics identified in *Navigating the Future IV (2013)* [226874] by the European Marine Board.

Several MRGs conduct research on specific topics in the context of **coastal, marine and maritime law**. The research topics include international law of the sea, the position of Belgium in the area of maritime law, international fisheries law, maritime boundaries, transport and maritime law, risks and consequences of human activities at sea (e.g. marine pollution), protection of the marine environment, piracy and boat refugees. There is also research on certain aspects of the **marine policy**, such as coastal zone management, marine spatial planning, port policy and fisheries policy.

In the context of **spatial planning**, a lot of research has been carried out concerning spatial planning at sea and in the coastal zone. Special attention has been paid to the response and adaptation to climate change.

The **economic research** of the MRGs is mainly aimed at **ports** and the associated **transport sector**. Several research topics are addressed, including competition and cooperation in the maritime and port sector, ports as nodes for logistic chains, productivity of terminals, economics of maritime transport, strategic planning in sea ports, traffic predictions, shipping networks and financing of port investments. Many of the aforementioned research topics are strongly linked with research on maritime law, marine policy and spatial planning. In addition, research is conducted on sustainable fish stock managment and on the use of the fishing fleet to optimise the economic development of the **fisheries** sector.

In the field of **communication and outreach,** the conducted marine and coastal research is shared and explained to certain target groups such as education, the general public, policy makers and the industry.

2.5 Opportunities and challenges for marine research

KEY POINTS FOR MARINE RESEARCH IN EUROPE

In October 2010, more than 400 representatives of the European marine research community gathered during the EurOCEAN 2010 Conference in Ostend (Belgium). The *EurOCEAN conferences* offer a platform for developing a joint vision of marine research, both at the European and national level (figure 1). During the conference, the '*Ostend Declaration (2010)*' [204867] was accepted unanimously. In this declaration, the international marine scientific community underlines:

- The critical role of the oceans in the earth and climate systems;
- The importance of coasts, seas and oceans and their ecosystems to our health and well-being;
- The increasing impacts of global environmental change on the marine environment and the significant socio-economic consequences of those impacts;
- The ongoing need for basic research to address major gaps in our fundamental knowledge of coasts, seas and oceans;
- The enormous opportunities for innovation, sustained wealth and job creation in new and existing maritime sectors such as aquaculture, renewable energy, marine biotechnology and maritime transport;
- The need to translate these messages to all sectors of society.

Europe emphasises the crucial role of science and technology in providing knowledge about the seas and oceans, in support of new opportunities and new technologies, sustainable management of ecosystems and natural resources and sustainable food, energy and health in the long term (**Marine research: the European context**).

During the *EurOCEAN 2010* Conference, the most important challenges and opportunities in the field of marine research were identified and specific measures for a focused response from the EU, the EU members and associated states were formulated. These measures address the growing need for coordinated action at the European level for joint planning and pooling of research resources and capacities (e.g. Horizon 2020, JPI-Oceans), infrastructure (e.g. European Ocean Observation System (EOOS), European Strategic Forum for Research Infrastructure (*ESFRI*)), and data systems (e.g. European Marine Observation and Data Network (*EMODnet*)). Furthermore, the measures deal with the importance of integrated and concrete co-operation with regard to marine research themes and agendas. The support of Member States to ensure structural funding for realising a marine research infrastructure and developing an integrated European Ocean Observation System (EOOS) is crucial. It is a strategic factor in the development of the European Research Areas (ERAs) both at the level of the regional seas and at a pan-European level. The upcoming programme Horizon 2020 and the Joint Programming Initiatives (JPIs) are also important consolidating factors for this purpose, in particular ERA-NETs and JPI-Oceans with formal representatives of 20 Member States. Together with the marine infrastructures of ESFRI and EOOS, they are some of the main components which constitute the backbone of the future ERA for marine research and technology. These goals and projects are also highlighted in *Navigating the Future IV* [226874], the vision document of the European Marine Board (*EMB*), in which the main European marine research institutes, funding agencies and university consortia determine the key points for future marine research in Europe.

MARINE RESEARCH IN FLANDERS AND BELGIUM: DIVERSITY AND QUALITY

In Belgium, marine research is conducted by 82 different marine research groups (MRGs) of several universities and research institutes (**Inventory of marine research**). These MRGs have a research capacity of at least 1,000 scientists and specialised staff, which are active in the different marine research disciplines (**Qualitative analysis of marine research**). This corresponds to approximately 2% of the total R&D capacity in Belgium (all research fields in the private and public sectors) and 3.9% of the public R&D sector in Belgium (higher education and government) (Source: Overleggroep CFS/STAT, see **Inventory of marine research**).

The research capacity is mainly located at the universities, with 48 MRGs at the Flemish universities and 26 MRGs at the universities of the Wallonia-Brussels Federation. Together, they represent 90% of the MRGs in Belgium. With little over 500 staff members, Flemish universities employ about half of the Belgian marine researchers and specialised staff. The Flemish research institutes employ about 200 marine staff members (figure 10). Together, these Flemish MRGs account for 67% of the dedicated marine research capacity (staff) in Belgium.

From a thematic perspective, the core of Belgian marine research lies in the domain of natural sciences, with 70% of the MRGs and 77% of staff. This is in part explained by the long standing tradition of marine research in Belgium (**History of marine research**). Natural sciences are also well represented in the overview of the peer-reviewed journals in which the MRGs publish most frequently (figure 15, table 4). This is in line with the research capacity, but also related to the tradition in natural sciences of publishing in peer-reviewed journals (source: Web of Science, see **Methodology**).

The quality of marine research of the MRGs is internationally renowned. An analysis of recent (2008-2012) marine peer-reviewed publications of the MRGs shows that, on average, a publication is cited 1.86 times per year (figure 16; source Web of Science), while a dozen publications of the analysed subset have an average of more than 10 citations per year. Although the number of citations is not a direct indicator of quality, the number of citations does express a certain level of impact. It should be mentioned that, as a general rule, the average number of citations per year increases when publications have been registered in the WoS database for a longer period of time.

Besides the traditional research topics, the MRGs have a wide and diverse range of expertise in new research fields and applications. This diversity is reflected in the qualitative analysis as well as in the high number of journals: between 2008 and 2012, the MRGs published in 499 different peer-reviewed journals (table 4). The MRGs have extensive expertise which is directly related to the great challenges for future research in the fields of aquaculture and integrated multitrophic aquaculture systems, blue growth and blue technology, climate studies, offshore technologies for renewable energy, energy storage and transport, public health related to seas and oceans, and sustainable management of resources from the (deep) sea (*Navigating the Future IV (European Marine Board, 2013)* [226874]). Several of these new marine research topics are addressed by PhD studies at MRGs in universities and scientific institutes. The tax incentives and additional investments by IWT and FWO-Vlaanderen have generated an increase in the number of PhD candidates since 2000. It is a focus of the current policy to offer these temporary researchers a long-term perspective for an academic career, as a strategic action in view of the further development of the European Research Area (*Vlaamse beleidsnota Wetenschappelijk onderzoek en Innovatie (2009-2014)* [229001]; policy document on scientific research and innovation (2009-2014) Flemish Government).

COMPARABILITY WITH MARINE RESEARCH INSTITUTES IN EUROPE

Unlike some of its neighbouring countries, Belgium does not have a dedicated national marine research centre and an associated research programme. Since 1976, the RBINS has a dedicated unit (Operational Direction Natural Environment, MUMM) that combines research, policy support and monitoring, for the BNS. Flanders, on the other hand, established a coordination and information platform for marine scientific research, the Flanders Marine Institute (Vlaams Instituut voor de Zee – VLIZ), in October 1999. VLIZ is also a focal point for marine and coastal research and serves as an international contact point.

Table 11. MRGs in Flanders and Belgium in comparison to national research centres (staff, publications and budget) (source: Scopus literature database, VLIZ 2013).

EUROPEAN MARINE RESEARCH INSTITUTES	STAFF	PUBLICATIONS, ANNUAL AVERAGE 2008-2012	BUDGET (MILLION EUROS)	NUMBER OF PUBLICATIONS/ STAFF
Institut Français de Recherche pour l'Exploitation de la Mer (*IFREMER*)	1593	407	213 (2010)	0.26
Alfred Wegener Institut (*AWI*)	>900	430	> 100 (2012)	0.46
National Oceanography Centre *NOC Southampton*	550	173	53 (2012)	0.31
Royal Netherlands Institute for Sea Research (*NIOZ*)	370	195	30 (2013)	0.53
MRGs Belgium	1075	372	-	0.35
MRGs Flanders	725	261	-	0.36

Compared to the larger marine research institutes in neighbouring countries, MRGs in Flanders and Belgium are - in terms of marine research capacity (staff) - similar to the capacity of the national marine institutes (table 11). When considering scientific output, Belgian and Flemish MRGs are comparable to the national marine institutes, both in the absolute number of peer-reviewed publications and relative to the number of employees. For the purpose of this comparison with foreign national marine institutes, the Scopus Database was consulted for scientific output by means of the 'affiliation search' query module. However, some footnotes should be taken into account: the specific assignments and mandates of research centres largely determine to what extent scientists can devote their staff time to effective research. For example the federal and Flemish research institutes tend to focus on generating knowledge output which is not necessarily suitable for peer-reviewed publications, such as the monitoring and evaluation of policy objectives and formulating policy advice. On the other hand, a considerable amount of staff time of researchers from academic and non-academic institutes may be spent on educational objectives and capacity building.

AN INTENSIVE INTERNATIONAL COOPERATION

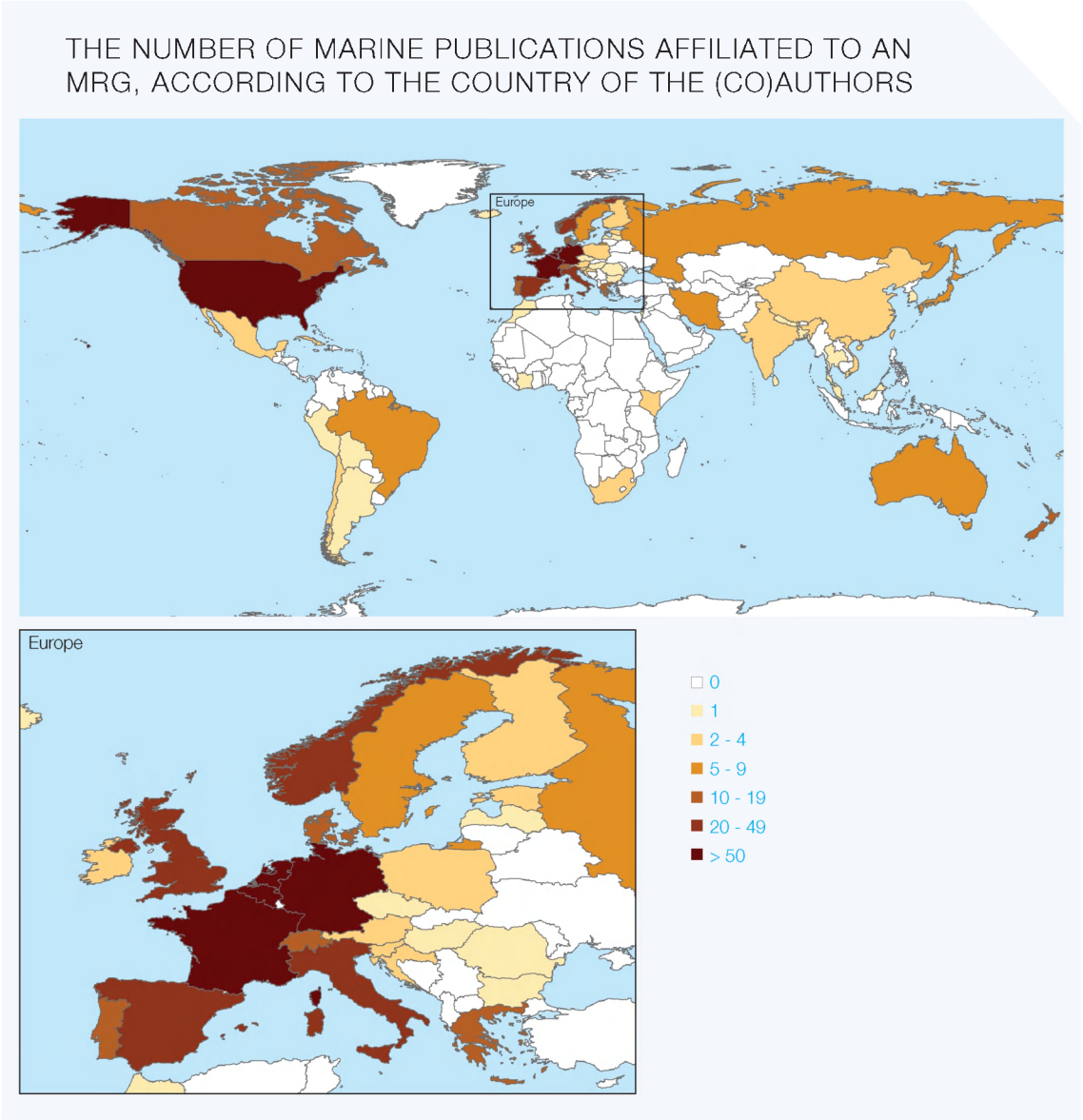

Figure 36. Geographical representation of the number of marine peer-reviewed and VABB publications affiliated to an MRG, by country of affiliation of the (co)authors (geographic representation of partnerships based upon peer-reviewed publications, 2010) (Source: IMIS, VLIZ 2013).

MRGs cooperate with international networks and foreign experts for most of their research. This is demonstrated by the partnerships in European projects (e.g. FPs), but also from bilateral or individual cooperations with foreign experts and (co)authors for publications. Of the inventoried marine peer-reviewed and VABB publications of the Belgian MRGs in 2010, 68% involved cooperation with foreign (co)authors of 57 different nationalities (figure 22 and figure 36).

This strong co-operation with foreign research institutes and integration in international research networks and programmes is also illustrated by the use of foreign research vessels. The scientific output of 2010 contains references to 41 different research vessels from 15 different countries (figure 24). Ensuring permanent access to this international research infrastructure is crucial for maintaining and developing the expertise in marine research in Flanders and Belgium. The current research infrastructure in Flanders and Belgium plays an important role in this context: besides the application for regional and local research, this infrastructure is also used within the framework of international cooperation and exchange.

The international character of the conducted marine research is also demonstrated by an analysis of the MRG publications (peer-reviewed and VABB) between 2008 and 2010. 70% of the conducted research focuses on study areas with an international character (European and worldwide); 30% of the research is regional (BNS, coastal zone and adjacent estuaries, Southern Bight of the North Sea).

THE NEED FOR AN INTEGRATIVE PLATFORM IN A FRAGMENTED AND DIVERSE LANDSCAPE

The marine research landscape in Flanders and Belgium is fragmented and diverse. The marine research community relies on complex funding mechanisms and has unique characteristics. An analysis of the peer-reviewed and VABB publications indicates that there is good cooperation between MRGs within universities, between MRGs of Flemish universities and federal institutes, and between MRGs of Flemish universities and Flemish scientific institutes. Even though there is no instrument available yet to measure inter- or multidisciplinary research, a preliminary analysis shows that cooperation occurs between MRGs from a wide range of research disciplines. There is an increasing need for a multidisciplinary approach to effectively address the present and future priorities in marine research and the societal challenges associated with the seas and oceans (*Navigating the Future IV (European Marine Board, 2013)* [226874]). The federal science policy has been stimulating cooperation between research groups in Belgium within the North Sea research programmes since 1997. Furthermore, interdisciplinary research has been supported through the funding of projects for interdisciplinary networks. The research programme BRAIN-be emphasises the importance of this interdisciplinary research and networking.

The importance of marine research will continue to grow over the next few decades and the MRGs will need central logistical support to face the current challenges. Hence, the marine research community will benefit from joining forces by means of a supporting, networking and integrating platform. VLIZ aims at a well-connected marine research community and stimulates collaboration between research groups, administrations, the federal level, neighbouring countries, the European Union, multilateral organisations and other interested parties. In this regard, VLIZ can function as a facilitator for the communication between policy makers and scientists by (1) helping to identify the needs of marine research in terms of supporting and informing policy; (2) providing scientific data and information to policy makers and the broad range of marine experts; and (3) disseminating marine knowledge. VLIZ maps the expertise of Flemish and Belgian research groups and connects this expertise in a coordinated way at a local and international level. These efforts increase the visibility of marine research locally as well as abroad, stimulate participation in international and regional activities and alignment with different policy levels.

FLANDERS AS AN INTERNATIONAL ACTOR IN MARINE RESEARCH

In the Flemish policy document on Scientific Research and Innovation (2009-2014) (*Vlaamse beleidsnota Wetenschappelijk onderzoek en Innovatie (2009-2014)* [229001]), the minister for Innovation, Ingrid Lieten, aligns the key policy issues with the international and European challenges. The current coalition agreement of the Flemish government (*Flemish government 2009*) reconfirms the commitment to the objective of *Pact 2020* to spend 3% of the GDP on research and development activities (*Andries et al. 2012* [229004]). Central to this policy are excellence in scientific research and education as well as a good interaction between science and industry to translate research products and applications to the market. For a small region as Flanders, the importance to increase the scale in order to intensify the participation in the European Research Area (JPI, EIT, Horizon 2020) cannot be overestimated. This

increase in scale is aimed at the level of aligning information providers and policy organisations as well as at the level of research infrastructure.

Since 2005, the Flemish government has supported the UNESCO/IOC project office (*IODE Project Office*) by means of structural funding (0.54 million euro per year) as well as by providing office space in Ostend, local staff and operational funds. Through UNESCO as implementing agency, the Flanders-UNESCO Science Trust Fund (FUST) contributes an additional 1.53 million euro per year, of which approximately 60% (0.9 million euro) is dedicated to marine and coastal programmes and projects. With this support, Flanders contributes to the development of international coordination in oceanography, capacity building and the promotion of sustainable use and development of coastal zones worldwide.

The *Hercules Foundation* of the Flemish government provides funding for medium to large-scale research infrastructure for fundamental and strategic research in all scientific disciplines. *ESFRI* maps the needs for pan-European research infrastructures of EU Member States and also acts as a consultation platform between Member States to realise these infrastructures. Flanders takes part in five projects in the ESFRI framework (*Hercules Foundation*), two of which are relevant for marine research: the Integrated Carbon Observation System (*ICOS*) and the E-Science European Infrastructure for Biodiversity and Ecosystem Research (*Lifewatch*).

Concerning the use of large infrastructures on a European scale, the Flemish marine research community is represented in the European Network of Marine Research Institutes and Stations (*MARS*) and in the European Research Vessels Operators (*ERVO*).

Besides physical components, research infrastructure also comprises collections and databases. Flanders participates actively in international networks for marine information management (e.g. *EURASLIC*, *IAMSLIC*, *ASFA*, *IODE*) and data standardisation and integration (e.g. *SMEBD*, *ERMS*, *WoRMS*, *OBIS*, *SeaDataNet*, *GLOSS*, *IODE*).

In 2012, European commissioner for Maritime Affairs and Fisheries, Maria Damanaki, decided to accept the offer of Flemish minister Ingrid Lieten to host the central secretariat of the European Marine Observation and Data Network (*EMODnet*) at the Innovocean site in Ostend. EMODnet is part of the European initiative “Marine Knowledge 2020” (*COM (2010) 461*). The Flemish government annually reserves 180,000 euro to support the EMODnet secretariat through VLIZ. This way, Flanders contributes significantly to the Europe 2020 objectives.

The European Marine Board (*EMB*) was established in 1995 to enhance the coordination between European marine research organisations – both research performing and research funding entities – and to develop a strategy for marine research in Europe. Since 2006, the secretariat of this European forum for marine science is located in Ostend. The Flemish agency FWO-Vlaanderen, the Walloon agency FNRS, and BELSPO (federal level) are the Belgian members in EMB (FWO-Vlaanderen is represented by VLIZ).

From the start of JPI-Oceans, Flanders and Belgium have joined in its development. Furthermore, the Flemish government attributes an annual contribution of 200,000 euro to support JPI-oceans and since 2011 VLIZ seconded a staff member to the JPI-Oceans secretariat. In 2012, the Coordination and Support Action (CSA) Oceans was established under FP7, bringing together eleven partners from nine different countries to cooperate on the operability of JPI-Oceans. In the CSA Oceans project, VLIZ is responsible for communication and outreach.

These concerted efforts increase the visibility of the marine research abroad and stimulate participation in international activities within the framework of integrated cooperation in research. Besides internationalisation, new research potential is being developed through increased participation in interregional cooperation.

Notwithstanding the decentralisation of marine research in Flanders and Belgium, the research community has been able to position itself both on a regional and an international level. The scientific capacity for multidisciplinary work is present in a broad range of marine research domains and disciplines. When the opportunity for multidisciplinary work presents itself in the future, the MRGs will be ready to respond. Communication, coordination and cooperation for necessary services are crucial in this regard. Through cooperation, the marine research community in Flanders and Belgium will increase its visibility and presence in national and international forums. This collectivity is also necessary to develop a coherent vision on scientific questions as well as on technological and infrastructural needs in an international and European context. Structural support for these partnerships – also towards the industry – offers a permanent added value for the foundations of our knowledge society and for responding to the great challenges of current and future marine research.

Legislation reference list

Table with international agreements, conventions, etc.

INTERNATIONAL AGREEMENTS, CONVENTIONS, ...			
Abbreviations (if available)	Title	Year of conclusion	Year of entering into force
OSPAR-Convention	Convention for the protection of the Marine Environment of the North-East Atlantic	1992	1998
HELCOM	The Helsinki Convention on the Protection of the Marine Environment of the Baltic Sea Area (adopted in 1992)	1992	
Bucharest Convention	The Bucharest Convention on the Protection of the Black Sea against Pollution (adopted in 1992)	1992	
Barcelona Convention	The Barcelona Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean (adopted in 1995)	1995	
	Convention on the Protection of the Underwater Cultural Heritage	2001	

Table with European legislation. The consolidated version of this legislation is available on *Eurlex*.

EUROPEAN LEGISLATION			
Abbreviations (if available)	Title	Year	Number
Directives			
Habitats Directive	Directive on the conservation of natural habitats and of wild fauna and flora	1992	43
Water Framework Directive	Directive establishing a framework for the Community action in the field of water policy	2000	60
Marine Strategy Framework Directive	Directive establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive)	2008	56
Birds Directive	Directive on the conservation of wild birds	2009	147
Regulations			
Common Fisheries Policy	Council Regulation on the conservation and sustainable exploitation of fisheries resources under the Common Fisheries Policy	2002	2371
	Council Regulation amending Regulation (EC) No 1543/2000 establishing a Community framework for the collection and management of the data needed to conduct the common fisheries policy	2007	1343
Other (Decisions, Communications, White Papers, etc.)			
	Communication from the Commission (COM): Towards a European research area	2000	6
	Communication from the Commission - More research for Europe - Towards 3% of GDP	2002	499
Integrated Maritime Policy	Communication from the Commission (COM): An Integrated Maritime Policy for the European Union	2007	575
	Communication from the Commission (COM): A European Strategy for Marine and Maritime Research A coherent European Research Area framework in support of a sustainable use of oceans and seas	2008	534

	Communication from the Commission (COM): Building a sustainable future for aquaculture A new impetus for the Strategy for the Sustainable Development of European Aquaculture {SEC(2009) 453} {SEC(2009) 454}	2009	162
	Communication from the Commission (COM): Towards the integration of maritime surveillance: A common information sharing environment for the EU maritime domain {SEC(2009) 1341}	2009	538
	Communication from the Commission (COM): MARINE KNOWLEDGE 2020 marine data and observation for smart and sustainable growth	2010	461
	Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: Horizon 2020 - The Framework Programme for Research and Innovation	2011	808
	Communication from the Commission (COM): Blue Growth opportunities for marine and maritime sustainable growth	2012	494
Limassol Declaration	Declaration of the European Ministers responsible for the Integrated Maritime Policy and the European Commission, on a Marine and Maritime Agenda for growth and jobs	2012	
	Proposal for a directive of the European Parliament and of the Council (COD) establishing a framework for maritime spatial planning and integrated coastal management	2013	133
	Communication from the Commission (COM): Action Plan for a Maritime Strategy in the Atlantic area Delivering smart, sustainable and inclusive growth	2013	279

Table with Belgian and Flemish legislation. The consolidated version of this legislation is available on *Belgisch staatsblad* and the *Justel-databases*.

BELGIAN AND FLEMISH LEGISLATION	
Date	Title
Laws	
Bijzondere wet van 8 augustus 1980	Bijzondere wet tot hervorming der instellingen
Royal Decrees	
KB van 22 augustus 2006	Koninklijk besluit tot wijziging van het KB/WIB 92 op het stuk van de aangifte in de bedrijfsvoorheffing
Decrees	
Decreet van 30 april 2009	Decreet betreffende de organisatie en financiering van het wetenschaps- en innovatiebeleid

Chapter 2

Use of the sea

1 Nature and environment

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Citation:

Degraer, S., Vincx, M., Bonte, D., Stienen, E., Provoost, S., Adriaens, P., Van Ginderdeuren, K., Pirlet, H., 2013. Nature and environment. In: Lescrauwaet, A.K., Pirlet, H., Verleye, T., Mees, J., Herman, R. (Eds.), Compendium for Coast and Sea 2013: integrating knowledge on the socio-economic, environmental and institutional aspects of the Coast and Sea in Flanders and Belgium. Oostende, Belgium, p. 75-92.

1.1 Introduction

The North Sea is surrounded by Norway, Sweden, Denmark, Germany, The Netherlands, France and the United Kingdom, and has a surface of approximately 750,000 km² and a volume of 94,000 km³ (*website Direction Natural Environment*, the Royal Belgian Institute of Natural Sciences (RBINS)). This maritime region belongs to a cold-temperate boreal biogeographical zone (*Dinter 2001* [24838]). Except for the waters near the Norwegian coast, the North Sea is a relatively shallow sea, situated on the European continental shelf. The water of the North Sea circulates counterclockwise and consists of a mixture of water originating from several rivers and water deriving from the Atlantic Ocean to which the North Sea is connected in the North as well as in the South (through the Channel). The North Sea bottom consists mainly of sandy sediment habitats, housing a large population of flatfish (*OSPAR QSR 2010* [198817]). With a surface of 3,454 km², the Belgian part of the North Sea (BNS) covers a modest part of the Southern Bight of the North Sea (*Belpaeme et al. 2011* [207333]).

1.2 Characteristics of the marine and coastal environment

1.2.1 Sea

BATHYMETRY AND SUBSTRATE

The BNS is a shallow part of the North Sea with a seabed that gradually deepens in north-western direction up to a depth of 40 to 45 m (see figure 1). The relief of the seabed is characterised by the presence of a complex system of gullies and sandbanks up to 30 m high, 15 to 25 km long and 3 to 6 km wide. The orientation of the banks varies from parallel to the coast to a southwest-northeast orientation further offshore (*Mathys 2009* [141685], *Mathys 2010* [144601]). The substrate of the seabed mainly consists of non-consolidated Quaternary sediments with a thickness that varies between a few meters in the gullies to 50 meters around the sandbanks. Underneath these Quarternary sediments,

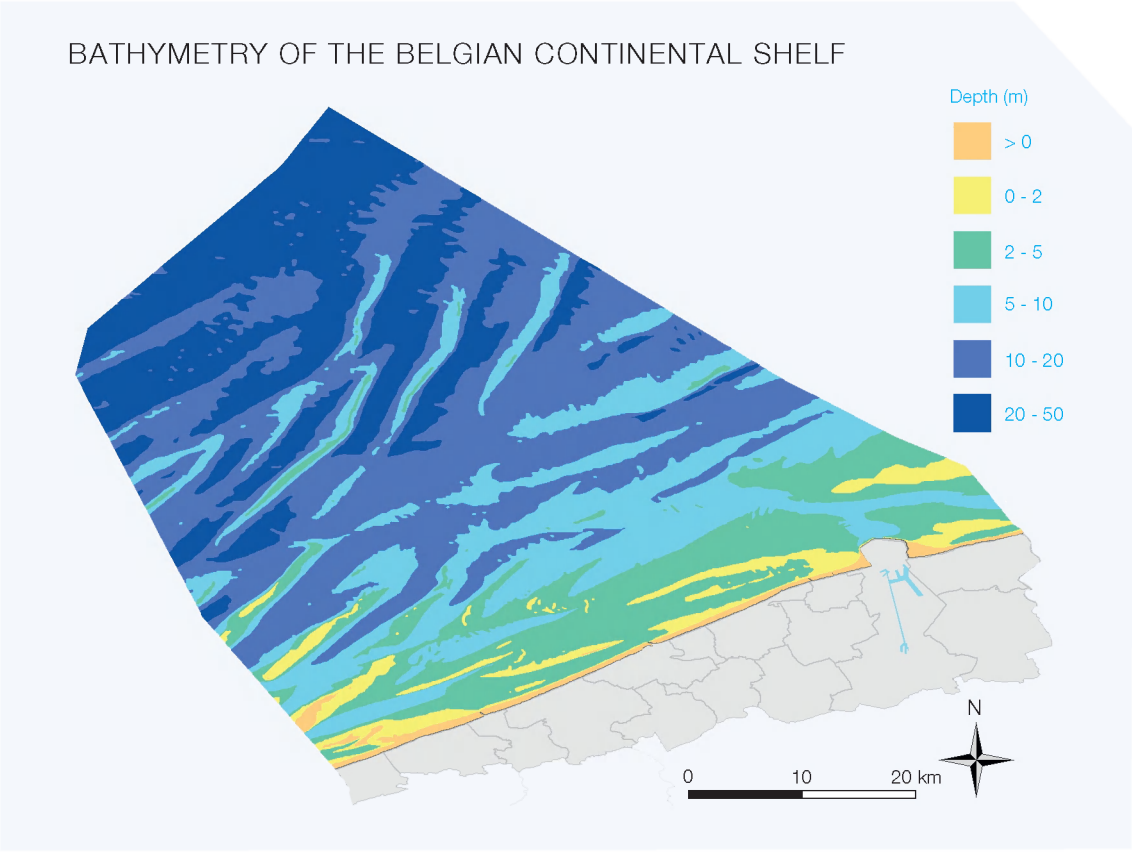

Figure 1. The bathymetry of the Belgian continental shelf (Source: Flemish agency for Maritime Services and Coast).

there is a layer of Tertiary clay that locally surfaces in the gullies (*Lanckeus et al. 2001* [24845] (*BUDGET project BELSPO*), *Le Bot et al. 2003* [41605] (BELSPO), *Mathys 2009* [141685], *Mathys 2010* [144601]). In general, the grain size of the sediment on the seabed increases from silty sediment near the coast over fine to coarse sandy sediment in deeper water (*Verfaillie et al. 2006* [107236], *Van Lancker et al. 2007* [126350] (*MAREBASSE project BELSPO*)).

HYDRODYNAMICS AND SEDIMENT TRANSPORT

The currents in the BNS are dominated by semi-diurnal tides. The tidal amplitude varies between 3 m during neap tide and more than 4.5 m during spring tide, whereby the tidal difference decreases towards the northeast. The tidal currents can reach up to 1.2 m/s and are an important means of sediment transport, although tides caused by wind may also play an important role (*Fettweis & Van den Eynde 2003* [40787], *De Moor 2006* [99123], *Van Lancker et al. 2012* [218318] (*QUEST4D project BELSPO*), *Baeye 2012* [215124]). Along the Belgian coast, a high concentration of suspended sediment occurs resulting in turbidity maximums (*Fettweis & Van den Eynde 2003* [40787], *Fettweis et al. 2007* [115401] (*MOCHA project BELSPO*), *Baeye 2012* [215124]).

Data and information about the hydrographical and meteorological aspects (tides, currents, waves, wind, etc.) of the BNS can be consulted on the website *Flemish Banks Monitoring Network*. Operational models of these hydro-meteo data are available on the *website of the Direction Natural Environment (RBINS)*.

CHARACTERISTICS OF THE SEAWATER

The temperature of the seawater in the BNS varies seasonally between 5°C and 20°C (*Flemish Banks Monitoring Network*). The salinity of the seawater in the BNS is strongly influenced by the rivers Scheldt, Rhine, Seine and Meuse which reduce the salinity of the Atlantic water (salinity 35) entering via the Channel (*Lacroix et al. 2004* [66529]). The carbon chemistry of the seawater undergoes a seasonal variation and affects the acidity of the water with a pH that fluctuates between 7.95 and 8.25 (*Gypens et al. 2011* [211480]). Information about the nutrients and oxygen level of the seawater was assembled *inter alia* in context of the *AMORE* (*AMORE project BELSPO*), *AMORE II* (*AMORE II project BELSPO*) and *AMORE III* (AMORE III project *phase 1* and *phase 2* BELSPO) projects and the monitoring obligations for OSPAR, the *Water Framework Directive* (WFD) and the *Marine Strategy Framework Directive* (MSFD) (see **Policy instruments**). The impact of climate change on the characteristics of the seawater in the BNS is discussed in *Van den Eynde et al. (2011)* [212421], (*CLIMAR project BELSPO*) (see also theme **Safety against flooding**).

A LARGE DIVERSITY OF BENTHIC LIFE

The sandbanks of the BNS are characterised by a very rich benthic life that fulfills an important role in the marine food web. The benthic organisms (benthos) have been intensively studied since 1970 (e.g. *Cattrijsse & Vincx 2001* [13369], *Degraer et al. 2006* [100260], *Degraer et al. 2010* [221235], *TROPHOS project* (*TROPHOS project BELSPO*), *WESTBANKS project* (*WESTBANKS project BELSPO*)). The benthos constitutes an important source of nutrition for fish, prawns and crabs, and is actively involved in the decomposition and transport of organic material. The marine food web largely depends on suspended food particles. Once these particles reach the seabed, they are processed by benthos (by bacteria as well as by other small organisms (bivalves, polychaete worms, crustaceans, nematodes, etc.)) (e.g. *Braeckman et al. 2010* [143590], *Braeckman 2011* [204685]). A complete overview of the species lists is available on the Belgian Register of Marine Species (*BeRMS*, *Vandepitte et al. 2010* [198989]).

On the bottom of the North Sea large numbers of starfish, brittle stars, crabs, lobsters, demersal fish and squids can be observed that are mainly “crawling” (epibenthos) and feed on small animals (*inter alia* larvae of fish, prawns) that are swimming just above the seabed (hyperbenthos). Most species can be found between the sand grains, up to an average depth of 10 cm below the seabed. These are mainly bivalves, polychaete worms, small crustaceans (macrobenthos), nematodes and copepods (meiobenthos). The occurrence of these benthic organisms is not uniform and is related to the physical characteristics of the seabed. Up to 811 species of macrobenthos have been counted in sediment samples (surface of 0.1 m^2), with a total of 150,000 organisms per square meter, in the ‘richer’ areas of the Western Coastal Banks, the Flemish Banks and the Sealand Banks. Each species prefers a certain type of sediment which is in turn determined by the current pattern.

The bottom of the BNS is characterised by (1) geogenic reefs (reefs whose topographical expression is the result of geological features such as the gravel beds of the *Hinderbanken* sandbanks) with a typical fauna that lives on top of the gravel beds (so-called epifauna with e.g. sponges, oysters, bryozoans, sea anemones), by (2) biogenic reefs (e.g. shaped by the worm *Lanice conchilega*) and by (3) soft substrates (ranging from silt to fine or coarse sand). In the soft mobile substrates of the subtidal sandbanks, four general types of macrobenthic communities are to be found: the *Macoma balthica* community, the *Abra alba* (– *Mysella bidentata*) community, the *Nephtys cirrosa* community and the *Ophelia limacina* (– *Glycera lapidum*) community. These communities are characterised by specific species, diversity and density and are found in a specific and well-defined environment (*Degraer et al. 2003* [33863], *Van Hoey et al. 2004* [59829]). Recently, implanted artificial hard substrates have created new possibilities for epifauna. The effects of the structures on the surrounding soft substrates are monitored closely (e.g. *Degraer et al. 2012* [218670]).

THE PELAGIC ECOSYSTEM

The pelagic ecosystem constitutes the largest habitat in the BNS. Unlike the benthic ecosystem, the pelagic ecosystem has been investigated or monitored very little. A PhD study on zooplankton and the diet of pelagic fish (*Van Ginderdeuren 2013* [226261]) shows that Crustacea, and more specifically calanoid copepods (holoplankton), dominate the zooplankton in a community that mainly has a coastal nature but is occasionally influenced by the incoming Atlantic water. *Temora longicornis, Acartia clausi, Paracalanus parvus, Centropages typicus* and *C. hamatus* are the most common calanoids (*Van Ginderdeuren et al. 2012a* [215782]). Also, meroplanktonic larvae (organisms that are planktonic in a certain stage of their life) of polychaetes, echinoderms, fish and barnacles are abundant.

Special attention goes to jellyfish, including the non-indigenous species *Mnemiopsis leidyi*, that has populated the entire Belgian coastal zone (*Van Ginderdeuren et al. 2012b* [215779]). Zooplankton density reaches a maximum a few kilometers off the coast, in the transition zone from coastal to offshore waters. A minimum in the zooplankton density occurs offshore. This is in line with the results of studies on other ecosystem components (demersal fish, epibenthos and macrobenthos), indicating the existence of a zone which is rich in species a few kilometers off the coast of the BNS (*Van Hoey et al. 2004* [59829], *De Backer et al. 2010* [205884]). Phytoplankton is the most important food source of zooplankton. The dynamics of phytoplankton in the southern North Sea are complex, and changes in phytoplankton affect the dynamics of zooplankton. It is important to monitor the problems related to the annual seasonal changes in the phytoplankton composition (*Phaeocystis* blooms) caused by eutrophication and the potential impact of this phenomenon on zooplankton.

Research on pelagic fish has revealed that herring and sprat are common in the BNS, although in low numbers. It mainly concerns immature individuals (0-, 1-year class) in coastal waters. Adult herring can be observed in autumn when the fish are migrating to the spawning areas in the Channel. In summer, two other pelagic species appear, namely mackerel and horse mackerel. Horse mackerel propagates in the BNS and juveniles are abundant in the offshore pelagic fish community (*Van Ginderdeuren et al. 2012a* [215782]).

Thorough knowledge about the spatial and temporal occurrence of zooplankton (food source for higher trophic levels), in relation to the presence of pelagic fish species and their food ecology (what kind of plankton do these fish eat, when and why), is necessary to assess the importance of zooplankton for the fish in the BNS.

THE IMPORTANCE OF THE BELGIAN PART OF THE NORTH SEA FOR BIRDS AND MARINE MAMMALS

The BNS is an important wintering and foraging area for seabirds (*Seys 2001* [20601], *Stienen & Kuijken 2003* [57820], *Haelters et al. 2004* [68414], *Stienen et al. 2007* [111966], *Degraer et al. 2010* [221235]). During the winter months, internationally important numbers (i.e. more than 1% of the biogeographic population) of the grebe *Podiceps cristatus* and the great black-backed gull *Larus marinus* frequently reside here. Furthermore, important numbers of the red-throated loon *Gavia stellata* and the common scoter *Melanitta nigra* are often observed in the BNS and were both included in appendix 1 of the *Birds Directive* (see **Policy instruments**).

On the beach, the groins and piers along the coast, internationally significant numbers of the European herring gull *Larus argentatus* and the ruddy turnstone *Arenaria interpres* regularly rest (*Adriaens & Ameeuw 2008* [189523]). In spring and summer, the coastal zone is an important foraging area for terns that mainly breed in the harbour of Zeebrugge. Three tern species exceed the 1%-limit, namely: the Sandwich tern *Sterna sandvicensis*, the common tern *Sterna hirundo* and the little tern *Sternula albifrons* (*Degraer et al. 2010* [221235]).

Finally, the BNS functions as an important migration corridor which is used by more than a million seabirds. During the migration period, internationally significant numbers (> 1%) of the lesser black-backed gull *Larus fuscus*, the little gull *Hydrocoloeus minutus*, the sandwich tern and the common tern are often found (*Stienen et al. 2007* [111966]).

The Belgian marine waters are important for two types of marine mammals that are discussed in appendix 2 of the *Habitats Directive* (see **Policy instruments**), namely harbour porpoise *Phocoena phocoena* and the harbour seal *Phoca vitulina*. In the period February – April, the numbers of the harbour porpoise in the BNS can rise to more than 1% of the estimated North Sea population (*Degraer et al. 2010* [221235]).

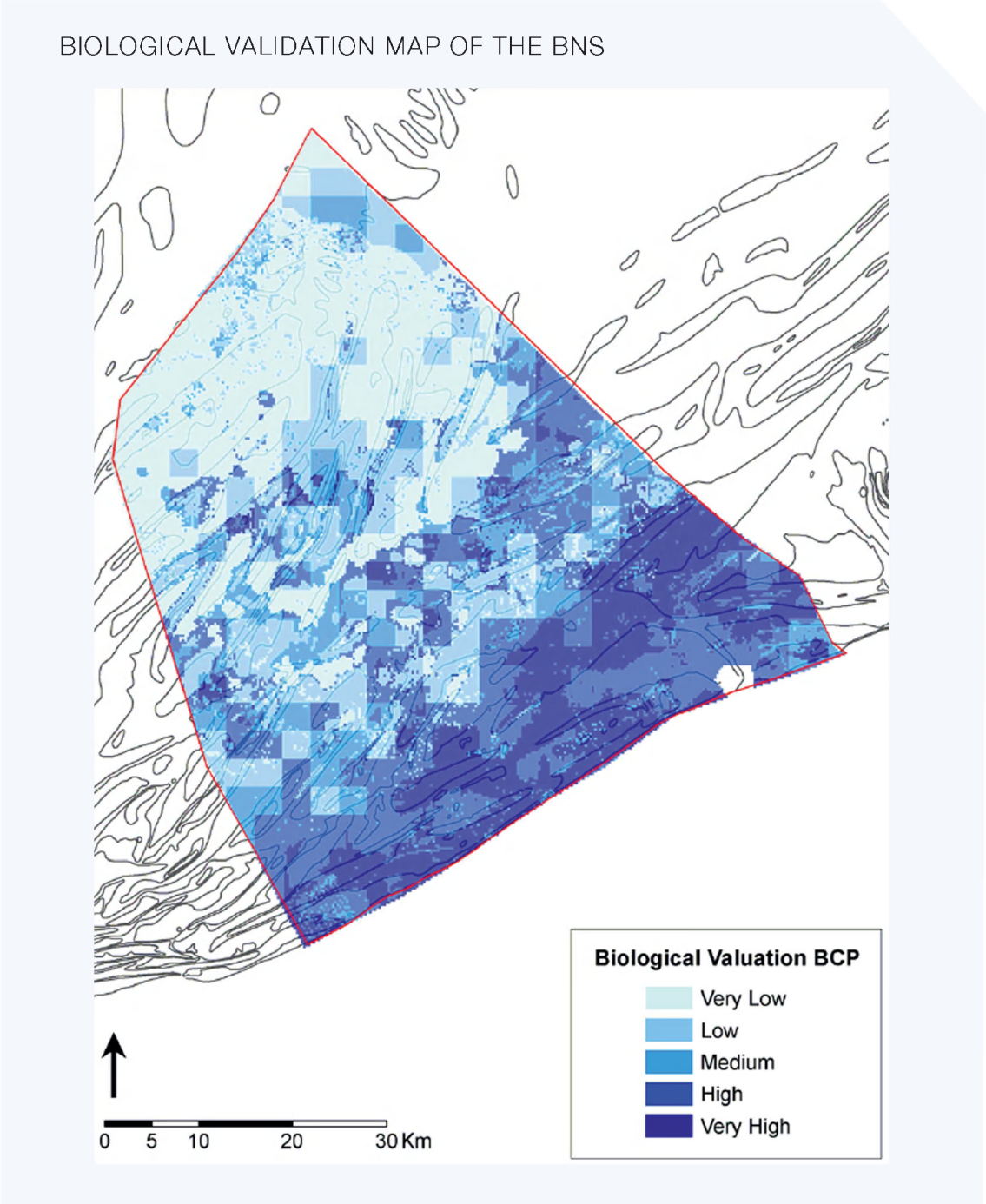

Figure 2. The biological validation map of the BNS, which combines the validation maps of the seabirds, macrobenthos, epibenthos and demersal fish (*Derous et al. 2007* [114316], *BWzee project*, *BELSPO*).

1.2.2 The beach

Beaches are relatively narrow, elongated strips that follow the boundary between land and sea, part of which is alternately situated above and below the water due to changes in the water level. The beaches along the North Sea coast are generally characterised by a micro relief: low, elongated sand ridges separated by shallow trench-shaped depressions (*zwinnen*), as well as other smaller features such as *wallen* and *hoornen*. Waves and currents shape all sorts of ripple marks on the beach. The beach sand along the Belgian coast is characterised by medium to fine quartz sand with a lot of debris from shells. The coast is subject to a semi-diurnal tide with tidal currents almost parallel to the coast. An elaborated overview of the geomorphology, processes and dynamics along the Flemish beach is given in *De Moor (2006)* [99123]. The beach is a unique habitat where large numbers of organisms are present. In *Speybroeck et al. (2005)* [77161] and *Speybroeck et al. (2008)* [122905] an overview is given of the most important habitats, species and their interactions.

Near the land wash, on the dry beach and in the embryonic dunes vascular plants can be found that are generally short living and spread by the sea (the most common species are: European sea rocket *Cakile maritima*, prickly glasswort *Salsola kali* subsp. *kali*, and sea sandwort *Honckenya peploides*). These zones are also the habitat for several terrestrial arthropods (the most common species: the sand hopper *Talitrus saltator* and true flies *Diptera*). Microphybenthos, especially diatoms, constitutes an important primary producer at the Belgian coast. The meio- and macrobenthos on the beach include specific communities such as the *Scolelepis squamata–Eurydice pulchra* community. This beach fauna is an important food source for higher trophic levels of the marine environment, such as young fish (e.g. plaice *Pleuronectes platessa*) and brown shrimps *Crangon crangon*.

Nowadays, birds only breed in the quiet beach reserves of Heist and Lombardsijde (e.g. the little tern *Sternula albifrons*, the common ringed plover *Charadrius hiaticula* and the Kentish plover *Charadrius alexandrinus*). However, the beaches remain an important resting and foraging area for e.g. the sanderling (*Calidris alba*).

1.2.3 Dunes

SAND DYNAMICS, WATER, BIOTA

The dune area of our coast covers a surface of approximately 75 km^2. Pedologically, this zone is characterised by the presence of sand that has been deposited by the wind. These deposits date from the last ice age, but in general they are not older than a few hundred years. The oldest dunes at our coast are situated between Adinkerke and Ghyvelde in the North of France. They originated supposedly 5,000 years ago (*De Ceunynck 1992* [216426], *Provoost & Hoffman 1996* [4588]). Currently, the formation of new dunes has largely stopped but one decade ago, significant eolian sand transport occurred in the Westhoek area and Ter Yde. At this moment, most of the coastal dynamics are limited to the beach ridge.

The age of the dunes determines the degree of decalcification of the sand which is an important ecological determinant (*Ampe 1999* [221389]). Quantitatively, however, the ecological diversity is mainly determined by the soil moisture, which is in turn determined by the dune relief in combination with the hydrology. The complex of soil and vegetation developments and numerous biotic interactions lead to a further differentiation of ecotypes (*Provoost & Hoffman 1996* [4588]). In terms of the European *Habitats Directive* (see **Policy instruments**) it is possible to differentiate 14 more or less natural ecotypes (*Decleer 2007* [114897]).

Six of these ecotypes are intertidal, the others belong to the dunes:

- Embryonic shifting dunes;
- Shifting dunes along the shoreline with European marram grass *Ammophila arenaria* (‘white dunes’);
- Fixed dunes with herbaceous vegetation (‘grey dunes’);
- Atlantic decalcified fixed dunes (*Calluno-Ulicetea*);
- Dunes with sea-buckthorn *Hippophae rhamnoides*;
- Dunes with creeping willow *Salix repens* ssp. *argentea* (*Salicion arenariae*);
- Wooded dunes of the Atlantic, continental and boreal region;
- Humid dune slacks.

In general, half of the species in Flanders can also be found at the coast. The ecological specificity of the dune ecosystem is mainly related to the geomorphological dynamics of the boundary between land and sea, the typical microclimate, the wet-dry gradient and calcareous and decalcified environments.

In the dunes, the typical coastal species can almost all be found in the embryonic shifting dunes, the white dunes and the grey dunes (*Provoost & Bonte 2004* [65548]). In the context of the European *Habitat and Birds Directive* (see **Policy instruments**) the following species deserve special attention:

- Plant species in appendix II: creeping marshwort *Apium repens* and fen orchid *Liparis loeselii*;
- Bats in appendix IX: normal whiskered bat *Myotis mystacinus* and brown long-eared bat *Plecotus auritus*;
- Birds in appendix I: black-crowned night heron *Nycticorax nycticorax*, little egret *Egretta garzetta*, European honey buzzard *Pernis apivorus*, pied avocet *Recurvirostra avosetta*, Kentish plover *Charadrius alexandrinus*, common tern *Sterna hirundo*, little tern *Sternula albifrons*, European nightjar *Caprimulgus europaeus*, middle spotted woodpecker *Dendrocopos medius*, woodlark *Lullula arborea* and bluethroat *Luscinia svecica*;
- Amphibians: Northern crested newt *Triturus cristatus* (appendix II) and natterjack toad *Epidalea calamita* (appendix IV);
- Snails in appendix II: narrow-mouthed whorl snail *Vertigo angustior* and Desmoulin's whorl snail *Vertigo moulinsiana*.

The influence of man on the coastal ecosystem is substantial. Approximately half of the dune area has been urbanised in the last 150 years and the remaining areas have undergone drastic changes of the landscape (*Provoost & Hoffman 1996* [4588]).

1.2.4 Polders and polder complex

'The polders' is the name of a flat rural zone and ecoregion along the coast. This region is characterised by a flat and low-lying landscape with inversion relief, caused by repeated marine floods due to the increasing sea level after the ice ages (*Provoost & Hoffman 1996* [4588], *Baeteman 2007* [109943]). Since the early Middle Ages, the region has no longer been subjected to marine influences as a result of land reclamation. It is also the name of the Habitats Directive Area in the coastal zone which overlaps with the Birds Directive Area 'poldercomplex' (*Ministerial Decree of 17 July 2000*) (see **Policy instruments**).

These special protected areas are designated for 6 European protected habitat types and 21 European protected animal species (*Paelinckx et al. 2009* [186966]). The habitat types are marshes, salt meadows, nutrient-rich herb communities, grasslands, fens and swamp forests. The species for which the Habitats Directive Area has been established are the pond bat *Myotis dasycneme* and the northern crested newt *Triturus cristatus*. For this last species only few recent observations are known.

The Birds Directive Area 'poldercomplex' has been established because the following European protected species breed in this area: Eurasian bittern *Botaurus stellaris*, little bittern *Ixobrychus minutus*, ruff *Philomachus pugnax*, short-eared owl *Asio flammea* and bluethroat *Luscinia svecica*. Also some non-breeding Birds Directive species are relevant for the poldercomplex: red-throaded loon *Gavia stellata*, tundra swan *Cygnus bewickii*, whooper swan *Cygnus cygnus*, lesser white-fronted goose *Anser erythropus*, barnacle goose *Branta leucopsis*, red-breasted goose *Branta ruficollis*, Western marsh harrier *Circus aeruginosus*, hen harrier *Circus cyaneus*, merlin *Falco columbarius*, European golden plover *Pluvialis apricaria*, wood sandpiper *Tringa glareola* and common kingfisher *Alcedo atthis* (*Courtens & Kuijken 2004* [157811]). The 'poldercomplex' has also been established because during winter months significant numbers of geese stay in this area. The pink-footed goose and the greater white-fronted goose annually exceed the 1%-limit (*Wetlands International 2006 – Waterbird Population Estimates*).

1.3 Ecosystem goods and services

The Millennium Ecosystem Assessment (*MEA 2005*) describes ecosystem services as the benefits humans obtain from the ecosystem. They can be divided into goods, regulatory services, cultural services and supporting services. The concept of ecosystem services has been elaborated to also include the economic aspects of the ecosystem (*The Economics of Ecosystems and Biodiversity*, *TEEB*). The average economic value of the services the marine and coastal ecosystems deliver has been estimated by *Costanza et al. (1997)* [68152] to be 252 and 4,052 dollars per hectare per year respectively. The demarcation of marine protected areas in 20 to 30% of all seas would create 1 million jobs worldwide (*Balmford et al. 2004* [200795]). This equals an estimated yield of 294 billion euros (compared to a cost of up to 15 billion euros in protection measures) (*Seys 2006* [100250], *Slabbinck et al. 2008* [127551]).

The *BEES project* tries to map the ecosystem services in Belgium. *Jacobs et al. (2010)* published the first inventory of the ecosystem services (and potential ecosystem profits) of Flanders. Nature valuation studies are available on the

LNE website and in *Hutsebaut et al. (2007)* [178762], whereas the *calculation instrument 'Natuurwaardeverkenner'* has been developed as a support for the quantification and economic estimation of the ecosystem services in a social cost-benefit analysis or other evaluations of (infrastructure) projects with an impact on nature (more information: *Liekens et al. 2009* [225433], *Liekens et al. 2010* [225437]).

Only a few studies on this topic are available for the BNS at this moment. An overview of types of goods and services that are delivered by marine biodiversity can be find in *Beaumont et al. 2007* [108529] and in the context of the *MSFD* a *socio-economic analysis of the users of the BNS (2012)* [220231] has been elaborated.

1.4 The impact on the marine and coastal environment

The marine and coastal environment, described above, is the scene of various human activities that each have a specific impact on the environment. In a number of reports, an overview of the activities and the associated impact is provided: *Maes et al. (2004)* [70936] (*MARE-DASM project BELSPO*), *Maes et al. (2005)* [78279] (*GAUFRE-BELSPO*), *Goffin et al. (2007)* [114225], *André et al. (2010)* [200613], *Initiële beoordeling van de staat van het mariene milieu (2012)* [220230]. Besides these integrated reports, numerous studies exist on the (specific) impact of a specific user function. These publications are discussed in the texts of the different user functions under the section 'impact'. In table 1, a list of the various theme texts of the Compendium for Coast and Sea is given, in which information sources on a specific impact can be found. This table does not provide an exhaustive overview of the impacts on the marine and coastal environment but serves as a readers' guide.

Table 1. Overview of which type of impact is discussed in the theme texts of the Compendium for Coast and Sea.

IMPACT	THEME TEXTS
Impact on air quality	Maritime transport, shipping and ports; Tourism and recreation; Fisheries; Agriculture; Sand and gravel extraction; Safety against flooding; Energy (incl. cables and pipelines)
Impact on the pelagic ecosystem (eutrophication, pollution, etc.)	Energy (incl. cables and pipelines); Agriculture; Tourism and recreation; Aquaculture; Maritime transport, shipping and ports; Military use; Dredging and dumping
Impact on fish stocks	Fisheries; Aquaculture; Tourism and recreation; Energy (incl. cables and pipelines)
Impact on seabirds and marine mammals	Energy (incl. cables and pipelines); Maritime transport, shipping and ports; Fisheries; Aquaculture; Military use
Impact on the seabed / habitats	Sand and gravel extraction; Dredging and dumping; Energy (incl. cables and pipelines); Military use; Safety against flooding; Fisheries; Aquaculture; Agriculture
Impact on hydrographical characteristics	Energy (incl. cables and pipelines); Maritime transport, shipping and ports; Military use; Safety against flooding; Aquaculture; Dredging and dumping; Sand and gravel extraction
Impact on spatial use (incl. Impact on nature area)	Social and economic environment; Tourism and recreation; Energy (incl. cables and pipelines); Fisheries; Aquaculture; Agriculture; Safety against flooding; Sand and gravel extraction; Maritime transport, shipping and ports
Impact on beaches and dunes	Tourism and recreation; Safety against flooding
Impact on groundwater	Tourism and recreation; Agriculture; Safety against flooding

1.5 Protection of the marine environment

1.5.1 Policy context: administrations and organisations

The environmental policy concerning the coast and sea is directed by several international, European and regional organisations. The International Maritime Organization (*IMO*) of the United Nations (*UN*) is a specialised agency responsible for the safety and security of shipping and the prevention of marine pollution caused by ships. The United

Nations Environment Programme (*UNEP*) aims to coordinate the development of the environmental policy on a global and regional level by bringing the environment to the attention of the governments and international community and by signaling new points of interest.

On the European level, the Environment Directorate-General (*DG Environment*) of the European Commission (EC) aims to protect, maintain and reinforce the European environment. The Directorate-General for Maritime Affairs and Fisheries (*DG MARE*) of the EC is competent for two policy domains: the Common Fisheries Policy (*CFP*) (see theme **Fisheries**) and the Integrated Maritime Policy (*IMP*). The *IMP* intends to provide an integrated answer to the current challenges of the European Seas: marine pollution, environmental protection, coastal development, job creation, etc. The European Environment Agency (*EEA*) of the European Union provides reliable and objective information about the environment to everyone, involved or interested in environmental policy. In the *OSPAR commission*, 15 countries from Western Europe (including Belgium) work together to protect the marine environment of the Northeast Atlantic Ocean.

In Belgium, the *Marine Environment Department* of the FPS Public Health, Safety of the Food Chain and Environment is competent for the environmental policy of the BNS. The department also presides the Advisory Commission for Marine Spatial Planning (*Royal Decree of 13 November 2012*). The scientific and technical support for the marine environmental policy is provided by the Management Unit of the North Sea Mathematical Models (*MUMM*) of the Royal Institute of Natural Sciences (*RBINS*). With regard to sand and gravel extraction, the *Continental Shelf Service* of the FPS Economy, SMEs, Self-Employed and Energy is the competent authority. The *policy document (2013)* [226455] of the minister of Economics, Consumers and North Sea stipulates the current North Sea policy.

All aspects of the environmental policy on the coast (landward from the baseline) are an exclusive competence of Flanders (*Dienst Communicatie en Informatie van het Departement LNE 2010* [208287]). The environmental policy to be executed by the Flemish Region as well as by the provinces and municipalities in matters of regional interest is outlined in the environmental policy plan (*Vlaamse Regering 2011* [208288], *Dienst Communicatie en Informatie van het Departement LNE 2010* [208287]). The Environment, Nature and Energy department (*LNE*) plays a key part in the environmental administration. The department is responsible for planning and evaluating the environmental policy in compliance with economic and social demands and for the coordination of all environmental actors as well as the implementation and enforcement of the environmental legislation in Flanders. Other important players within the LNE department are the Agency for Nature and Forest (*ANB*), the Research Institute for Nature and Forest (*INBO*), the Flemish Agency for Energy (*VEA*), the Public Waste Agency of Flanders (*OVAM*), the Flemish Environment Agency (*VMM*), the Flemish Land Agency (*VLM*) and the Flemish Regulator of the Electricity and Gas market (*VREG*) (*website LNE 2011*).

The *Province of West Flanders* fulfils an intermediary function between the regions and municipalities and has competences with regard to the *environment* as it is responsible for the coordination of an integrated water policy and the management of the provincial domains and green axes.

The municipal environmental services are competent for the treatment of complaints concerning the environment and nature, nature preservation, monitoring and advice about environmental permits, waste management, environmental policy planning, development of a sustainable policy and awareness raising on the themes of nature, environment and sustainability amongst the citizens and other target groups (*website LNE*).

1.5.2 Policy instruments

The intense activities in the sea and the coastal zone have led to an elaborated package of legislations and regulations with the aim of mitigating, reducing or avoiding the impact of certain user functions on the environment. These mostly sectoral legislations and regulations are discussed in the theme texts of the relevant user functions in the topics '**Policy context**' and '**Sustainable use**'. A selection of these nature and environment related legislations and regulations are given in **Chapter 3** of the Compendium. Besides, a selection of the most relevant nature and environment related policy instruments for the BNS and the coastal zone is given below.

RAMSAR CONVENTION

The *Ramsar Convention* (Ramsar, Iran, 1971) is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources (*Goffin et*

al. 2007 [114225]). The convention attempts to achieve the protection of sustainable use of wetlands of international importance (incl. marine waters of which the water depth during ebb tide is less than 6 meters) by means of local and national measures and international cooperation.

OSPAR CONVENTION

The *OSPAR Convention* constitutes an overarching legal framework for the protection of the marine environment of the Northeast Atlantic Ocean. The OSPAR convention replaces the Convention of Oslo (1972) and the Convention of Paris (1974). The convention contains general regulations on the protection of the marine environment from specific sources of pollution, such as pollution from land by disposal or combustion and by offshore activities. Furthermore, agreements on the evaluation of the quality of the marine environment (*OSPAR QSR 2010* [198817]) and the protection and preservation of the ecosystems and biological diversity are part of the OSPAR Convention (*Goffin et al. 2007* [114225]).

THE MARINE STRATEGY FRAMEWORK DIRECTIVE

The European *Marine Strategy Framework Directive* (MSFD) (*Directive 2008/56/EG*) is the environmental pillar of the *Integrated Maritime Policy* (IMP) (*COM (2007) 575*) of the European Union (EU). The *MSFD* intends to achieve the Good Environmental Status (GES) of the European marine waters by 2020 as well as the protection of the resources on which economic and social activities depend. The GES is described in article 9 of this directive based upon 11 descriptors (see table 2). The Member States need to define indicators and associated target values for each of these descriptors (*DG Leefmilieu 2012* [216779]). The EU supports the Member States by developing methodologies for these indicators and by giving scientific advice per descriptor (see table 2). Based on these scientific advices, a decision (*2010/477/EU*) has been published which further elaborates the criteria and methodological standards for the implementation of the *MSFD* and the determination of the GES in marine waters.

In the context of the implementation of the *MSFD* in the BNS (*Royal Decree of 23 June 2010 - Marine Strategy*), Belgium drafted an initial assessment of the state of the marine waters (*initiële beoordeling van de staat van het mariene milieu (2012)* [220230]), including a socio-economic analysis of the users of the BNS (*socio-economische analyse van de gebruikers van het BNZ (2012)* [220231]). Furthermore, a document with the description of the GES and the environmental targets for the BNS was published (*Omschrijving van de Goede Milieutoestand & vaststelling van Milieudoelen* [220232]) (more information: *website Marine Environment Department*). Based on this document, *MUMM* is developing a monitoring programme (July 2014) that enables the measurement of the evolution and condition of the environment. The Marine Environment Department will subsequently coordinate the development of a programme of measures by July 2015. Every six years (2018, 2024, etc.), a revision should be performed based on the results of the monitoring programme and the programme of measures (*DG Leefmilieu 2012* [216779]).

WATER FRAMEWORK DIRECTIVE

The European *Water Framework Directive* (WFD) (*Directive 2000/60/EG*) stipulates that all European 'natural' surface waters should achieve a good ecological (GES) and good chemical status (GCS) by 2015. For 'heavily modified' or 'artificial' water bodies[1], the ecological targets are adapted and 'good ecological potential' (GEP) is used. The deadline (2015) to achieve these objectives can be extended (under certain conditions) up to a maximum of two adjustments of the river basin management plan (2021/2027). With regard to the GES, the *WFD* applies to 1 nautical mile seaward from the low tide mark and up to 12 nautical miles seaward from the low tide mark for the GCS (*Coördinatiecommissie Integraal Waterbeleid 2010* [131912], *FOD Volksgezondheid, Veiligheid van de Voedselketen en Leefmilieu 2009* [196140]).

The GES needs to be described by 5 biological quality elements: phytoplankton, aquatic flora, benthic invertebrate fauna and fish fauna (in transitional waters). The thresholds between the two most important ecological status classes (very good/good and good/average) are documented in a decision. If the target value between the good and average status is not achieved, measures to improve the environmental status need to be taken. The thresholds for polluting chemical substances are stipulated in *directive 2008/105/EC*.

1 Artificial water bodies have been created by humans in places where no natural water body was present. A heavily modified water body is a natural water body that has changed significantly due to human activity.

Table 2. An overview of the 11 descriptors, and the associated technical reports, of the *MSFD*.

1	Biological diversity	*Cochrane et al. (2010)* [202484]
2	Non-indigenous species	*Olenin et al. (2010)* [202485]
3	Commercially exploited fish and shellfish	*Piet et al. (2010)* [202482]
4	Food webs	*Rogers et al. (2010)* [202488]
5	Eutrophication	*Ferreira et al. (2010)* [199550]
6	Seafloor integrity	*Rice et al. (2010)* [202490]
7	Hydrographical features	
8	Contaminants and pollution effects	*Law et al. (2010)* [202492]
9	Contaminants in fish and other seafood	*Swartenbroux et al. (2010)* [199553]
10	Marine litter	*Galgani et al. (2010)* [199555]
11	Underwater noise and other forms of energy	*Tasker et al. (2010)* [202493]

To achieve the objectives of the *WFD*, the Member States need to develop river basin management plans every six years. The first plans were drafted in 2009. The next version of the management plans is due by the end of 2015 (more information: *tijdsschema en werkschema tweede generatie stroomgebiedbeheerplannen 2012* [226461]). All surface waters of the coastal zone belong to the international River Basin District of the Scheldt: in accordance with the competences of the Flemish and federal government, the river basin management plans are divided into a river basin management plan for the Scheldt (*Coördinatiecommissie Integraal Waterbeleid 2010* [131912]) and a river basin management plan for the Belgian coastal waters (*FOD Volksgezondheid, Veiligheid van de Voedselketen en Leefmilieu 2009* [196140]).

Coordination between the competent authorities of the River Basin District (The Netherlands, France, the three regions and the federal government of Belgium) takes place in the International Scheldt Commission (*ISC*) and at the Belgian level in the Coordination Committee for International Environmental Policy (*CCIEP*).

The implementation of the *WFD* is guaranteed by the *Royal Decree of 23 June 2010* for the federal legislation and by the *Decree of 18 July 2003* for the Flemish legislation.

HABITATS DIRECTIVE

The European *Habitats Directive* (*Directive 92/43/EEC*) aims to maintain and repair the threatened European natural habitats and wild fauna and flora. The Member States need to designate special protection areas (Habitats Directive Areas) for some habitats and species of European importance, listed in the annexes I and II of the directive. These Habitats Directive Areas constitute together with the Bird Directive Areas, the European Ecological *Natura 2000 Network*.

The aim is to achieve a favourable conservation status for the habitats listed in annex I and for the species in annex II and IV of this directive. The conservation status is determined by means of scientifically underpinned conservation objectives.

According to the *Habitats Directive* (art. 17), the Member States are obligated to report every six years to the EC about the conservation status of the habitat types and species as well as about the results of the conducted policy. The next reporting in the framework of the *Habitats Directive* is the period 2007-2012. The conservation objectives of the marine Natura 2000 areas are not yet determined (*Raeymaekers 2011* [208734]). A proposal for the objectives for the protected species and habitats of the BNS has been elaborated by *Degraer et al. (2010)* [221235]. For the landward side, the conservation status of the species and habitats of European importance was reported for the first time in Belgium in 2007 (*Dumortier et al. 2007* [123132]).

BIRDS DIRECTIVE

The European *Birds Directive* (*Directive 2009/1147/EG*) aims at the protection of all wild bird species. Special protection measures have been taken for the habitats of the bird species from annex I and all species that occur in certain areas in internationally significant numbers as breeding bird, migratory bird or winter bird. Each Member State needs to designate special protection areas ('Bird Directive Areas') that are part of the European Ecological *Natura 2000 Network*. According to the *Birds Directive* (art. 12), the Member States are obligated to report every six years about the conservation status of the species and the results of the conducted policy to the EC. The next reporting in the framework of the *Birds Directive* covers the period 2008-2012. An official report directed towards Europe about the status of these bird species compared to the conservation objectives, has not yet been published. In *Paelinckx et al. (2009)* [186966] and *Degraer et al. (2010)* [221235], the conservation of the bird species of the *Birds Directive* at the level of Flanders and the North Sea has already been described in support of the determination of the conservation objectives.

The implementation of the *Habitats* and *Birds Directives* in the federal legislation has been provided by several decrees of the *law of 20 January 1999*: e.g. the *Royal Decree of 21 December 2001*, the *Royal Decree of 14 October 2005* and the *Royal Decree of 5 March 2006*.

MARINE ENVIRONMENT LAW

The *Marine Environment law* (*law of 20 January 1999*) intends to maintain the nature, the biodiversity and the integral character of the marine environment by means of protection measures (*inter alia* the demarcation of marine protected areas) and by means of measures to repair environmental damage. In addition to the prohibition of some activities, this law has introduced objective liability in case of damage and environmental disturbance (*Goffin et al. 2007* [114225]). Since 20 July 2012, this law has also outlined the organisation and procedure of the marine spatial plan. Furthermore, the law stipulates which activities are subject to a permit or authorisation of the competent minister and associated environmental impact assessment.

DECREE OF THE DUNES - FLEMISH ECOLOGICAL NETWORK - SPATIAL IMPLEMENTATION PLANS

Besides the already mentioned *Ramsar Convention* and the *Habitats* and *Birds Directives*, other policy instruments for the protection of nature areas in the coastal zone are of importance. At the Flemish level, the *Decree of 21 October 1997* on nature preservation and the natural environment provides direction to the overall objectives of the nature policy and the elaboration of policy instruments with regard to species as well as certain areas. The spatial basis of these instruments is constituted by the regional spatial plans of the seventies. In the context of the Decree of the Dunes (Chapter 9 *law of 12 July 1973*) additional areas were protected, either as 'protected dune area' or as 'agricultural area important for the dune area' (*Provoost 1999* [127133]).

The Flemish Ecological Network (*FEN*) comprises current valuable nature in Flanders, supplemented with areas with a high nature potential or nature corridor. In these areas, nature is additionally protected and users and owners receive extra instruments and opportunities to help building a nature- and human-friendly environment. For the FEN-areas, nature policy plans (*natuurrichtplannen* (*NRP*)) have been elaborated in which measures suited to the area have been agreed upon, in addition to general protection regulations (e.g. *NRP Duinen van de Middenkust tussen Oostende en Blankenberge 2007* [121758]).

Finally, space for nature development is provided by spatial planning through the demarcation of natural structure in the spatial structural plans (*Ruimtelijk Structuurplan Vlaanderen* [214774], *Provinciaal Ruimtelijk Structuurplan West-Vlaanderen* [57831]), subsequently implemented as spatial implementation plans (formerly: regional spatial plans).

1.5.3 Protected areas

Belgium has several statutes for the protection of nature areas in the coastal and marine zone: Wetlands or Ramsar areas, Natura 2000 areas, Flemish and Recognised Nature Reserves, Forest Reserves, areas of the Decree of the Dunes, Protected Landscapes and the Flemish Ecological Network (FEN) (see **Policy instruments**). It often occurs that 2 or more of the mentioned regulations overlap each other. More than 1,200 km² or about 36% of the BNS has been designated as a marine protected area (see table 3).

Table 3. An overview of the protected areas, their surface, status and associated legislation (Source: *Raeymaekers 2011* [208734]).

PROTECTED AREAS IN THE BNS			
Protected area	Surface	Status	Legislation
Special Protection Area SBZ-1 (*Birds Directive*)	110.01 km²	• Policy plan available (*Beleidsplan* [196133]) • Conservation objectives to be determined (scientific advice: *Degraer et al. 2010* [221235]) • Management plan to be determined	*Royal Decree of 14 October 2005 - speciale beschermingszones en speciale zones voor natuurbehoud*
Special Protection Area SBZ-2 (*Birds Directive*)	144.80 km²	• Policy plan available (*Beleidsplan* [196133]) • Conservation objectives to be determined (scientific advice: *Degraer et al. 2010* [221235]) • Management plan to be determined	
Special Protection Area SBZ-3 (*Birds Directive*)	57.71 km²	• Policy plan available (*Beleidsplan* [196133]) • Conservation objectives to be determined (scientific advice: *Degraer et al. 2010* [221235]) • Management plan to be determined	
Special Protection Area H1 Tapegeer-Stroombank (*Habitats Directive*)	181.00 km²	• Policy plan available (*Beleidsplan* [196133]) • Conservation objectives to be determined (scientific advice: *Degraer et al. 2010* [221235]) • Management plan to be determined	
Special Protection Area H2 Vlakte van de Raan (*Habitats Directive*)	19.17 km²	• Designation as Habitats Directive Area annulled • Definitive designation as Natura 2000 zone	
Special Protection Area 'Flemish Banks' (*Habitats Directive*)	1,099.939 km²	• Expansion of the area 'Trapegeer-Stroombank' • Study of demarcation of the area: *Degraer et al. (2009)* [143363] • Registered at the EC as "Site of Community Importance"	*Royal Decree of 16 October 2012*
Marine Reserve	6.76 km²	• Policy plan available (*Beleidsplan* [196133])	*Royal Decree of 5 March 2006*
Ramsar site Western Coastal Banks	19 km² (*list Ramsar areas*)		

The draft of the Marine Spatial Plan (*Ontwerp van koninklijk besluit tot vaststelling van het marien ruimtelijk plan (2013)* [227527]), as proposed by the Minister in charge of the North Sea, further elaborates on the protection of the environment. Certain restrictions are imposed on seabed-disturbing activities in sensitive zones of the Habitats Directive Area 'Flemish Banks' such as sand and gravel extraction (see theme **Sand and gravel extraction**), recreational and commercial fisheries (see theme **Fisheries**). In addition, the draft of the marine spatial plan also mentions opportunities for the multiple use of space with a view to nature protection or development (more information: *actieplan Zeehond*).

Approximately 22% of the surface of the coastal communities is protected by some kind of nature preservation. This share is higher compared to the hinterland (± 16%) and Flanders (± 14%) (*Maelfait et al. 2012* [221016]).

The remaining ecologically valuable dune areas, with a total surface of approximately 2,830 ha are almost entirely protected. Only 5% of these domains do not belong to green areas of the regional spatial plan or to 'higher' protection statutes (protected dune area, nature protocol for military domains or nature reserves). It mainly concerns inner-

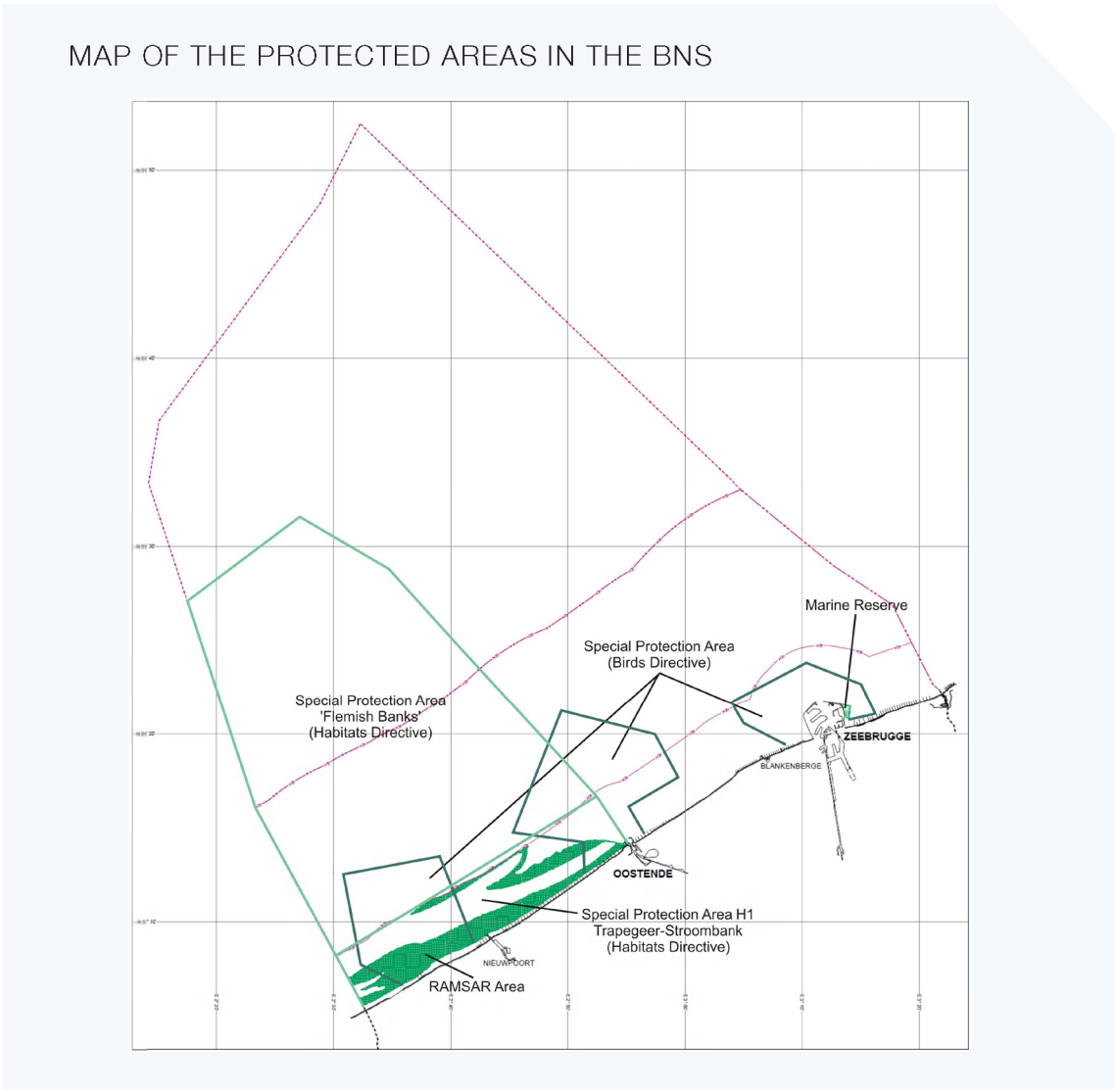

Figure 3. A map of the protected areas in the BNS (Source: *Continentaal Plat & Vlaamse Hydrografie 2013*).

dune areas and areas at the edge of the dunes, e.g. at Cabour (old dunes of Adinkerke), Sandeshoved and Oude Hazegraspolder at Knokke. However, these areas have been marked as special protection areas and belong to the 'agricultural area important for the dune area' of the Decree of the Dunes (Chapter 9 *law of 12 July 1973*) (*Dumortier et al. 2003* [36508]).

These statutes only provide spatial protection, but do not guarantee that the present nature values are preserved. This usually requires active nature management (*Maelfait et al. 2012* [221016]). The *Decree of 21 October 1997* is a suitable legal framework that provides the designation of nature reserves and the drafting of management plans.

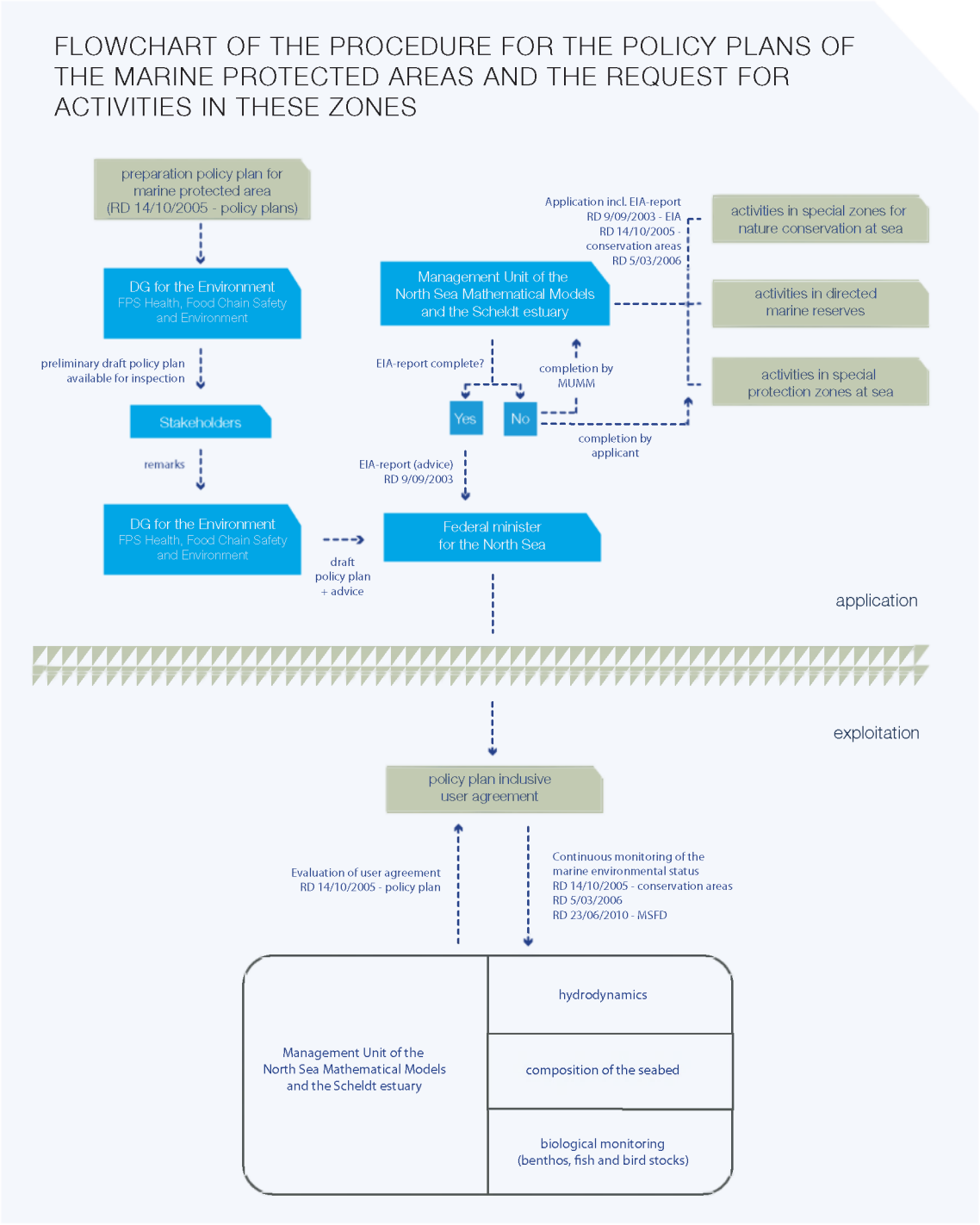

Figure 4. Flowchart of the procedure for the policy plans of the marine protected areas and the request for activities in these zones (*law of 20 January 1999*). The prohibited activities in the different types of protected areas are listed in the *Royal Decree of 14 October 2005* and the *Royal Decree of 5 March 2006*.

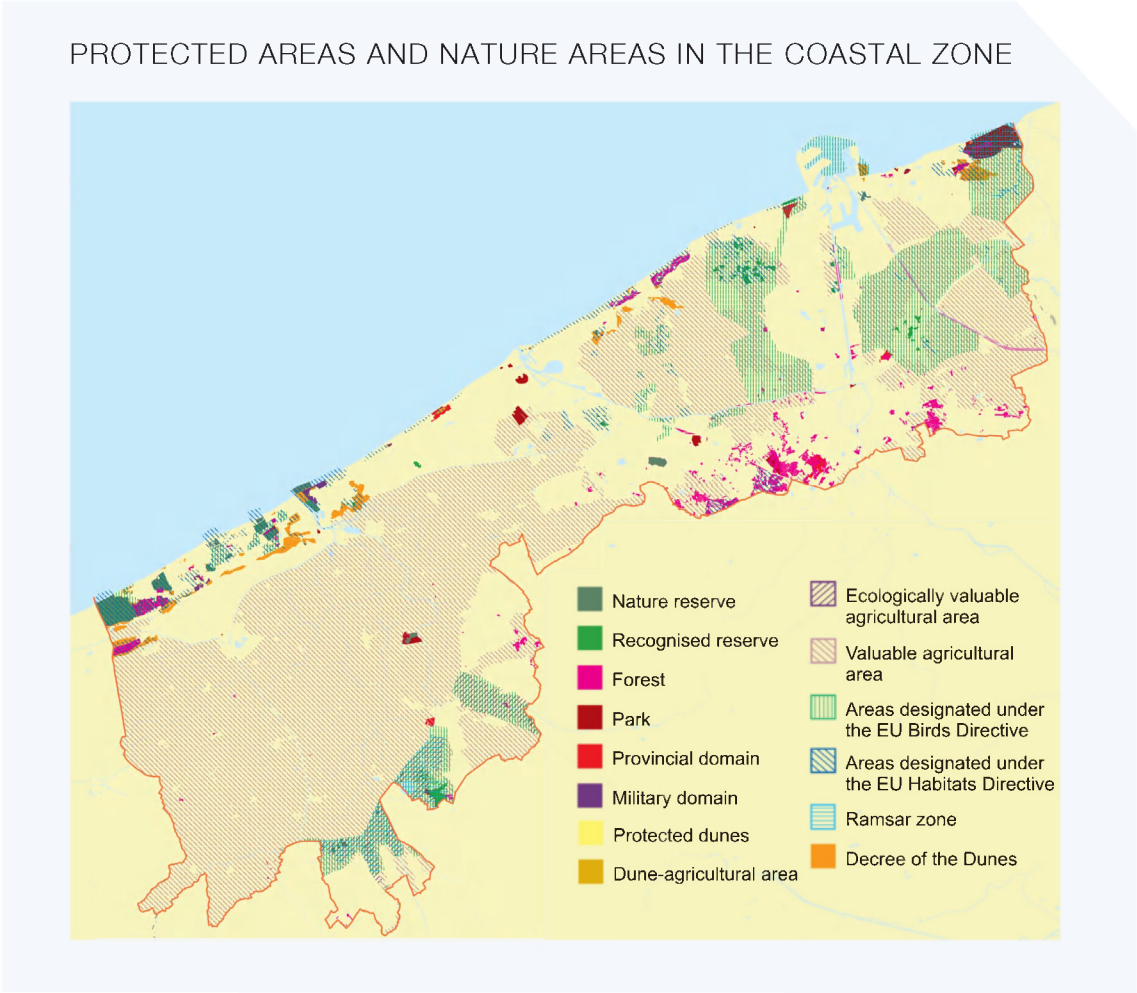

Figure 5. Protected areas and nature areas in the coastal zone (Source: *Coastal Atlas*).

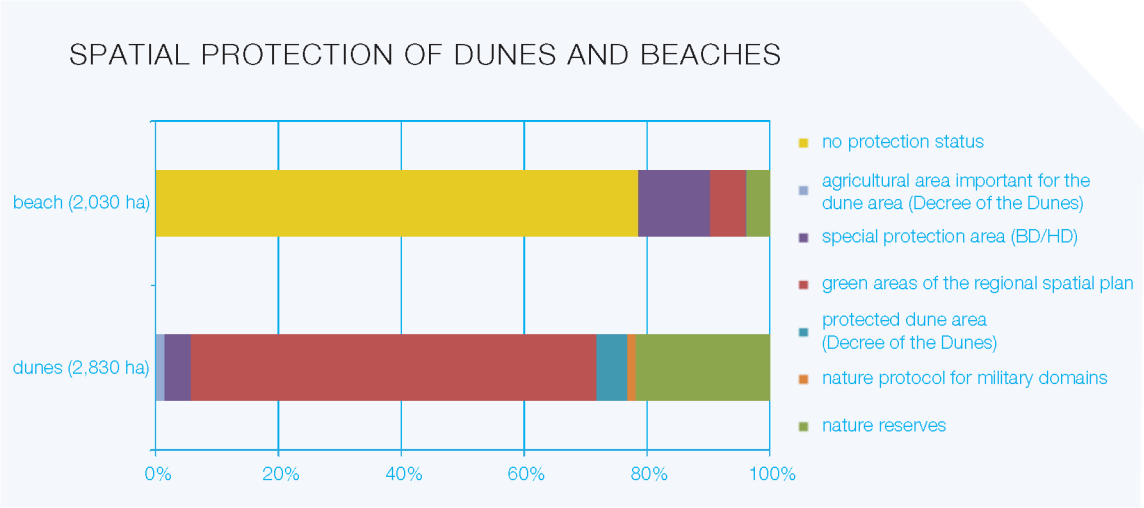

Figure 6. Spatial protection of the ecologically valuable dune ecotypes and beaches according to the different statutes for nature preservation (*Dumortier et al. 2003* [36508]).

Legislation reference list

Table with international agreements, conventions, etc.

INTERNATIONAL AGREEMENTS, CONVENTIONS, ...			
Abbreviations (if available)	Title	Year of conclusion	Year of entering into force
Ramsar Convention	Convention on Wetlands of International Importance especially as Waterfowl Habitat	1971	1975
OSPAR Convention	Convention for the protection of the Marine Environment of the North-East Atlantic	1992	1998

Table with European legislation. The consolidated version of this legislation is available on *Eurlex*.

EUROPEAN LEGISLATION			
Abbreviations (if available)	Title	Year	Number
Directives			
Habitats Directive	Directive on the conservation of natural habitats and of wild fauna and flora	1992	43
Water Framework Directive	Directive establishing a framework for Community action in the field of water policy	2000	60
Marine Strategy Framework Directive	Directive establishing a framework for Community action in the field of marine environmental policy (Marine Strategy Framework Directive)	2008	56
	Directive on environmental quality standards in the field of water policy, amending and subsequently repealing Council Directives 82/176/EEC, 83/513/EEC, 84/156/EEC, 84/491/EEC, 86/280/EEC and amending Directive 2000/60/EC of the European Parliament and of the Council	2008	105
Birds Directive	Directive on the conservation of wild birds	2009	147
Other (Decisions, Communications, White Papers, etc.)			
Integrated Maritime Policy	Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions - An Integrated Maritime Policy for the European Union	2007	575
	Commission Decision of 1 September 2010 on criteria and methodological standards on good environmental status of marine waters	2010	477

Table with Belgian and Flemish legislation. The consolidated version of this legislation is available on *Belgisch staatsblad* and the *Justel-databanken*.

BELGIAN AND FLEMISH LEGISLATION	
Date	Title
Laws	
Wet van 12 juli 1973	Wet op het natuurbehoud: Vlaamse Gewest
Wet van 20 januari 1999	Wet ter bescherming van het mariene milieu en ter organisatie van de mariene ruimtelijke planning in de zeegebieden onder de rechtsbevoegdheid van België
Royal Decrees	
KB van 21 december 2001	Koninklijk besluit betreffende de soortenbescherming in de zeegebieden onder de rechtsbevoegdheid van België
KB van 14 oktober 2005 – speciale beschermingszones en speciale zones voor natuurbehoud	Koninklijk besluit tot instelling van speciale beschermingszones en speciale zones voor natuurbehoud in de zeegebieden onder de rechtsbevoegdheid van België
KB van 14 oktober 2005 – gebruikers-overeenkomsten en beleidsplannen	Koninklijk besluit betreffende de voorwaarden, sluiting, uitvoering en beëindiging van gebruikersovereenkomsten en het opstellen van beleidsplannen voor de beschermde mariene gebieden in de zeegebieden onder de rechtsbevoegdheid van België.
KB van 5 maart 2006	Koninklijk besluit tot instelling van een gericht marien reservaat in de zeegebieden onder de rechtsbevoegdheid van België en tot wijziging van het koninklijk besluit van 14 oktober 2005 tot instelling van speciale beschermingszones en speciale zones voor natuurbehoud in de zeegebieden onder de rechtsbevoegdheid van België
KB van 23 juni 2010 – oppervlaktewa-tertoestand	Koninklijk besluit betreffende de vaststelling van een kader voor het bereiken van een goede oppervlaktewatertoestand
KB van 23 juni 2010 – mariene strategie	Koninklijk besluit betreffende de mariene strategie voor de Belgische zeegebieden
KB van 16 oktober 2012	Koninklijk besluit van 16 oktober 2012 tot wijziging van het koninklijk besluit van 14 oktober 2005 tot instelling van speciale beschermingszones en speciale zones voor natuurbehoud in de zeegebieden onder de rechtsbevoegdheid van België.
KB van 13 november 2012	Koninklijk besluit betreffende de instelling van een raadgevende commissie en de procedure tot aanneming van een marien ruimtelijk plan in de Belgische zeegebieden
Decrees	
Decreet van 14 juli 1993	Decreet houdende maatregelen tot bescherming van kustduinen
Decreet van 21 oktober 1997	Decreet betreffende het natuurbehoud en het natuurlijk milieu
Decreet van 18 juli 2003	Decreet betreffende het integraal waterbeleid
Other	
Besluit van de Vlaamse regering van 17 juli 2000	Besluit van de Vlaamse regering tot wijziging van het besluit van de Vlaamse regering van 17 oktober 1988 tot aanwijzing van speciale beschermingszones in de zin van artikel 4 van de richtlijn 79/409/EEG van de Raad van de Europese Gemeenschappen van 2 april 1979 inzake het behoud van de vogelstand betreffende de speciale beschermingszone «3.2. Poldercomplex»
Besluit van de Vlaamse regering van 24 mei 2002	Besluit van de Vlaamse regering tot vaststelling van de gebieden die in uitvoering van artikel 4, lid 1, van Richtlijn 92/43/EEG van de Raad van de Europese Gemeenschappen van 21 mei 1992 inzake de instandhouding van de natuurlijke habitats en de wilde flora en fauna aan de Europese Commissie zijn voorgesteld als speciale beschermingszones

2 Maritime transport, shipping and ports

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Neyts, D., Maes, F., Merckx, J.P., Pirlet, H., 2013. Maritime transport, shipping and ports. In: Lescrauwaet, A.K., Pirlet, H., Verleye, T., Mees, J., Herman, R. (Eds.), Compendium for Coast and Sea 2013: integrating knowledge on the socio-economic, environmental and institutional aspects of the Coast and Sea in Flanders and Belgium. Oostende, Belgium, p. 93-112.

Currently, more than 90% of the globally traded goods are transported by sea. In 2010, 8.4 billion tons of goods were transported by sea-going ships. By the end of 2010, the world merchant fleet consisted of 104,304 ships (over 100 GT), equalling a total of 1,043.01 million GT (*International Shipping facts and figures, IMO 2012* [225485]). In 2009, the merchant fleet of the European Union (EU) consisted of 11,621 ships (over 100 GT), 177 of which were Belgian (*EU transport in figures 2011* [225490]).

The Belgian sea ports are situated at some of the busiest trade routes worldwide, with over 150,000 ship movements a year (*Goffin et al. 2007* [114225], *Vermeersch & Desnouck 2009* [135696]), in the so-called Le Havre-Hamburg range (with Antwerp, Ghent, Zeebrugge, Rotterdam, Amsterdam, Bremen, Hamburg, Dunkirk and Le Havre as the main sea ports). Ostend has also been taken into account in the figures of the Flemish sea ports (*Notteboom 2003* [38411]). The total traffic in the Le Havre-Hamburg range in 2012 was 1,102 million tons, with the Flemish ports accounting for a market share of 23.3% (Source: *Flemish Port Commission*).

Maritime transport and shipping in the Belgian part of the North Sea (BNS) will be discussed in detail below. When discussing ports in this theme, only sea ports (with the main purpose of handling sea-going ships) are taken into account, whereas fishing ports (mooring for fishing boats, cf. theme **Fishing**) and the marinas (mooring for recreational boats, cf. theme **Tourism and recreation**) are not considered (*Jargon list website Flemish Port Commission*).

2.1 Policy context

On the international level, shipping and maritime transport are covered by several international treaties and resolutions of the International Maritime Organization (*IMO*, *IMO brochure* [214699]). The *United Nations Convention on the Law of the Sea*, *UNCLOS*, 1982 can be considered as the primary piece of legislation. This convention can be regarded as the constitution of the sea, including the general rights and obligations of nations (flag states, coastal states, port states). Furthermore, the IMO is responsible for a significant amount of other conventions about, *inter alia*, safety at sea, traffic regulations and pollution prevention (see *list at IMO website*), that will be further discussed in detail in the section **Sustainable use**.

The European Union (EU) also takes policy initiatives related to the ports in the EU (more information: *website Flemish Port Commission, VHC*), maritime transport in the EU, maritime safety and pollution prevention. The publication Harbour Light (*Merckx et al. 2012* [220411]) provides an overview of the European regulations that are important with regard to the ports (more information: *website Flemish Port Commission, VHC*). Besides the regulations of the EU, the *Bonn Agreement* regulates the collaboration between the North Sea coastal states in case of pollution by oil and other harmful substances (*brochure 40 years of the Bonn Agreement* [214697], *Goffin et al. 2007* [114225]).

In Belgium, maritime transport is a federal matter, covered by the *FPS Mobility, Directorate-General (DG) Maritime Transport* (*Policy document Energy, Environment and Mobility 2012* [226456], *Policy document Economy, Consumers and the North Sea 2013* [226455], other federal actors are listed in table 1). The DG Maritime Transport ensures that the ships sailing under a Belgian flag or ships entering at Belgian ports, meet the international maritime regulations concerning shipping safety, such as the construction and equipment standards, but also the crew standards and the environmental regulations, both technically and administratively. The DG Maritime Transport represents Belgium within the IMO. The navigation regulations that have to be observed are listed on the website of the *FPS Mobility and Transport*.

The *law of 8 August 1980* defines that waterways and their appurtenances, ports and their appurtenances, pilotage and fairway services towards the ports, as well as rescue and towing services at sea are the responsibility of the Flemish Region, within the policy domain of *Mobility and Public Works* (MOW) (see list of Flemish actors in table 1).

The port policy is stipulated by the *Ports Decree* (*2 March 1999*) (*Flemish Policy Document Mobility and Public Works 2009-2014* [226458]). The Flemish Port Commission (*VHC*) has both an advisory and an informative function related to the socio-economic aspects of port projects, while the *Milieu- en Natuurraad van Vlaanderen* (*Minaraad*) provides advice on environmental aspects of port projects of over 10 million euros which require funding. The initiative *Flanders Port Area* aims to promote the collaboration between the four Flemish sea ports. In this context, the Flemish sea ports of Antwerp, Ghent, Ostend and Zeebrugge and the Flemish port associations have concluded a cooperation agreement with 30 points of collaboration in order to strengthen the competitiveness on an international level.

Table 1. Overview of the Flemish and Federal partners of the Coast Guard.

FLEMISH PARTNERS OF THE COAST GUARD	FEDERAL PARTNERS OF THE COAST GUARD
Vloot	Federale politie (*Shipping police*)
Water and Port Policy Division	*FPS Home Affairs*
Afdeling Internationaal Milieubeleid	*FPS Foreign Affairs*
Maritime Acces Department	*FPS Economy, S.M.E.s, Self-Employed and Energy*
Shipping Assistance Division	*FPS Finances* (*Belgian Customs*)
Coastal Division	*FPS Mobility and Transport* (*DG Maritime transport*)
Pilotage	*FPS Health, Food Chain Safety and Environment* (*Marine Environment Department*)
Dienst Zeevisserij	*Ministry of Defence*
	POD Duurzame Ontwikkeling
	PPS Science Policy (Management Unit of The North Sea Mathematical Models (*MUMM*), scientific service of the Royal Belgian Institute of Natural Sciences (*RBINS*))

The coordination and the consultation between federal, Flemish as well as regional authorities (see table 1) and the Province of West Flanders (*cooperation agreement of 8 July 2005*) is carried out by the *Coast Guard*. The organisational structure of the coast guard consists of a policy-making body, a consultation body and a secretariat. The policy-making body coordinates the collaboration between the different partners and advises the responsible ministers (article 6 of the *cooperation agreement of 8 July 2005*). The consultation body of the coast guard investigates certain files and gathers information for the policy body (article 12 of the *cooperation agreement of 8 July 2005*).

The coast guard centre is the operational section of the coast guard and consists of two services, which collaborate intensively: the Maritime Rescue and Coordination Centre (*MRCC*) in Ostend and Maritime Security Centre Belgium (*MIK*) in Zeebrugge. Their tasks were stipulated in the *Decree of 16 June 2006*, the *Agreement of the Flemish government of 26 October 2007* and the *Royal Decree of 6 February 2009*.

An overview of the legislation concerning marine usage, shipping and ports is also available in the coastal codex, themes *shipping* and *port and industry*.

2.2 Spatial use

In the BNS, a large part of the traffic is taking place in frequently used routes. For these routes, a routeing system (*ship's routeing, IMO*) was adopted within the *IMO*:

- The **traffic separation scheme North Hinder**, dealing with East-West traffic in the northern part of the exclusive economic zone (EEZ). This traffic separation scheme is part of a larger traffic separation scheme through the English Channel and the Strait of Dover, and is used by ships sailing between the Southern part of the North Sea and the Northern part of the North Sea or the connection to the Baltic Sea. This is one of the busiest shipping routes worldwide.
- **Traffic separation scheme Westhinder**. In Dunkirk, this traffic separation scheme is connected to the East-West traffic route and is used by ships travelling from and to the Belgian ports (the sea ports as well as the Scheldt ports). More than 90% of shipping traffic on this route has its destination or departure in a Scheldt port, and will thus navigate to or from the Scheldt estuary. At the end of this route, a precautionary area (defined by the IMO) is indicated, where ships subject to compulsory pilotage can be boarded by a pilot. To do so in a safe way, the **anchorage area Westhinder**, as well as the **anchorage area Oost Dijck**, have been demarcated, complemented by an area to be avoided between the anchorage area Westhinder and the traffic separation scheme Westhinder The anchorage area Westhinder is a possible refuge for ships that need assistance.
- A **deepwater route** is connected to the anchorage area Westhinder. This is a route with a greater depth, allowing large vessels to navigate to the coastal ports or to the Scheldt estuary. These ships have limited manoeuvrability, which means that a safe passage requires a strictly delimited route with specific regulations.

MAP WITH INDICATIONS OF THE IMO FAIRWAYS AND OTHER IMPORTANT SHIPPING ROUTES

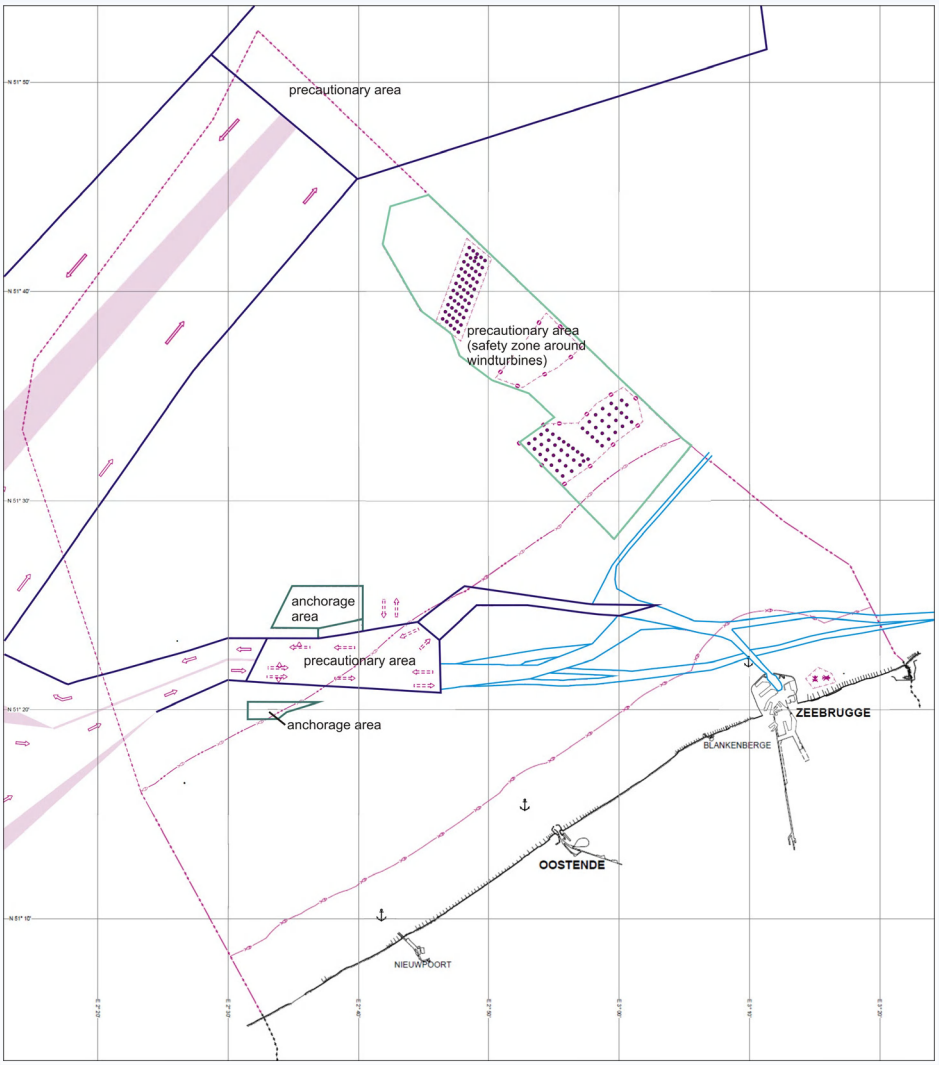

Figure 1. Map with the IMO fairways (dark blue) and other important shipping routes (light blue) (*Continental Shelf & Flemish Hydrography 2013* [227521]).

Furthermore, the concession area for the installation of offshore electricity production is surrounded by a safety zone of 500 meters (this zone does not enter the Dutch EEZ boundary). This area is indicated by the IMO as a **precautionary area**. In addition, a safety zone of 500 meters is demarcated around every construction within the concession areas (*Royal Decree of 11 April 2012*, see also theme **Energy (including cables and pipelines)**).

In addition to the frequently used routes, for which IMO has created routeing systems, there exist **other important and frequently used shipping routes** in the BNS towards the ports or the Scheldt area. These routes are used by ships as they are marked and/or dredged, guaranteeing a safe shipping depth. Most of these routes are also pilotage routes. Therefore, the maritime pilot on board the ship will advise the captain to take these routes. Most of the merchant ships are subject to compulsory pilotage. Only when the captain has a valid pilotage exemption certificate, or when the ship itself is exempt, it is not necessary to take aboard a maritime pilot to navigate the ship from and to the Belgian ports. The most obvious example of ships with the aforementioned exemption are ferries that frequently

call at a Belgian port. They choose the most economical and the fastest routes. For the ferries which sail to the north of England, a frequently used route runs along the west side of the zone reserved for offshore electricity production. Beyond this reserved zone, the route curves northwards to the precautionary area at the end of the traffic separation scheme North Hinder, in order to avoid crossing the traffic separation scheme as this involves extra traffic regulations. These ferries also have a limited depth, and can therefore easily navigate in shallow water.
The most important frequently used routes, where no IMO routeing system is applied, are:

- The **Westpit route**. This is a route along the south side of the reserved area for offshore electricity production and has an east-west orientation. This route is used by vessels navigating between Belgian ports and ports to the north of Belgium: e.g. ships heading for Antwerp or Ghent use this route (only smaller ships can use the Oostgat Channel to navigate to Antwerp or Ghent). All traffic from and to Zeebrugge uses the Westpit Channel; ships coming from the north or heading northwards use this route. This is a very busy route with large ships that have large depths (this accounts for about 4,500 shipping movements in 2012). The intensity of the traffic in this route will still increase in the next years, due to the development of wind farms at sea. At the moment, deep draft ships can still use the routes in the middle of the offshore wind farm area, but once the development of this area has started, this will no longer be possible. Last year, about 1,500 deep ships navigated through the wind farm zone from and to the Belgian ports. In the future, these ships will also have to use the Westpit route. The Westpit route will become one of the most important shipping routes for ships going from and to the Belgian ports, because the other routes are much longer and therefore economically unfavourable.
- The **route of the pilotage station Westpost to Zeebrugge and Vlissingen**. This route departs from the Westhinder precautionary area, south of the deepwater route, delimited by IMO, and passes *Wielingen*, *Scheur*, *Vaargeul*, *Ribzand* and *Zand*. It is used by ships sailing from and to the port of Zeebrugge, to the Scheldt Estuary or to the Westpit route. The traffic coming from the south, with a Belgian port as destination, will navigate via this route when the ship is not bound to the deepwater route demarcated by the IMO. This route is frequently used as well because most ships with the latter destinations are subject to compulsory pilotage. Hence, they will also navigate through this route.
- Other **frequently used routes to the coastal ports**. The ships bound for the port of Ostend navigate from the precautionary area Westhinder to the port of Ostend, passing the buoys A1 and KB. Ships sailing from Ostend to Vlissingen or vice versa use the coastal route. This route is only 1 nautical mile off the coast. To Nieuwpoort and back, ships navigate via *Kleine Rede*. The ships navigating directly to Nieuwpoort, use the route via *Negenvaam*, from the buoy A1. These are mostly smaller ships, such as ferries or coastal ships, navigating via the 'Short Sea Shipping' routes. These ships usually do not have a maritime pilot aboard, and therefore do not need to navigate via the pilotage routes. The captain usually chooses the shortest way, avoiding the busy traffic at the other shipping routes.
- The **Outer Routes**: These are the routes that lead to Dover or Calais via the buoy KB. They are mainly used by the ferries with a fixed shipping line between the United Kingdom and a Belgian port. The captain often holds a certificate and is therefore not subject to compulsory pilotage. They navigate via the most economical routes. This concerns about 2,000 ships a year.

(Source: *FPS Mobility and Transport, DG Maritime Transport*)

A full list of the navigation regulations ships need to observe, is provided on the website of the *FPS Mobility and Transport*. Information concerning the shipping in the BNS is communicated via the *Notices to Mariners* (BaZ, more information: general provisions *BaZ 2013 nr. 1* [225449]).

In the draft of the Marine Spatial Plan (*Ontwerp van koninklijk besluit tot vaststelling van het marien ruimtelijk plan, 2013* [227527]), as proposed by the Minister competent for the North Sea, some spatial policy choices concerning maritime transport and shipping have been formulated (See also theme **Maritime Spatial Planning**):

- The investigation of the possibility of extra ship routeing systems and starting the procedure for registration of these systems by IMO;
- No burdening of the important traffic flows;
- The conservation of the number of safe shipping routes between the Belgian coast and the British Isles;
- Not obstructing the possibilities for temporary emergency waiting berths in the reserved areas in the deeper sea;
- A fixed tugboat station in view of the service Westpit, Ferry, and the rest of the BNS.

2.2.1 Port zones

The demarcation of the different port zones was stipulated in the *Royal Decree of 2 February 1993* and in the *Decision of the Flemish Government of 13 July 2001* (*Maes et al. 2004* [70936] (*MARE-DASM project BELSPO*)). The total surface and the water surface of the Flemish sea ports are represented in table 2.

Table 2. Overview of the Flemish sea ports and their total surface and water surface (Source: *Flemish Port Commission*).

PORTS	TOTAL SURFACE	WATER SURFACE
Port of Ostend	658 ha	199 ha
Port of Ghent	4,667 ha	623 ha
Port of Zeebrugge	2,847 ha	1,010 ha
Port of Antwerp	13,057 ha	2,011 ha

In the draft of the Marine Spatial Plan (*Ontwerp van koninklijk besluit tot vaststelling van het marien ruimtelijk plan, 2013* [227527]), as proposed by the Minister competent for the North Sea, space is provided for the expansion of the ports of Zeebrugge and Ostend (see also theme **Maritime Spatial Planning**).

2.3 Societal interest

2.3.1 Employment

The total employment in the Belgian ports (= the Flemish sea ports of Antwerp, Zeebrugge, Ghent and Ostend, and the ports of Liège and Brussels) declined to 256,382 full-time equivalents (FTE) in 2011 (figure 2). This figure can be divided into 115,600 direct FTE and 140,782 indirect FTE. The Flemish sea ports account for 87.7% of this employment, with Antwerp accounting for more than half (51.9%), followed by Ghent (23.0%), Zeebrugge (8.6%) and Ostend (4.2%). This difference in employment is partly related to the type of industry and shipment of goods in the different ports (See below). In 2011 the total employment in the ports equalled 9.8% of the total Flemish employment and 6.4% of the Belgian employment. Until 2008, there was a slow increase in the number of FTE in the Belgian ports, followed by a decrease from 2009, as a result of the global economic crisis (Mathys 2013 [227525]).

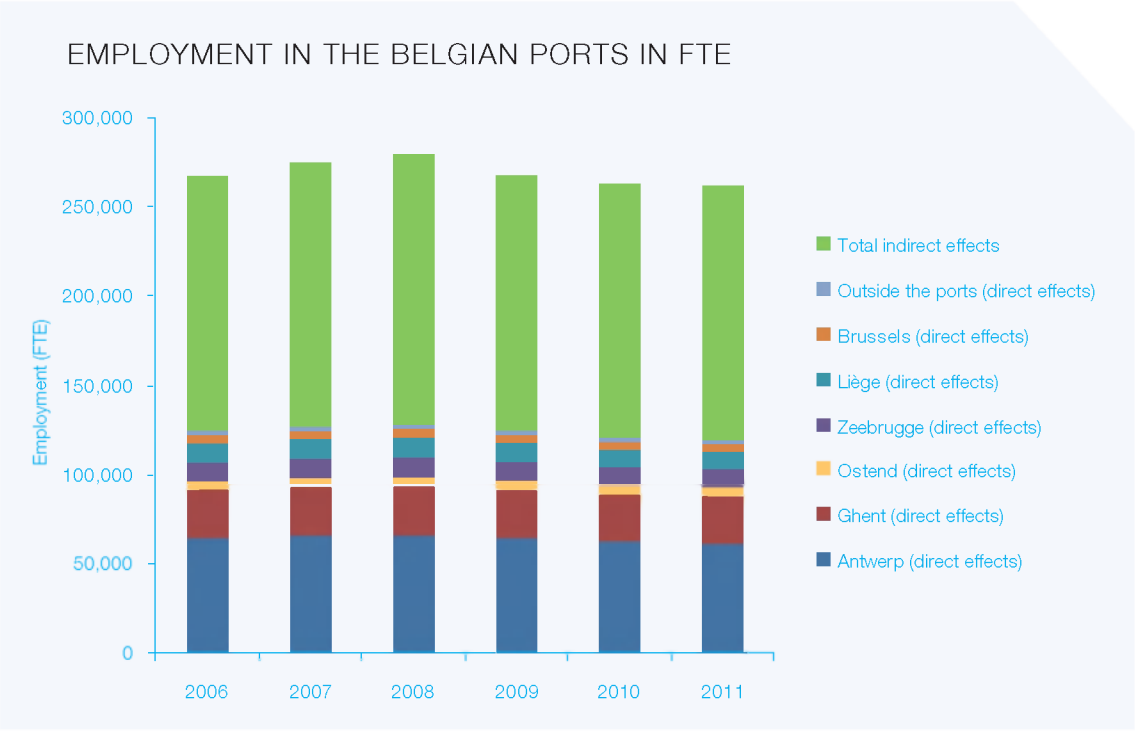

Figure 2. The direct and indirect employment in the Belgian ports between 2006 and 2011 (*Mathys 2013* [227525]).

The economic importance of the Belgian ports in 2011 (*Mathys 2013* [227525]) presents a social balance of the employment in the ports (composition of the staff, education, rotation of the staff, working time, type of contract, wage costs, promotion measures and training). The workforce in the ports in 2011 largely consisted of males (84%). Blue-collar

workers constitute the majority of the port staff, with 53% in 2011, followed by white-collar workers (43%) and other staff (4%).

2.3.2 Added value

The total added value of the Belgian ports equalled 30,859.4 million euros in 2011. A distinction can be made between the direct (16,482.0 million euros) and indirect added value (14,377.4 million euros) (figure 3). Between 2006 and 2011, the total added value of the ports grew by 1.6%. The Flemish sea ports accounted for 87.9% of the direct added value in 2011, with Antwerp accounting for more than half of the direct added value (58.6%), followed by Ghent (20.6%), Zeebrugge (5.8%) and Ostend (2.9%) (*Mathys 2013* [227525]).

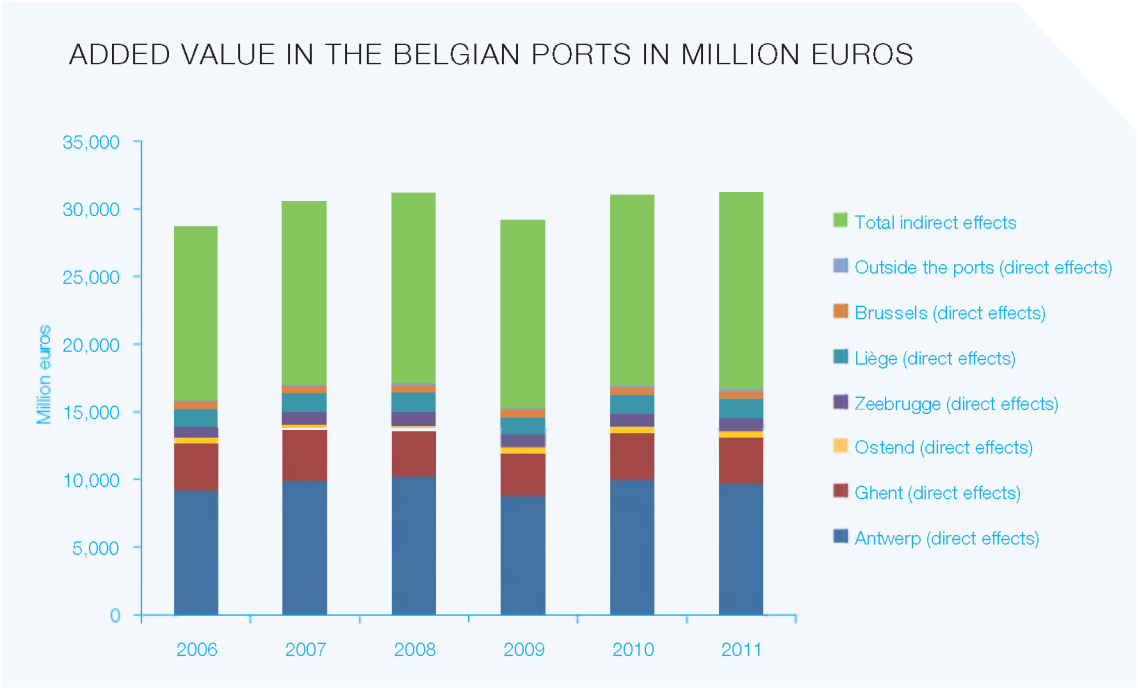

Figure 3. The direct and indirect added value in the Belgian ports (in million euros) between 2006 and 2011 (*Mathys 2013* [227525]).

2.3.3 Shipment of goods

After a decrease in 2009, due to the worldwide economic crisis, cargo traffic in the Flemish ports increased to more than 265 million tons in 2011, followed by a decrease to approximately 257 million tons in 2012 (figure 4). In terms of shipment of goods, Antwerp remains by far the most important port with 184.135 million tons in 2012. Cargo traffic in Zeebrugge, Ostend and Ghent was 43.544, 3.196 and 26.303 million tons respectively. In 2012, cargo traffic in the Flemish ports accounted for 23.3% of the total amount in the Le Havre-Hamburg range (Source: *Flemish Port Commission*).

In 2012, the port of Antwerp was the leader in the handling of containers (104.060 million tons) (more information on intermodal container traffic: *Notteboom 2006* [106432], *Merckx & Neyts 2009* [140471]), dry bulk (19.106 million tons), liquid cargo (45.276 million tons) and break bulk cargo (7.534 million tons). Zeebrugge is the most important port with regard to roll-on/roll-off traffic with 12.549 million tons (Source: *Flemish Port Commission*, more information on car traffic: *Notteboom 2010* [200621]).

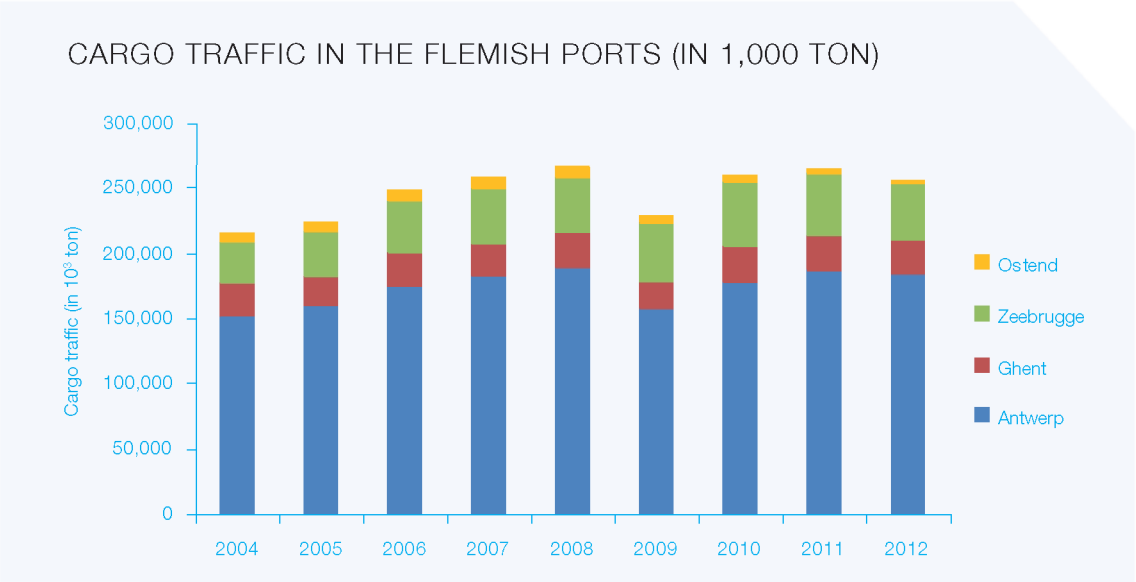

Figure 4. Cargo traffic in the Flemish ports (in 1,000 tons) (Source: *Flemish Port Commission*).

2.3.4 Passenger traffic

In 2012 a total of 810,539 passengers embarked or disembarked in the Flemish ports. Zeebrugge accounted for the majority of this figure with 713,152 passengers, followed by Ostend (93,472 passengers), Antwerp (2,777 passengers) and Ghent (1,138 passengers). Since the 1980s, passenger traffic in the Flemish ports has known a substantial decrease given that more than 5 million passengers embarked or disembarked in 1980 (Source: *Flemish Port Commission*). This decline is due to the opening of the Channel Tunnel, the closure of the *Regie voor Maritiem Transport* (RMT) ferry service and the cancellation of certain ferry lines (*Notteboom 2004* [67570]).

2.3.5 Investments

In 2011, direct investments in the Belgian ports equalled 3,393.8 million euros, a decrease of 8.7% in comparison to 2010. In total, 3,139.2 million euros have been invested in the Flemish sea ports. The majority of these investments were destined for the port of Antwerp (2,339.3 million euros), followed by Ghent (439.1 million euros), Zeebrugge (268.2 million euros) and Ostend (92.6 million euros). Moreover, 302.7 million euros have been invested in maritime companies outside the Belgian port areas (*Mathys 2013* [227525]). Public expenditures in the Flemish ports in 2012 equalled 338.3 million euros, 217.4 million euros (64.3%) of which were allocated to maritime access. Besides maritime access, 73.1 million euros were spent on the port of Antwerp, 8.4 million euros on Ghent, 29.3 million euros on Zeebrugge and 10.0 million euros on Ostend (Source: *Flemish Port Commission*).

2.4 Impact

Shipping traffic has a large number of effects on the marine environment. Table 3 gives an overview of the different types of impact and their relevant literature.

Moreover, the installation and operation of the ports also has certain effects on the environment. These effects are *inter alia* indicated in the environmental impact assessments (EIAs) of the strategic plans of the ports (See table 4, non-exhaustive list, see also *database LNE departement*).

Table 3. Overview of the effects of shipping on the environment.

IMPACT	LITERATURE
Oil pollution and pollution by other pollutants and toxic materials, due to accidental, operational or illegal discharge	*Schallier 2001* [24539], *Seys & Kerckhof 2003* [35234], *Maes et al. 2004* [70936] (*MARE-DASM project BELSPO*), *Seys 2004* [214644], *Schrijvers & Maes 2005* [78295] (*GAUFRE project BELSPO*), *Le Roy et al. 2006* [101068] (*RAMA project BELSPO*), *Lescrauwaet et al. 2006* [105200], *Volckaert et al. 2006* [103038] (*MIMAC project BELSPO*) , *Goffin et al. 2007* [114225], *Schallier et al. 2008* [213584], *OSPAR QSR 2010* [198817] *André et al. 2010* [200613], *Dittman et al. 2012* [219855], *Lagring et al. 2012* [213584], *Maebe et al. 2012* [221528]
Air pollution, caused by particles in the emissions of marine engines (NO_x, SO_x, CO_2, etc.)	*Maes et al. 2004* [70936] (*MARE-DASM project BELSPO*), *Schrijvers & Maes 2005* [78295] (*GAUFRE project BELSPO*), *Goffin et al. 2007* [114225], *Maes et al. 2007* [117043] (*ECOSONOS project BELSPO*), *Gommers et al. 2007* [214629] (*MOPSEA project BELSPO*), *OSPAR QSR 2010* [198817], *Bencs et al. 2012* [226554] (*SHIPFLUX project BELSPO*)
Waste dumping	*Schallier 2001* [24539], *Lescrauwaet et al. 2006* [105200], *Goffin et al. 2007* [114225], *Claessens et al. 2010* [197434], *OSPAR QSR 2010* [198817], *André et al. 2010* [200613], *Van Franeker et al. 2011* [209289], *AS-MADE project BELSPO*
Leaching of polluting anti-fouling substances (e.g. tributyltin (TBT))	*Maes et al. 2004* [70936] (*MARE-DASM project BELSPO*), *Schrijvers & Maes 2005* [78295] (*GAUFRE project BELSPO*), *Goffin et al. 2007* [114225], *OSPAR QSR 2010* [198817], *Claessens et al. 2010* [197434]
Introduction of non-indigenous species due to their attachment to the keel or the discharge of ballast water	*Maes et al. 2004* [70936] (*MARE-DASM project BELSPO*), *Schrijvers & Maes 2005* [78295] (*GAUFRE project BELSPO*), *Goffin et al. 2007* [114225], *OSPAR QSR 2010* [198817]
Pollution and physical impact due to the loss of ships or cargo	*Schallier 2001* [24539], *Seys & Kerckhof 2003* [35234], *Le Roy et al. 2006* [101068] (*RAMA project BELSPO*), *Goffin et al. 2007* [114225], *De Baere et al. 2010* [197436], *OSPAR QSR 2010* [198817]
Other physical impact, such as noise and collisions with marine mammals	*Maes et al. 2004* [70936] (*MARE-DASM project BELSPO*) [70936], *OSPAR QSR 2010* [198817], *André et al. 2010* [200613], *compilation national reports ASCOBANS*
Impact on other users (safety, spatial impact, etc.)	*Maes et al. 2004* [70936] (*MARE-DASM project BELSPO*), *Schrijvers & Maes 2005* [78295] (*GAUFRE project BELSPO*), *Le Roy et al. 2006* [101068] (*RAMA project BELSPO*), *Volckaert et al. 2006* [103038] (*MIMAC project BELSPO*)

Table 4. An overview of the documents concerning the EIAs of the Flemish sea ports.

PORTS	EIAs
Ostend	*plan MER strategisch plan haven Oostende (kennisgevingsnota) 2004* [65798] Richtlijnen milieueffectrapportage Strategisch plan haven Oostende Goedkeuring milieueffectrapport Strategisch plan haven Oostende *plan MER kustverdediging en maritieme toegankelijkheid Oostende 2007* [214633]
Antwerp	Richtlijnen milieueffectrapportage Strategisch plan haven van Antwerpen *Kennisgeving plan MER Strategisch plan haven van Antwerpen 2006* [227511] *plan MER strategisch plan haven van Antwerpen (niet-technische samenvatting) 2008* [214715] *Goedkeuring MER Strategisch plan haven van Antwerpen 2009* [225616] *kennisgeving Verruiming vaargeul Beneden-Zeeschelde en Westerschelde 2006* [104600] *tussentijds strategisch plan haven van Antwerpen 2006* [132421]
Zeebrugge	*plan MER strategisch plan haven van Zeebrugge 2004* [214635] *kennisgeving project MER van het strategisch haveninfrastructuurproject (SHIP) in de westelijke achterhaven van Zeebrugge 2011* [225608] *Richtlijn milieueffectrapportage van het strategisch haveninfrastructuurproject (SHIP) in de westelijke achterhaven van Zeebrugge 2011* [227516]
Ghent	nota-plan MER strategisch plan haven van Gent

2.5 Sustainable use

2.5.1 Long term vision of the Flemish sea port policy

Between 2002 and 2005 a *Long term vision of the Flemish sea port policy* [225483] was conceived (more information: *guidelines for EIA Long term vision* [227512], *approval EIA Long term vision 2006* [225614]). This is a strategic vision for the Flemish sea port policy, in which recommendations concerning the goals of the sea port policy and the policy strategies to achieve these goals are formulated.

One of the most important conclusions of the Long term vision is that the sea port policy needs to have wider purposes than only the economic efficiency and competitiveness. In the Long term vision, the sea port policy focuses on broader societal purposes, such as economic prosperity, social well-being and environmental quality.

The long term vision offers five policy strategies. They all focus on raising the societal value of the Flemish sea ports.

- Responding to the synergy between sea ports and logistics;
- Enabling sea ports in the context of sustainable industry and transport;
- Enabling sea ports in the knowledge economy;
- Responding to the European policy, in a proactive way;
- Optimising the internal structure of the governmental policy with respect to the sea ports.

2.5.2 Sustainable development of the port area

In order to implement the Flemish coalition agreements of 1999 and 2004, each Flemish sea port developed a strategic plan that had to visualise the long term vision (up to 2030) for the port development. The final result should consist of a target scenario and an action plan. The policy objectives of these strategic plans are: the careful use of space and environment, sustainable mobility, clear and liveable borders between the port and the surrounding area, and respect for the presence of important natural values in and around the ports. The strategic plans include the long-term port development plans and the associated compensation measures for nature.

EIAs (see also **Impact**) and spatial safety reports are drafted regarding all aspects of the strategic plans. The spatial interpretation of the objectives of strategic plans is guaranteed through regional spatial implementation plans (GRUP). Hence, these strategic plans are important for the final demarcation of the Flemish sea port areas.

Since 1999, every port area in Flanders needs to draft a strategic plan and a spatial implementation plan (RUP) based on maximum protection of the surrounding residential areas, the conservation and strengthening of the ecological infrastructure in and outside of the port area, and a smart use of space (more information: *website Flemish spatial structure plan*). The spatial development and accessibility of the sea ports are also discussed in the Green Paper and in the White Paper of the new Spatial Policy Plan, where the sea ports are regarded as important gateways with a strategic importance for the economy. The importance of the ports and their connection to other nodes within the Trans-European Network (*TEN-network*) is emphasised in the *Green Paper Flanders 2050 (2012)* [225489]. The ports constitute important international gateways for goods and are well connected to inland nodes via different modes (water, railways, roads and pipelines), making the transport system as efficient as possible.

When nature is lost due to the port developments, this is usually compensated by the creation and delimitation of new nature reserves. The ecological compensation areas are usually demarcated in consultation with the Flemish Land Company (*VLM*). Examples of these nature compensation projects can be seen in the southern part of the port of Zeebrugge (*website VLM*) or in the Sea Scheldt basin, as stipulated in the Sigmaplan (see theme **Scheldt Estuary**). The environmental legal context with regard to the port policy, management and operation is discussed in detail in *Van Hooydonk et al. (2003)* [214805]. An overview of the legislation concerning the ports is given in the coastal codex, theme *Port and industry*.

2.5.3 Sustainable development of EU maritime transport

The strategic goals and recommendations concerning the maritime transport policy of the EU until 2018 have been elaborated in *COM (2009) 8*. The key values are sustainable development, economic growth and open markets with fair competition and strict environmental and social standards.

In the White Paper 'Roadmap to a Single European Transport Area' *COM (2011) 144*, 40 concrete initiatives have been elaborated, in order to achieve a competitive and economical European transport system (*COM (2006) 314*). The development of the ports is essential in order to handle larger cargo volumes by means of short sea shipping in the EU as well as via shipping to the rest of the world. The ports play a crucial part regarding logistical facilities, and need efficient hinterland connections. The Motorways of the Sea constitute the maritime element of this transport system. On a national level, the European regulations have been implemented in the *Royal Decree of 30 September 2005* concerning the promotion of combined transport.

The European Commission (EC) conducts an active policy to promote short sea shipping (SSS) (see *inter alia*, *COM (2004) 453* on short sea shipping, *SEC (2007) 1367* on the Motorways of the Sea and *COM (2009) 10* on establishing a European maritime transport space without barriers). This type of transport, using short sea lanes, is indeed a safer and more environmentally friendly alternative to road transport (*Maelfait 2006* [106438], *Goffin et al. 2007* [114225]). The EU finances different programmes that contribute to the promotion of SSS, such as *Marco Polo*, *TEN-T* and *Motorways of the sea*. Motorways of the sea are regular, frequent and direct connections of high quality, reducing the transport times. SSS is the most important transport mode within the concept of the Motorways of the Sea. In Flanders, the Flemish government established the *Short Sea Promotion Centre* in 1998. Since 1999, this neutral and non-commercial advisory body has gathered the SSS statistics of the 4 Flemish ports and of shipping traffic from rivers towards the sea (*statistieken 2012*).

On the informal Transport Council of October 2010 in Antwerp, the Belgian chairmanship and the EC proposed the *Blue Belt project* to the European ministers of Transport. Within the scope of the broader European goals to stimulate marine and maritime growth, the Blue Belt project aims to reduce the administrative burden for maritime transport to a level comparable to other modes of transport (air transport, railway transport or road transport) (*COM (2012) 573*).

2.5.4 Safety measures at sea: construction, equipment and crew of sea-going ships

Maritime safety, the prevention of shipping disasters, and the safety of life at sea are settled in a few international treaties, such as the *SOLAS Convention* (International Convention for the Safety of Life at Sea), *COLREG* (The International Regulations for Preventing Collisions at Sea, 1972, *IMO*), the *STWC Convention* (International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, *IMO*) and the *SAR Convention* (International Convention on Maritime Search and Rescue, *IMO*) (see also **Policy Context**).

The *SOLAS Convention* of 1974, complemented by the Protocol of 1978, is constantly being amended. The Protocol was amended in 1981 and replaced by the Protocol of 1988. The Protocol of 1988 improved and harmonised the obligations with regard to inspection and research, and introduced new models of safety certificates which are required by the *SOLAS Convention*, the *MARPOL Convention* and the *International Convention on Load Lines*. The annexes to the *SOLAS Convention* include the requirements concerning the construction of the ship (Chapter II), fire protection, fire detection and fire extinction (Chapter II-1), life-saving appliances and arrangements (Chapter III), radio communications (Chapter IV), safety of navigation (Chapter V), the safe carriage of cargoes (Chapter VI), the safe transport of dangerous goods (Chapter VII) and the safety of nuclear ships (Chapter VIII). With the amendment in 1994, three new chapters were added to the *SOLAS Convention*: Chapter IX on management for the safe operation of ships, Chapter X on Safety measures for high-speed craft, Chapter XI - Regulation 1 on special measures to enhance maritime safety, and Chapter XI – Regulation 2 on special measures to enhance maritime security. By the end of 2000, Chapter V of the *SOLAS Convention* was revised and stipulated the obligation to install a 'voyage data recorder' (VDR) and an 'automatic identification system' (AIS). This AIS is a satellite application that allows the automatic identification of a ship at sea and provides information on the ship to other ships as well as to the authorities ashore. The implementation and the surveillance of the safety measures is a competence of the FPS Mobility and Transport (*inter alia* via maritime inspection regulation – *Royal Decree of 20 July 1973* and often revised). The *Shipping Assistance Division* (Agency for Maritime and Coastal Services) guarantees safe and easy shipping in the maritime fairways from and to the Belgian sea ports, by organising and offering Vessel Traffic Services (VTS).

The *International Convention on Standards of Training, Certification and Watchkeeping for Seafarers* (STCW, 1978) targets the safety of human life and goods, as well as the protection of the marine environment. The convention includes a few regulations, which refer directly to the prevention of marine pollution and focus on the required knowledge and the responsibilities during watchkeeping. This convention imposes minimal standards with regard to training, and a certificate of competence for seafarers. Formerly, each flag state set these requirements independently which resulted in large differences in the competence of the seafarers. Article X of the convention enables parties to the convention to control ships of non-party states, without any favourable treatment. In this

context, IMO drafted inspection procedures which put more focus on the human elements with regard to maritime safety and the prevention of marine pollution. In 1995, a new international code concerning the standards of training, certification and watchkeeping for seafarers was elaborated. The inspection is not preferably performed anymore by the authorities of the flag states (for ships sailing under the Belgian flag: FPS Mobility and Transport). The inspection can be carried out by any party to the convention when a ship is situated in the port of a party to the convention (also FPS Mobility and Transport). The IMO also has an inspection task. The parties to the convention are obliged to provide detailed information to the IMO, on anything related to the execution of the convention (such as the training courses and certification procedures). The implementation and the supervision of the crew regulations is a matter of the FPS Mobility and Transport, via *inter alia* the maritime inspection regulations in the *Royal Decree of 20 July 1973* (and often revised).

Since the *Directive 94/58/EC* on the minimum level of training of seafarers, the EU has also implemented a regulation concerning the minimum level of training of seafarers, on community ships, and ships calling at community ports, in view of enhanced safety at sea.

The Belgian Port State Control (FPS Mobility and Transport) inspects foreign ships that call at Belgian ports to check whether they meet all international regulations of the IMO and International Labour Organisation (ILO). When ships do not meet these standards, departure can be refused, or special conditions can be imposed. E.g. when a ship has a defect that endangers the safety of the ship and the crew, and which cannot be repaired in a Belgian port, Belgian Port State Control can enforce an obligation to navigate to the closest shipyard (for the regional collaboration on Port State Control, see *Memorandum of Understanding on Port State Control* (*Paris MOU*)).

2.5.5 Pollution prevention

The *MARPOL Convention* (MARPOL 73/78) aims to prevent the accidental and deliberate discharge of oil and other polluting substances by ships. This is achieved by means of strict operational discharge conditions, a discharge prohibition, or by means of technical measures concerning the construction and equipment of the ship. *MARPOL* 73/78 consists of two protocols and six technical annexes, each treating one type of pollution. Annex I contains regulations for the prevention of pollution by oil. Annex II includes regulations for the control of pollution by noxious liquid substances in bulk. Annex III discusses the prevention of pollution by harmful substances carried by sea in packaged form. Annex IV treats the prevention of pollution by sewage from ships. Annex V concerns the prevention of pollution by garbage from ships. In Annexes I, II and V, special marine areas can be indicated, where stricter discharge conditions may apply. With the Protocol of 1997, a new Annex VI was ratified, concerning the prevention of air pollution from ships. In addition to these annexes, two original protocols exist: Protocol II concerning the arbitration of disputes and Protocol I about the regulations on the reporting of incidents involving noxious substances. The annexes are constantly subject to amendments.

After the shipping disaster with the oil tanker Erika in 1999, a series of measures have been issued by Europe, known as the Erika I (*COM (2000) 142*), II (*COM (2000) 802*) and III (*COM (2005) 585*) measures, in order to enhance maritime safety. This series of measures include the *Directive on common rules and standards for ship inspection and survey organisations and for the relevant activities of maritime administrations* (*94/57/EC*), the *Directive on reporting formalities for ships arriving in and/or departing from ports of the Member States* (*2010/65/EC*), the *Directive establishing a Community vessel traffic monitoring and information system* (*2002/59/EC*), the *Port State Control Directive* (*2009/16/EC*), the *Regulation on double-hull oil tankers* and the *Regulation establishing a European Maritime Safety Agency*, *EMSA*. The international regulations concerning shipping safety and protection of the marine environment are also implemented by the Port State Control services (*Port State Control Directive*). Furthermore, maritime safety is increased by initiatives such as *SafeSeaNet* (EMSA) which offers a centralised European information platform for the sharing of maritime data between the responsible authorities.

As a result of the accident with the oil tanker Prestige off the Spanish coast in November 2002, the phasing-out of single-hull oil tankers (set by *Regulation 417/2002*) has been accelerated again by the EU, by means of *Regulation 1726/2003* and *Regulation 530/2012*. The IMO has implemented this accelerated phase-out in Europe. *Regulation 1726/2003* states that from 2010 onwards, single-hull oil tankers sailing under the flag of a Member State as well as other oil tankers cannot enter the ports or offshore terminals of a Member State anymore.

The implementation of international and European legislation in federal legislation can be consulted in the coastal codex, theme shipping.

2.5.6 Measures concerning pollution prevention and mitigation

Within the measures concerning the prevention and combating of pollution from ships, a distinction can be made between accidental and operational discharges. *UNCLOS* provides the general international legislative framework, dealing with problems such as marine pollution (part XII). In case of accidental or operational pollution of the marine environment due to shipping, the *MARPOL Convention (1973/1978)* is the most important international convention (see above). Apart from these two conventions, other important IMO conventions exist, such as the *OPRC Convention* (Oil Pollution Preparedness, Response and Co-operation), the *HNS Convention* (Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances), the *CLC Convention* (International Convention on Civil Liability for Oil Pollution Damage), the *FUND Convention* (International Fund for Compensation for Oil Pollution Damage), etc. (see list at *IMO website*).

The *Bonn Agreement* regulates the collaboration between the coastal states of the North Sea with regard to the detection, reporting and combating of pollution in the North Sea, caused by oil and other pollutants from ships and offshore installations.

In the context of the *OSPAR Convention*, certain biological indicators have been set, e.g. the degree of oil contamination in guillemots is considered a proxy for oil pollution in the marine environment. This indicator is a so-called EcoQO or Ecological Quality Objectives. The Research Institute for Nature and Forest (INBO) annually reports the degree of oil contamination of the birds washed ashore on the Belgian beaches (*Verstraete et al. 2007* [116947], *2008* [127497], *2009* [142499]). The statistics can also be consulted on the following *website about beached birds*.

On a European level, the *Marine Strategy Framework Directive* (*2008/56/EC*) (MSFD) defines the concentrations of pollutants as one of the descriptors of the environmental status. Pollution from ships has been identified as a pressure without a distinction between accidental and operational pollution (more information: *Law et al. 2010* [202492]). The European Maritime Safety Agency (*EMSA*) aims to reduce the risk of maritime accidents, marine pollution from ships and the loss of life at sea. EMSA has a network of European ships at its disposal for combating oil pollution in European waters (*Regulation 1406/2002*, *website EMSA*).

On the Belgian level, the *law of 6 April 1995* provides the legal framework for the implementation of the *MARPOL Convention*. In case of serious pollution, the Emergency Plan North Sea regulates the intervention in the BNS (*Ministerial Decree of 19 April 2005*). Since the Erika shipping accident (1999), the Belgian government has a wider range of specific instruments at its disposal to combat oil pollution (*website FPS Health, Food Chain Safety and Environment*). In 2005, an intervention plan was drafted for the shelter and care of birds beached due to oil pollution at sea (*Intervention Plan Birds, 2007* [107076]). A new instrument in the fight against oil pollution is the OSERIT model (Oil Spill Evaluation Response Integrated Tool, conceived by MUMM (Direction Natural Environment, RBINS)), that allows to simulate the impact of oil pollution, as well as the identification of the polluter via backtracking (*Dulière & Legrand 2011* [202777], *OSERIT project BELSPO*).

On an international level, operational discharges are tackled by a network of police experts and prosecutors called NSN (North Sea Network of Prosecutors and Investigators) under the umbrella of OSPAR. In the context of the *Bonn Agreement*, aerial surveillances have been organised in the BNS since 1991 in order to stop illegal discharges from ships. The observation programme is executed by MUMM (Direction Natural Environment, RBINS) in collaboration with the Belgian Army. In total, 250 flight hours are performed above the BNS each year, *inter alia* in the context of aerial surveillance of marine pollution (*website MUMM*). The results of the aerial surveillance of 2011 have been reported in *De Montpellier et al. (2012)* [217097]. The Belgian Army also performs surveillance flights above the BNS, with so-called UAVs (unmanned aerial vehicles). Since the beginning of the aerial surveillance in 1991, a declining trend in the number of oil discharges and in the estimated oil volume has been observed (figure 5). It seems that the measures within the European directive on port reception facilities for ship-generated waste and cargo residues (*Directive 2000/59/EC*) and the *MARPOL Convention*, as well as the enhanced surveillance, have a positive effect (*Goffin et al. 2007* [114225], *André et al. 2010* [200613], *Lagring et al. 2012* [213584], *Maebe et al. 2012* [221528]). The degree of oil contamination of beached birds (see above) also serves as an indicator for operational discharges.

At a European level, the penalties for infringements with regard to the pollution from ships are regulated by the *Directive 2005/35/EC*. The European Maritime Safety Agency (*EMSA*) coordinates the European collaboration and harmonisation of the European policy in the fight against illegal pollution from shipping. Via the *CleanSeaNet*, EMSA has developed an additional instrument to trace oil pollution from shipping by means of satellite images.

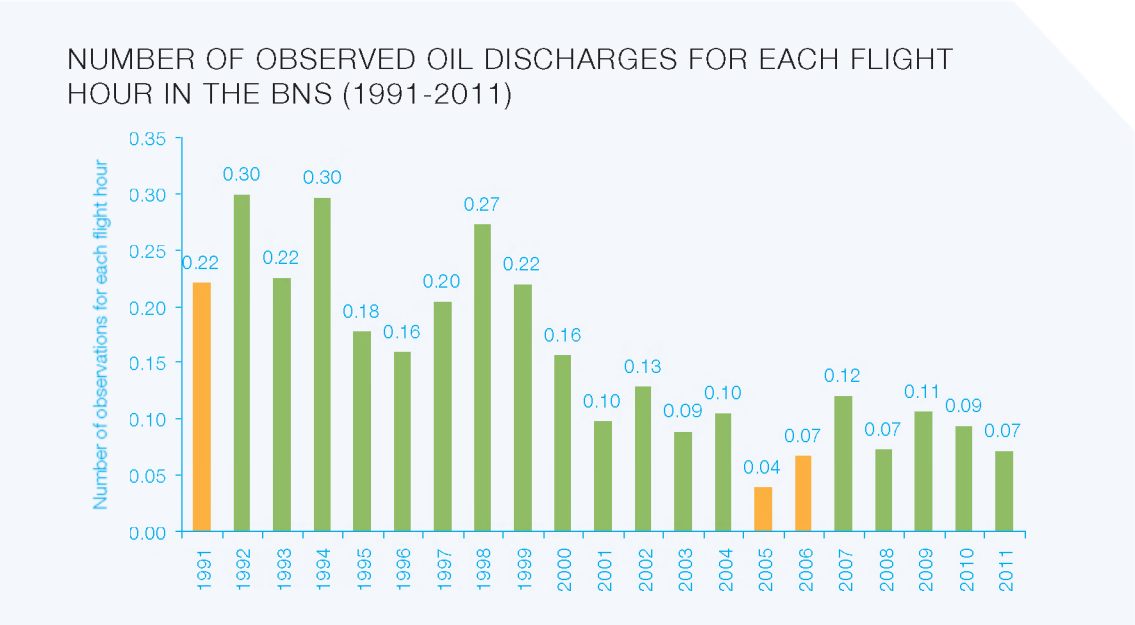

Figure 5. Number of observed oil discharges for each flight hour of the observation programme in the BNS (1991, 2005 and 2006 were transitional years, indicated in red) (MUMM, *Maebe et al. 2012* [221528]).

2.5.7 Measures against the disposal of waste from ships

The *MARPOL Convention (1973/1978)* regulates which waste can be discharged into the marine environment by ships (see above). The problem of ship-generated waste is discussed by *Directive 2000/59/EC* concerning the port reception facilities for ship-generated waste and cargo residues. This directive wants to oblige the ships to bring their waste to the ports in a sustainable way. In the *MSFD* (*2008/56/EC*), the presence of marine litter was regarded as one of the descriptors of the condition of the marine environment and was identified as a physical pressure on the environment. The criteria and methodological standards concerning the determination of the good environmental status (GES) with regard to marine litter were discussed in *Galgani et al. (2010)* [199555].

In Flanders, the policy with respect to the waste management of ships in the ports is stipulated in subsection 12 of the Flemish regulation on waste prevention and management (*VLAREA*). The waste management of ships in the Flemish ports between 2004 and 2006 is discussed by *Goffin et al. (2007)* [114225]. An exhaustive study of the waste streams in the ports was conducted in the context of the ECOWARE project (*Maes & Buyse 2000* [5082]). The waste stream of fishing ships was discussed in *Maes & Douvere (2004)* [214627] and *Belpaeme (2006)* [101455]. In the 'Fishing for Litter' project, fishermen have been reimbursed for collecting marine sourced litter (*Bonne & Tavernier 2007* [122168]). Furthermore, there is a new European project called '*Waste Free Oceans*', in which the industry pays fishermen for fishing litter (*Vanagt et al. 2012* [218533]).

2.5.8 Measures against air pollution from shipping

The air pollution, generated by sea-going ships is regulated in the Annex VI of the *MARPOL Convention (1973/1978)*. This annex reduces the sulphur content of the fuel to a maximum of 4.5% and 1.5% in certain areas ('Emission Control Areas', ECAs). The convention prohibits the emission of substances damaging the ozone layer, such as CFCs, and imposes emission limits for nitrogen. Besides the aforesaid convention, the EU has also implemented a series of measures in order to combat air pollution generated by ships. *Directive 2005/33/EC* stipulates that the sulphur content of shipping fuels is now subject to similar restrictions as the ones set in Annex VI of *MARPOL 73/78* (see above). In addition, the directive imposes a maximum sulphur content of 0.1% for gasoline fuels, used by the auxiliary engines in the European ports. In 2008, Annex VI of *MARPOL* was amended (entering into force on 1 July 2010), reducing the sulphur content in shipping fuel to 3.50% from 1 January 2012 onwards, and 0.50% after 1 January 2020. For ships in ECAs, the sulphur content is reduced to 1% from 1 July 2010 onwards and to 0.10% after 1 January 2015 (see also *Directive 2012/33/EU*).

An amendment of Annex VI of *MARPOL* in 2012 introduced a new Chapter 4 concerning a better energy efficiency technology (Energy Efficiency Design Index – EEDI) for newly-constructed vessels and a shipping energy efficiency management plan for all ships over 400 BT. In the long term, shipping will thus contribute to the reduction of the emission of greenhouse gases.

The EC has also launched a new climate plan (*IP/08/80* [214781]), in which Europe makes a commitment to reduce the emission of greenhouse gases by at least 20% by 2020. On a national level, the measures against air pollution from ships are settled in the *Royal Decree of 27 April 2007* (implementation of the *MARPOL Convention* and the European measures on the Belgian level).

Ships switching to the use of Liquefied Natural Gas (LNG) as an alternative fuel and the availability of cold ironing facilities are important measures against air pollution from shipping. LNG is by far the most important and environmentally friendly alternative for heavy fuel oil. The emission of sulphur and particulate matter from LNG is insignificant, and the NO_x and carbon emissions are 85 to 90% and 15 to 20% lower, respectively. In all Flemish sea ports, preparations are executed to allow LNG supply in the future. On the other hand, the cold ironing facilities ensure that ships no longer need their engines or generators while in the port. In several Flemish ports and on the quays of the inland waterways, onshore power facilities will be installed for boats, inland ships and sea-going vessels. Ships using an environmentally friendly fuel can submit a dossier to the Public Waste Agency of Flanders (*OVAM*), in the context of the European *Directive 2000/59/EC*. An overview of the legislation with regard to shipping is given in the coastal codex, theme *shipping*.

2.5.9 Measures against the introduction of non-indigenous species

In order to combat the introduction of non-indigenous species by means of the ballast tanks of ships, the *Ballast Water Convention* (IMO, 2004) forces ships to draft a 'Ballast Water and Sediment Management Plan' and to keep aboard a 'Ballast Water Record Book', reporting all ballast operations. The management of ballast water must take place according to the standard procedures (see *website IMO*) and with regard to the water treatment, systems recognised by IMO should be used. Until the ratification of this convention, OSPAR advises to adopt certain measures concerning the ballast water of ships on a voluntary basis (*OSPAR general guidance 07/2010* [227517]). Prior to the IMO *Ballast Water Convention*, the 1997 IMO resolution (*A.868(20)* [115831]) provided guidelines for the control and treatment of ballast water in order to reduce the transfer of harmful aquatic organisms and pathogens.

The International Council for the Exploration of the Sea (*ICES*) has established two working groups in order to investigate biological invasions and non-indigenous species: the ICES/IOC/IMO Working Group on Ballast and Other Ship Vectors (*WGBOSV*) and the Working Group on Introduction and Transfers of Marine Organisms (*WGITMO*). In 2010, ICES also organised a workshop on harmful phytoplankton potentially transported by ballast water (*Report 2010* [214650]). In 2005, ICES published a new version of the 1995 '*Code of Practice* [78789]' on the introduction and transfer of marine organisms.

At the European level, the introduction of non-indigenous species was recognised as a biological pressure and was included as a descriptor of the environmental status in the *MSFD* (*2008/56/EC*). The criteria and methodological standards for the determination of a GES with regard to non-indigenous species were discussed in *Olenin et al. (2010)* [202485]. At the moment, no general European instrument to tackle invasive species exists. *COM (2008) 789* presents policy options for a European strategy with respect to invasive species.

In Belgium, the intentional as well as the accidental introduction of non-indigenous species (through ballast water) is forbidden by the *law of 20 January 1999*, and the *Royal Decree of 21 December 2001* in implementation of the latter law. In the context of the *Belgian Forum on Invasive Species*, a protocol has been elaborated (invasive species environmental impact assessment (ISEIA), *Branquart 2009* [225606]) in order to evaluate the impact of non-indigenous organisms on the environment, and the possibility of spread and colonisation. The non-indigenous species in the BNS are reported to the ICES working group (*WGITMO*) by MUMM. An overview of all alien species in the BNS is given by *Kerckhof et al. (2007)* [114365] and the *list* of the '*VLIZ alien species consortium*' (more information: *Vandepitte et al. 2012* [217736]).

2.5.10 Measures against harmful anti-fouling substances

On 5 October 2001 in London, the *IMO* accepted the '*International Convention on the Control of Harmful Anti-fouling Systems on Ships*' which entered into force on 17 September 2008. This convention prohibits the use of harmful tributyltin compounds (TBT) in anti-fouling paint for ships and offers a mechanism to combat the future use of other harmful substances in anti-fouling systems. This convention resulted from the IMO resolution (A.895(21)) that calls for a legal instrument which completely forbids the use of TBT in anti-fouling paints by 1 January 2003 and which prohibits the presence of TBT in anti-fouling paint on hulls (which can be leached in contact with sea water) by 1 January 2008 (*Goffin et al. 2007* [114225]). Organic tin compounds were included in the *OSPAR List of Chemicals for Priority Action 2009* [227518] (more information: *OSPAR background document on organic tin compounds* [214804]).

At the European level, the use of organic tin compounds in anti-fouling substances of ships is prohibited by the *Directive 2002/62/EC*, which was preceded by the *Directives 89/677/EC* and *99/51/EC*. In *Regulation 782/2003* the measures of the IMO convention were implemented in the European legislation. In the *Water Framework Directive* (*2000/60/EC*) organic tin compounds are included in the list of priority substances and certain other pollutants. In Belgium, the IMO *Convention on the Control of Harmful Anti-fouling Systems on Ships* was implemented by the *law of 16 January 2009* and the *Decree of 9 May 2008*. An overview of the legislation concerning shipping is given in the coastal codex, theme *shipping*.

2.5.11 Safety on ships sailing to and from ports as well as in ports

Federal as well as Flemish instances have certain competencies with regard to the safety and security on ships sailing to and from Belgian ports as well as in Belgian ports (see also **Policy context**).

The Belgian port state control (FPS Mobility and Transport) inspects foreign ships that call at Belgian ports to investigate whether they meet the international IMO and ILO standards. Ships that do not meet these standards cannot leave the port unless the shortcomings have been resolved (for regional collaboration see: the Memorandum of Understanding on Port State Control (*Paris MOU*)).

The *Shipping Assistance Division* (Agency for Maritime and Coastal services) is responsible for safe and smooth shipping on the maritime fairways from and to the sea ports by organising and offering Vessel Traffic Services (VTS).

Important aspects of accidents or emergency situations at sea are part of the tasks of the *Coast Guard Centre*, which consists of the Maritime Rescue and Coordination Centre (*MRCC*) and Maritime Security Centre Belgium (*MIK*). The governor of the Province of West Flanders is the general coordinator of the Emergency Plan North Sea (*Ministerial Decree of 19 April 2005*). The MRCC is the first contact point for ships in need and also coordinates the emergency actions (more information: *Decree of 16 June 2006* and the *decision of the Flemish government of 26 October 2007*, *Ministerial Decree of 19 April 2005* – emergency plan North Sea and the *law of 27 July 2011*). In the case of MIK, the navy, the maritime police and customs collaborate in order to ensure that the law is being complied with at sea (the *Royal Decree of 6 February 2009*).

A list of the European regulations concerning the safety at sea and in the sea ports is given in Harbour Light (*Merckx et al. 2012* [220411]) and on the *website of the VHC* (more information: *eurlex website*). In the coastal codex, themes *shipping* and *port and industry*, the implementation of the international and European legislation can be consulted.

2.5.12 Measures against underwater noise from shipping

On the international level, recommendations have been formulated in the context of the Marine Environment Protection Committee (*MEPC*) of the IMO by means of resolutions which limit the effects of underwater noise on cetaceans. In the context of *ASCOBANS*, measures against the impact of underwater noise from shipping on small cetaceans are discussed (*resolution ASCOBANS 2003* [206790], *resolution ASCOBANS 2006* [206792]).

On the European level, the problem of underwater noise was included in the *MSFD* (*2008/56/EC*) where underwater noise and other forms of energy were identified as descriptors for a good environmental status (*Tasker et al. 2010* [202493]).

Legislation reference list

Table with international agreements, conventions, etc.

INTERNATIONAL AGREEMENTS, CONVENTIONS, ETC.			
Abbreviations (if available)	Title	Year of conclusion	Year of entering into force
CLL	International Convention on Load Lines	1966	
CLC	International Convention on Civil Liability for Oil Pollution Damage	(1969) - 1992	(1975) - 1996
FUND	International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage	1992 – (2003)	1996
COLREG	Convention on the International Regulations for Preventing Collisions at Sea	1972	1977
MARPOL	International Convention for the prevention of pollution from ships, as modified by the Protocol of 1978 relating thereto	1973	1978
SOLAS	International Convention for the Safety of Life at Sea	1974	1980
STWC	International Convention on Standards of Training, Certification and Watchkeeping for Seafarers	1978	1984 (major revisions in 1995 and 2010)
SAR	International Convention on Maritime Search and Rescue	1979	1985
UNCLOS	United Nations Convention on the law of the sea	1982	1994
Paris MOU	Paris Memorandum of Understanding on Port State Control	1982	
Bonn Agreement	Agreement for cooperation in dealing with pollution of the North Sea by oil and other harmful substances	1983	1989
HNS Convention	The International Convention on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances by Sea	1984	
OPRC	International Convention on Oil Pollution Preparedness, Response and Co-operation	1990	1995
ASCOBANS	Agreement on the conservation of small Cetaceans of the Baltic, North East Atlantic, Irish and North Seas	1991	1994
OSPAR Convention	The Convention for the Protection of the marine Environment of the North-East Atlantic	1992	1998
	International Convention on the Control of Harmful Anti-fouling Systems on Ships	2001	2008
BWM Convention	International Convention for the Control and Management of Ships' Ballast Water and Sediments	2004	

Table with European legislation. The consolidated version of this legislation is available on *Eurlex*.

EUROPEAN LEGISLATION			
Abbreviations (if available)	Title	Year	Number
Directives			
	Council Directive 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	1989	677
	Council Directive of 22 November 1994 on common rules and standards for ship inspection and survey organizations and for the relevant activities of maritime administrations	1994	57
	Council Directive of 22 November 1994 on the minimum level of training of seafarers	1994	58
	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)	1999	51
	Directive port reception facilities for ship-generated waste and cargo residues	2000	59
Water Framework Directive (WFD)	Directive establishing a framework for Community action in the field of water policy	2000	60
	Directive on the minimum level of training of seafarers	2001	25
	Directive on national emission ceilings for certain atmospheric pollutants	2001	81
	Directive establishing a Community vessel traffic monitoring and information system and repealing Council Directive 93/75/EEC	2002	59
	Directive adapting to technical progress for the ninth time Annex I to Council 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 (organostannic compounds)	2002	62
	Directive amending Directive 1999/32/EC as regards the sulphur content of marine fuels	2005	33
	Directive on ship-source pollution and on the introduction of penalties for infringements	2005	35
	Directive on ambient air quality and cleaner air for Europe	2008	50
Marine Strategy Framework Directive (MSFD)	Directive establishing a framework for community action in the field of marine environmental policy	2008	56
PSC Directive	Directive on port State Control	2009	16
	Directive on reporting formalities for ships arriving in and/or departing from ports of the Member States and repealing Directive 2002/6/EC	2010	65
Regulations			
	Regulation on the accelerated phasing-in of double hull or equivalent design requirements for single hull oil tankers and repealing Council Regulation (EC) No 2978/94	2002	417
	Regulation establishing a European Maritime Safety Agency	2002	1406
	Regulation on the prohibition of organotin compounds on ships	2003	782
	Regulation amending Regulation (EC) No 417/2002 on the accelerated phasing-in of double-hull or equivalent design requirements for single-hull oil tankers	2003	1726

EUROPEAN LEGISLATION (continuation)			
Abbreviations (if available)	Title	Year	Number
	Regulation establishing the second Marco Polo programme for the granting of Community financial assistance to improve the environmental performance of the freight transport system (Marco Polo II) and repealing Regulation (EC) No 1382/2003	2006	1692
	Regulation on the accelerated phasing-in of double-hull or equivalent design requirements for single-hull oil tankers	2012	530
Other (Decisions, Communications, White Papers, etc.)			
Erika I	Communication from the Commission to the European Parliament and the Council on the safety of the seaborne oil trade	2000	142
Erika II	Communication from the Commission to the European Parliament and the Council on a second set of community measures on maritime safety following the sinking of the oil tanker Erika	2000	802
	Communication from the Commission on Short Sea Shipping	2004	453
Erika III	Communication from the Commission: Third package of legislative measures on maritime safety in the European Union	2005	585
	Communication from the Commission: Keep Europe moving - Sustainable mobility for our continent Mid-term review of the European Commission's 2001 Transport White Paper	2006	314
	Commission staff working document (SEC): Report on the Motorways of the Sea State of play and consultation	2007	1367
	Communication from the Commission: towards an EU strategy on invasive species	2008	789
	Communication from the Commission: Strategic goals and recommendations for the EU's maritime transport policy until 2018	2009	8
	Communication from the Commission: Communication and action plan with a view to establishing a European maritime transport space without barriers	2009	10
	Commission recommendation on the safe implementation of the use of low sulphur fuel by ships at berth in Community ports	2009	1020
	White Paper: Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system	2011	144
	Communication from the Commission: Single Market Act II Together for new growth	2012	0573

Table with Belgian and Flemish legislation. The consolidated version of this legislation is available on *Belgisch staatsblad* and the *Justel-databases*.

BELGIAN AND FLEMISH LEGISLATION	
Date	Title
Laws	
Bijzondere wet van 8 augustus 1980	Bijzondere wet tot hervorming der instellingen
Wet van 20 januari 1999	Wet ter de bescherming van het mariene milieu in de zeegebieden onder de rechtsbevoegdheid van België
Wet van 6 april 1995	Wet betreffende de voorkoming van de verontreiniging van de zee door schepen
Wet van 16 februari 2009	Wet houdende instemming met het Internationaal Verdrag van 2001 betreffende de controle op schadelijke aangroeiwerende systemen op schepen, en met de Bijlagen, gedaan te Londen op 5 oktober 2001
Wet van 27 juli 2011	Wet betreffende de bevoegde instantie voor de opvang van schepen die bijstand behoeven
Royal Decrees	
KB van 20 juli 1973	Koninklijk besluit houdende zeevaartinspectiereglement
KB van 2 februari 1993	Koninklijk besluit tot vaststelling van de lijst van de havens en hun aanhorigheden overgedragen van de Staat aan het Vlaamse Gewest.
KB van 21 december 2001	Koninklijk besluit betreffende de soortenbescherming in de zeegebieden onder de rechtsbevoegdheid van België
KB van 30 september 2005	Koninklijk besluit betreffende de bevordering van het gecombineerd goederenvervoer
KB van 27 april 2007	Koninklijk besluit betreffende de voorkoming van luchtverontreiniging door schepen en de vermindering van het zwavelgehalte van sommige scheepsbrandstoffen
KB van 6 februari 2009	Koninklijk besluit tot oprichting en organisatie van het maritiem informatiekruispunt
KB van 11 april 2012	Koninklijk besluit tot instelling van een veiligheidszone rond de kunstmatige eilanden, installaties en inrichtingen voor de opwekking van energie uit het water, de stromen en de winden in de zeegebieden onder Belgische rechtsbevoegdheid
Decrees	
Havendecreet (2 maart 1999)	Decreet houdende het beleid en het beheer van de zeehavens
Decreet van 16 juni 2006	Decreet betreffende de begeleiding van de scheepvaart op de maritieme toegangswegen en de organisatie van het Maritiem Reddings- en Coördinatiecentrum
Decreet van 9 mei 2008	Decreet houdende instemming met het Internationaal Verdrag betreffende de controle van schadelijke aangroeiwerende systemen op schepen, opgemaakt in Londen op 5 oktober 2001
Ministerial Decrees	
MB van 19 april 2005	Ministerieel besluit tot vaststelling van het « Rampenplan Noordzee »
Other	
Besluit van de Vlaamse regering van 13 juli 2001	Besluit van de Vlaamse regering houdende de aanduiding van de voorlopige begrenzing van de havengebieden
Besluit van de Vlaamse regering van 26 oktober 2007	Besluit van de Vlaamse Regering betreffende het Maritiem Reddings- en Coördinatiecentrum
Besluit van de Vlaamse regering van 26 oktober 2007	Besluit van de Vlaamse Regering betreffende de begeleiding van de scheepvaart
Samenwerkingakkoord van 8 juli 2005	Samenwerkingsakkoord tussen de Federale Staat en het Vlaamse Gewest betreffende de oprichting van en de samenwerking in een structuur Kustwacht

3

Dredging and dumping

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Citation:

Van den Eynde, D., Lauwaert, B., Martens, C., Pirlet, H., 2013. Dredging and dumping. In: Lescrauwaet, A.K., Pirlet, H., Verleye, T., Mees, J., Herman, R. (Eds.), Compendium for Coast and Sea 2013: integrating knowledge on the socio-economic, environmental and institutional aspects of the Coast and Sea in Flanders and Belgium. Oostende, Belgium, p. 113-120.

More than 99% of the sediments that are dumped at sea derive from dredging in ports and fairways. Between 1990 en 2007 the total amount of dumped materials at sea in the OSPAR region fluctuated between 80 and 130 million tons (dry weight). About 90% of all dredged sediments are dredged and dumped in the Southern part of the North Sea. This is largely due to the maintenance of the fairways to big ports such as Hull, Antwerp, Rotterdam, Hamburg and Esbjerg. In 2007, Germany and France were the leaders of the OSPAR region with regard to dumping sediments in the sea, with 27.775 million tons and 24.402 million tons (dry weight) respectively (*OSPAR QSR 2010* [198817]). In Belgium, 10.066 million tons (dry weight) have been dumped in 2010 (*Lauwaert et al. 2011* [210175]). The evolution of the amount of dumped sediment in the Belgian Part of the North Sea (BNS) has been recorded since 1991 (*table dredged material* - The Management Unit of the North Sea Mathetical Models MUMM (RBINS)). In the future, the amount of dredged and dumped sediments will probably increase, due to the growing vessel size and the associated widening and deepening of fairways (*OSPAR QSR 2010* [198817]). In this text, the focus is on the dredging and dumping activities in the BNS. The specific situation of these activities in the Scheldt estuary is discussed in the text about the Scheldt Estuary.

3.1 Policy context

The maintenance and deepening of the maritime access channels to ports and the maintenance of the depth in the ports is a competence of the Flemish Region. The Department of Mobility and Public Works (MOW), *Maritime Access Division*, is responsible for the fairways and for the Port of Zeebrugge (except for the dredging of commercial piers, where the works, performed by the Maritime Access Division, are financed by *Maatschappij van de Brugse Zeevaartinrichtingen N.V.*), while the Agency for Maritime and Coastal Services (MD&K), *Coastal Division*, is responsible for the maintenance of the Flemish marinas of Ostend, Blankenberge and Nieuwpoort. However, the competence with regard to the dumping of dredged material at sea is a federal matter. Hence, the management of dredged material in Belgium is a shared competence, for which a cooperation agreement was concluded (12 June 1990) between the Flemish Region and the federal State, as modified by the *cooperation agreement of 6 September 2000*.

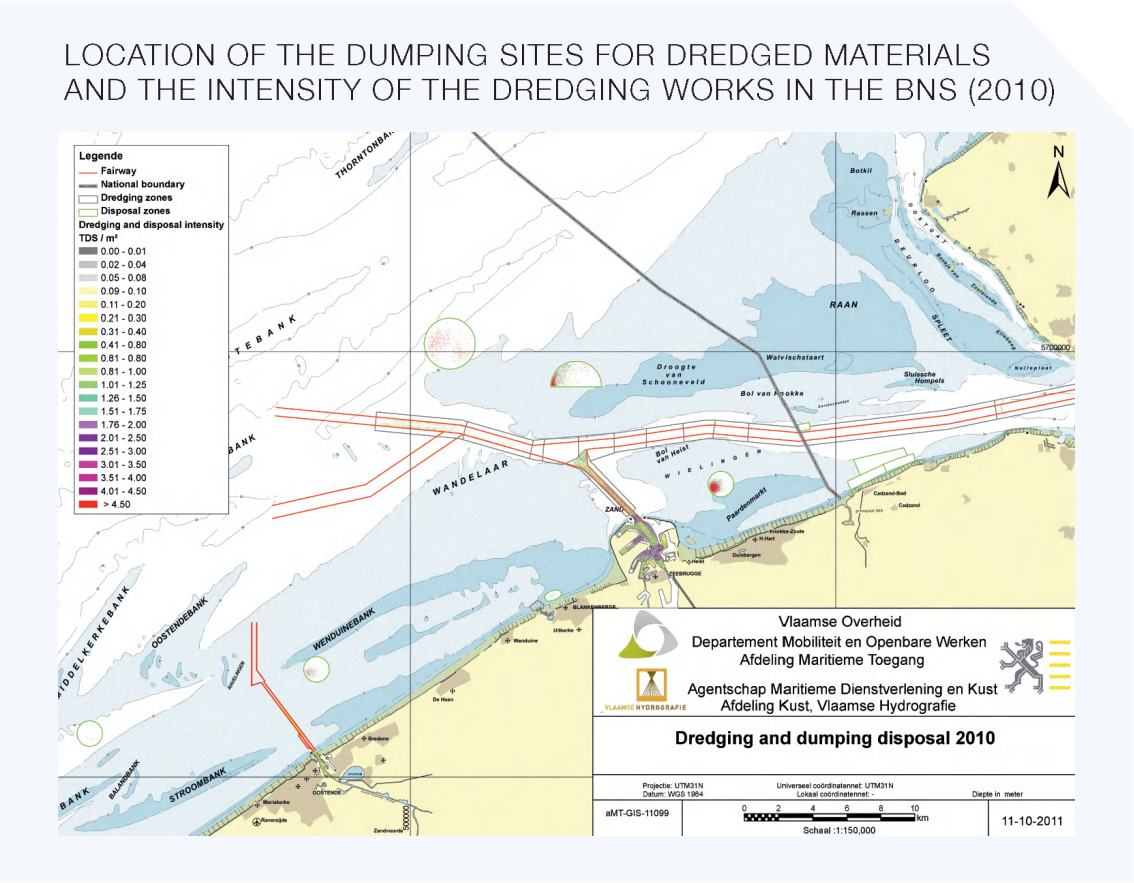

Figure 1. The location of the dumping sites for dredged materials and the intensity of the dredging works in the BNS in 2010 (*Lauwaert et al. 2011* [210175]).

3.2 Spatial use

The majority of dredging activities in Belgium take place in the Port of Zeebrugge and its channel (*Pas van het Zand*), in the fairway to the Western Scheldt (*Scheur*), and in the Sea Scheldt between the Belgian-Dutch border and the Deurganck dock (see theme **Scheldt Estuary**). In the BNS, five official dumping sites have been demarcated: *Bruggen en Wegen* Zeebrugge Oost, Oostende, Nieuwpoort, S1 and S2 (figure 1) (*Lauwaert et al. 2011* [210175]).

The procedure for obtaining a permit to dump dredged materials at sea has been stipulated by the *Royal Decree of 12 March 2000*. The maximum amount of dredged material and the location of the dredging and dumping sites of the permits that have been granted to the Maritime Access Division and to MD&K, can be found in several Ministerial Decrees (see *Belgisch Staatsblad*).

In the draft of the Marine Spatial Plan (*Ontwerp van koninklijk besluit tot vaststelling van het marien ruimtelijk plan* [227527]), as proposed by the Minister competent for the North Sea, certain spatial policy choices have been formulated concerning dredging and dumping. In this draft, the actual dredging locations are safeguarded with a view to safe maritime access and in relation with the evolution of ships. In order to prevent intensive use of certain locations and reflux of the material, a reservation zone has been demarcated as an alternative dumping site.

3.3 Societal interest

The Flemish ports are important economic gateways (see theme **Martime transport, shipping and ports**). Because of the increase in scale of the ships, it is necessary to regularly maintain the channels to the ports and to deepen and widen these fairways (this is connected to the developments in shipping in the Hamburg-Le Havre range). Each year, the Flemish government invests about 200 million euros to safeguard the accessibility of the ports (including the Scheldt Estuary, figure 2, Source: *Flemish Port Commission*). The accessibility of the Flemish ports of Ostend, Zeebrugge, Ghent and Antwerp is guaranteed by the *Martime Access Division* of the MOW department. The tasks of this department include maintenance dredging works, wreck salvage, deepening of the channels and sludge processing (also see *Decision of the Flemish government of 13 July 2001*). The *Ministerial Decrees of 28 December 2011* granted 4 permits for the dumping of 26.450 million tons of dry matter, at 4 dumping sites in the BNS to the

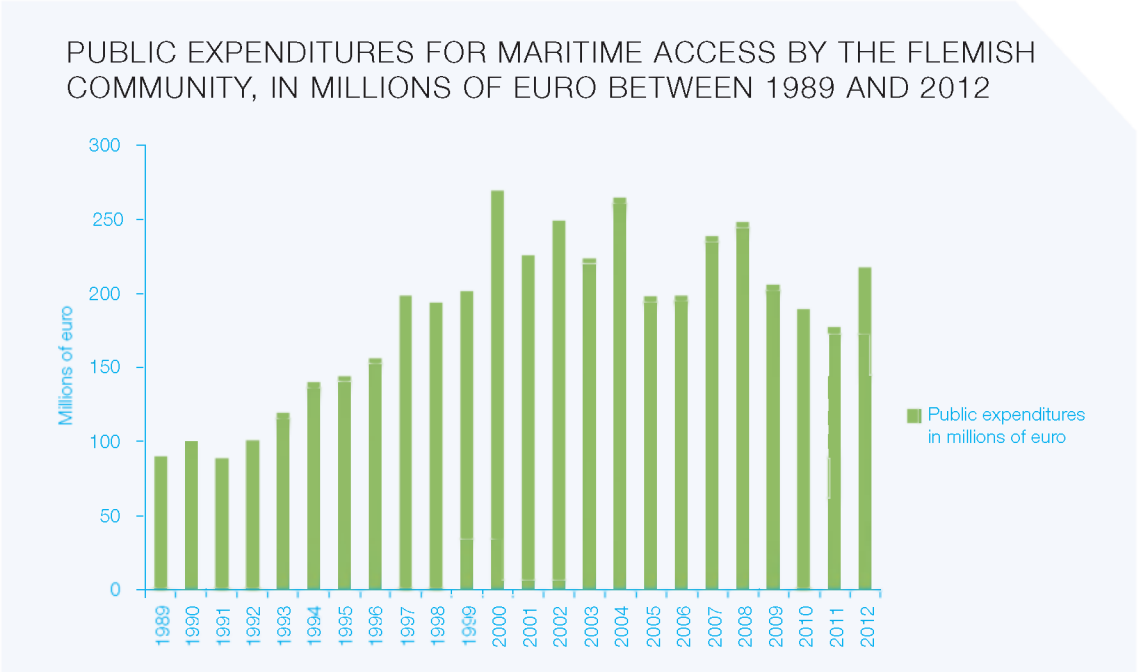

Figure 2. Public expenditures for maritime access by the Flemish Community, in millions of euro between 1989 and 2012 (in prices of 2012). Note: modifications may still happen through *Financieringsfonds voor schuldafbouw en eenmalige investeringsuitgaven* (Source: *Flemish Port Commission*, after: Flemish Community, MOW Department, Maritime Access Division).

Maritime Access Division from 1 January 2012 until 31 of December 2013. In addition, the Agency for Maritime and Coastal Services was allowed 3 permits for the dumping of 1,850,000 tons of dry matter in total. Both permit holders together dumped 11,910,431 and 10,066,736 tons of dry matter in 2009 and 2010 respectively.

A study by the Flanders Marine vzw (*haalbaarheidsstudie (2010)* [205773]) reveals that 2.9% of the total direct employment (50,195 jobs) in the marine/maritime sector in the Flanders region was situated in the dredging sector in 2008.

3.4 Impact

The most common type of dredging ship is the trailing suction hopper dredger. This ship is equipped with big suction pipes and a large dredge drag head that function as an enormous hoover tube, sucking the sediment out of the channels. In this process the sediment is removed until the minimum guaranteed nautical depth is achieved, including a small margin (maximum 30 cm on average over the entire channel) to anticipate sudden sedimentation. The sediment ends up in the cargo hold of the ship and can be dumped at the licensed dumping sites (or taken ashore in certain cases) by opening the doors or slides. The impact of dredging and dumping activities on the marine environment is of a physical, chemical and biological nature. (*Lauwaert et al. 2011* [210175] and table 1). The impact of dredging and dumping activities on other users is discussed in *Verfaillie et al. 2005* [78299] (*GAUFRE project BELSPO*).

Table 1. An overview of the environmental effects of dredging and dumping activities.

ENVIRONMENTAL IMPACT	LITERATURE
Physicochemical impact: changes of the seabed morphology and composition (grain size) and the sedimentological effects (sediment plumes, turbidity, release of pollutants, etc.)	*Lauwaert et al. 2002* [25571], *Seys 2002* [214470], *Fettweis et al. 2003 (MOMO)* [110922], *Fettweis et al. 2004a (MOMO)* [110923], *Fettweis et al. 2004b (MOMO)* [110969], *Lauwaert et al. 2004* [111007], *Fettweis et al. 2005a (MOMO)* [110962], *Fettweis et al. 2005b (MOMO)* [110921], *Verfaillie et al. 2005* [78299] (*GAUFRE project BELSPO*), *Fettweis et al. 2006a (MOMO)* [107892], *Fettweis et al. 2006b (MOMO)* [137709], *Lauwaert et al. 2006* [96485], *Fettweis et al. 2007a (MOMO)* [113770], *Fettweis et al. 2007b* [115401] (*MOCHA project BELSPO*), *Goffin et al. 2007* [114225], *Du Four & Van Lancker 2008* [203866], *Fettweis et al. 2008a (MOMO)* [119293], *Fettweis et al. 2008b (MOMO)* [122757], *Lauwaert et al. 2008* [130875], *Fettweis et al. 2009a (MOMO)* [199633], *Fettweis et al. 2009b (MOMO)* [199631], *Fettweis et al. 2009c (MOMO)* [144454], *Lauwaert et al. 2009* [144191], *Van Hoey et al. 2009* [143498], *Fettweis et al. 2010 (MOMO)* [197423], *André et al. 2010* [200613], *Fettweis et al. 2011a (MOMO)* [202998], *Fettweis et al. 2011b (MOMO)* [206659], *Fettweis et al. 2011c* [200595], *Lauwaert et al. 2011* [210175], *Fettweis et al. 2012 (MOMO)* [217195], *Fettweis et al. 2013 (MOMO)* [222062]
Biological impact: effects on the fauna and flora (benthos disturbances, impact of released pollutants, etc.)	*Seys 2002* [214470], *Lauwaert et al. 2002* [25571], *Lauwaert et al. 2004* [111007], *Verfaillie et al. 2005* [78299] (*GAUFRE project BELSPO*), *Lauwaert et al. 2006* [96485], *Lauwaert et al. 2008* [130875], *Lauwaert et al. 2009* [144191], *Van Hoey et al. 2009* [143498], *André et al. 2010* [200613], *Lauwaert et al. 2011* [210175]

3.5 Sustainable use

In order to tackle the impact on the marine environment of the dumping of dredged materials, this activity is globally governed by the *The London Convention (1972)*, and the *London Protocol (1996)* about the pollution due to dumping material at sea. In our region, these activities are also covered by the *OSPAR convention (1992)*, which aims to protect the marine environment in the Northeastern part of the Atlantic Ocean (including the North Sea). *OSPAR* also issued guidelines for the sustainable use of dredged materials (*OSPAR Guidelines for the management of Dredged Material 2009* [226539]).

On the European level, the *Water Framework Directive* (WFD) and the *Marine Strategy Framework Directive* (MSFD) indentify the changing concentration of sediments in the water column due to human intervention as one of the important pollutants. In the *MSFD* some of the descriptors for a good environmental status (GES) are relevant for dredging and dumping: the seafloor integrity (more information: *Rice et al. 2010* [202490]), underwater noise and other

forms of energy (more information: *Tasker et al. 2010* [202493]), contaminants and pollution effects (more information: *Law et al. 2010* [202492]) and the permanent alteration of the hydrographical conditions. In the *MSFD*, changes in siltation due to dredging and dumping activities are incorporated in the list of pressures and impacts. The implementation of the *MSFD* in Belgian legislation is provided by the *Royal Decree of 23 June 2010*. The environmental targets and indicators per descriptor for the BNS are elaborated in the following publication: *de Omschrijving van de Goede Milieutoestand & vaststelling van Milieudoelen voor de Belgische mariene wateren (2012)* [220232] (see theme **Nature and environment**). In addition, the *Birds Directive* (*2009/147/EC*) and the *Habitats Directive* (*92/43/EEC*) constitute an important framework for the reduction of the impact of dredging and dumping activities, given the obligation of assessment before the execution of a project.

In the BNS, dredging and dumping is governed by the *law of 20 January 1999*. The *Royal Decree of 12 March 2000* stipulates that a synthesis report must be presented every 2 years to the competent minister. In this report the effects of the dredging and dumping activities are discussed, and recommendations supporting the development of a stronger environmental policy are formulated (synthesis reports: *Lauwaert et al. 2002* [25571], *Lauwaert et al. 2004* [111007], *Lauwaert et al. 2006* [96485], *Lauwaert et al. 2008* [130875], *Lauwaert et al. 2009* [144191], *Lauwaert et al. 2011* [210175]). Moreover, the dredged material that is dumped needs to meet certain sediment quality criteria (*website BMM*, *Goffin et al. 2007* [114225], *OSPAR national action levels for dredged material 2008* [226538]). If the limits of three criteria are exceeded, the dredged material cannot be dumped in the sea. If the result of the analysis is situated between the target value and the limit, further analysis is required. About every 10 years, a large-scale monitoring programme is established to determine the sediment quality of dredging areas (*website MUMM*).

Holders of a permit are subject to a monitoring and scientific programme. Within the MOMO-programme, MUMM does the monitoring and modelling of the cohesive sediment transport, and evaluates the effects on the marine ecosystem as a consequence of dredging and dumping operations (see *inter alia* *Fettweis et al. 2013 (MOMO)* [222062]). The Institute for Agricultural and Fisheries Research (*ILVO*) investigates the biological and chemical aspects and intends to optimise the monitoring programme.

Legislation reference list

Table with international agreements, conventions, etc.

INTERNATIONAL AGREEMENTS, CONVENTIONS, ...			
Abbreviations (if available)	Title	Year of conclusion	Year of entering into force
The *London Convention*	Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter	1972	1975
The London Protocol	Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter	1996	2006
The *OSPAR Convention*	Convention for the protection of the Marine Environment of the North-East Atlantic	1992	1998

Table with European legislation. The consolidated version of this legislation is available on *Eurlex*.

EUROPEAN LEGISLATION			
Abbreviations (if available)	Title	Year	Number
Directives			
Habitats Directive	Directive on the conservation of natural habitats and of wild fauna and flora	1992	43
Water Framework Directive	Directive establishing a framework for Community action in the field of water policy	2000	60
Marine Strategy Framework Directive	Directive establishing a framework for Community action in the field of marine environmental policy (Marine Strategy Framework Directive)	2008	56
Birds Directive	Directive on the conservation of wild birds	2009	147

Table with Belgian and Flemish legislation. The consolidated version of this legislation is available on *Belgisch staatsblad* and the *Justel-databases*.

BELGIAN AND FLEMISH LEGISLATION	
Date	Title
Laws	
Wet van 20 januari 1999	Wet ter de bescherming van het mariene milieu in de zeegebieden onder de rechtsbevoegdheid van België
Royal Decrees	
KB van 12 maart 2000	Koninklijk besluit ter definiëring van de procedure voor machtiging van het storten in de Noordzee van bepaalde stoffen en materialen
KB van 23 juni 2010	Koninklijk besluit betreffende de mariene strategie voor de Belgische zeegebieden
Ministerial Decrees	
MB van 28 december 2011	Machtiging voor het storten van baggerspecie bij ministeriële besluiten van 28 december 2011
Other	
Samenwerkingsakkoord van 12 juni 1990	Samenwerkingsakkoord tussen de Belgische Staat en het Vlaamse Gewest ter vrijwaring van de Noordzee van nadelige milieu-effecten ingevolge bagger-specielossingen in de wateren die vallen onder de toepassing van de Conventie van Oslo

BELGIAN AND FLEMISH LEGISLATION (continuation)	
Date	Title
Samenwerkingsakkoord van 6 september 2000	Samenwerkingsakkoord tot wijziging van het Samenwerkingsakkoord van 12 juni 1990 tussen de Belgische Staat en het Vlaamse Gewest ter vrijwaring van de Noordzee van nadelige milieu-effecten ingevolge bagger-specielossingen in de wateren die vallen onder de toepassing van de Conventie van Oslo.
Besluit van de Vlaamse Regering van 13 juli 2001	Besluit van de Vlaamse Regering betreffende de aanduiding van de maritieme toegangswegen en de bestanddelen van de haveninfrastructuur

4

Sand and gravel extraction

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Van Lancker, V., Lauwaert, B., De Mol, L., Vandenreyken, H., De Backer, A., Pirlet, H., 2013. Sand and gravel extraction. In: Lescrauwaet, A.K., Pirlet, H., Verleye, T., Mees, J., Herman, R. (Eds.), Compendium for Coast and Sea 2013: integrating knowledge on the socio-economic, environmental and institutional aspects of the Coast and Sea in Flanders and Belgium. Oostende, Belgium, p. 121-130.

Up to 100 million m³ of marine sediments are annually extracted in the OSPAR Region. These are mainly sand and gravel for the construction industry and beach nourishment. Furthermore, marl is extracted to improve farmland and to filter water (*OSPAR QSR 2010* [198817]). Most of the marine sediment is extracted in the North Sea by countries such as the Netherlands (62.9 million m³ of extracted sediment in 2012), United Kingdom (11.5 million m³ of extracted sediment in 2012), France (7.7 million m³ of extracted sediment in 2012) and Denmark (5 million m³ of extracted sediment in 2012) (*Report of the Working Group on the Effects of Extraction of Marine Sediments on the Marine Ecosystem (ICES, WGEXT) 2012* [225413]). On the Belgian continental shelf (BCS), most of the extracted sediment is sand with an annual volume that fluctuated in the last ten years between 1.5 and 2.5 million m³ and amounted to more than 3 million m³ in 2012. Due to the low quality, the extraction of gravel is less important (Source: FPS Economy, Continental Shelf Service).

4.1 Policy context

The sand and gravel extraction on the BCS is a federal competence that belongs to the FPS Economy, SMEs, Self-employed and Energy and is regulated by the *law of 13 June 1969*. The coordination of the parties involved in the management of the exploration and exploitation on the continental shelf and in the territorial sea is executed by an advisory committee (*Royal Decree of 12 August 2000*).

4.2 Spatial use

The geographical demarcation and accessibility of the zones for the exploitation and exploration of mineral and other non-living resources in the territorial sea and on the continental shelf have been registered in the *Royal Decree of 1 September 2004* (table 1 and figure 1). Prior to this demarcation, a study about the possible concession zones for sand extraction was conducted (*Schotte 1999* [128514]). In total, 3 control zones have been demarcated in sectors for which concessions can be obtained. A fourth control zone was defined in 2010, in which 4 new sectors were demarcated based on new exploration data (*Ministerial Decree of 24 December 2010*). If a negative seabed evolution occurs due to extraction that does not meet the legal requirements (max. 5 m relative to a reference level), certain sections of the zones can be closed.

Table 1. An overview of the different control zones for sand extraction in the Belgian part of the North Sea (BNS) with their location and accessibility (RD to be published).

CONTROL ZONE	SECTOR	LOCATION	ACCESSIBILITY
1	A	Thornton Bank	Open, except for the area THBREF
	B	Goote Bank	Use is not recommended due to a new IMO-shipping route
2	A, B	Kwinte Bank	Open, except for KBMA and KBMB
	C	Buiten Ratel – Oostdyck	Open
3	A	Sierra Ventana	Open
	B	Sierra Ventana	Closed as long as the sector is used as a dumping site for dredged material
4	A	Noordhinder	Open
	B	Oosthinder	Open
	C	Oosthinder	Open
	D	Westhinder	Open

The extraction of sand and gravel at sea requires a concession permit (figure 2). In order to obtain a permit, an application form has to be submitted to the director of the Directorate General Quality and Safety of the FPS Economy according to the procedure stipulated in the *Royal Decree of 1 September 2004*. Furthermore, the *Royal Decree of 1 September 2004 concerning the environmental impact assessment (EIA)* defines that an environmental impact report has to be submitted to the Management Unit of the North Sea Mathematical Models (MUMM) (RBINS) (*MER voor de extractie van mariene aggregaten op het BNZ, 2006* [101387], *MER voor de extractie van mariene aggregaten in de exploratiezone van het BNZ, 2010* [214857]). The EIA by MUMM (*milieueffectenbeoordeling Pichot 2006* [214858]) is transferred to the minister/state secretary competent for Economy (Source: *website FPS Economy*).

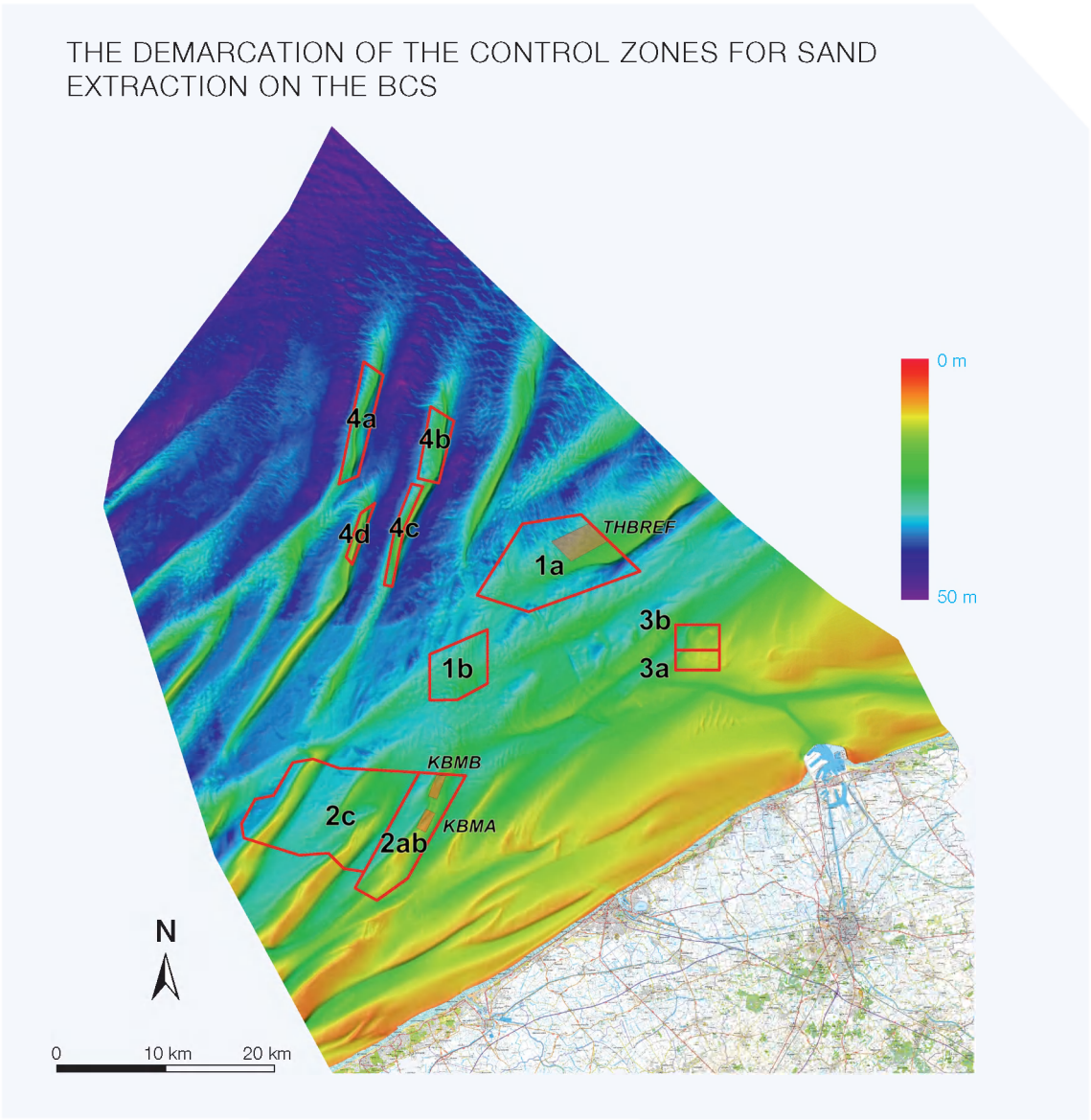

Figure 1. The demarcation of the control zones for sand extraction on the BCS (Source: FPS Economy, Continental Shelf Service, RD to be published).

The concessions that have been granted for the exploration and exploitation of the mineral and other non-living resources on the BCS are to be found in the Ministerial Decrees in the Belgian Official Journal (*Belgisch staatsblad*) (table 2).

In the draft of the Marine Spatial Plan (*Ontwerp van koninklijk besluit tot vaststelling van het marien ruimtelijk plan, 2013* [227527]), as proposed by the Minister competent for the North Sea, some spatial policy choices have been formulated concerning sand and gravel extraction on the BCS:

- The four existing extraction areas are preserved;
- The sectors of zone 2 are redefined in view of shipping safety and environmental protection;
- The introduction of an appropriate assessment as an additional part of the environmental impact report for the concessions within the marine protected area 'Flemish Banks' (see theme **Nature and environment**);
- The maximum allowed extraction volumes are preserved with a gradual decrease of the extractions in the Habitats Directive Areas (see theme **Nature and environment**);
- Multiple use of space is possible given the temporary character of the extraction activities.

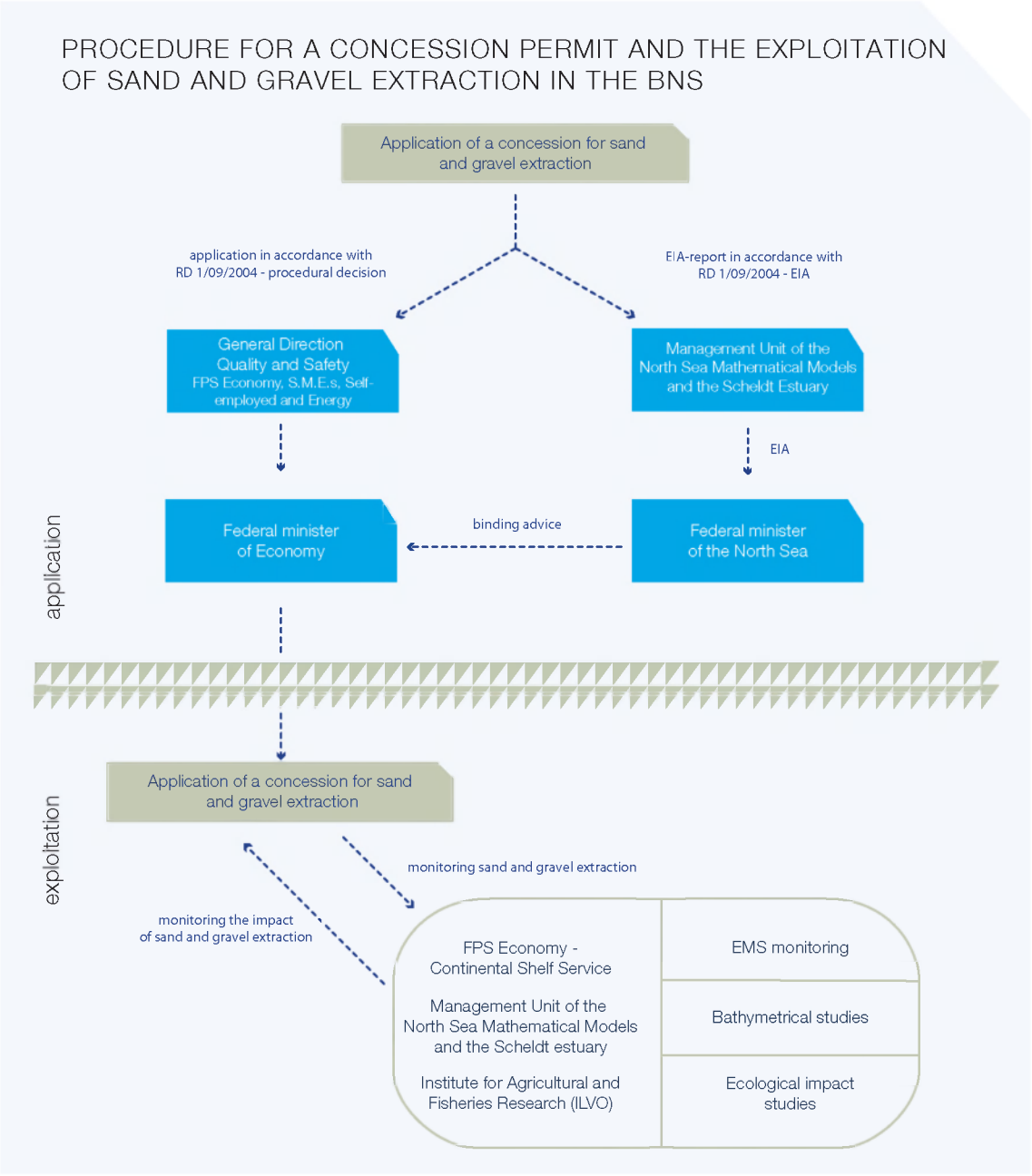

Figure 2. Flowchart of the procedure for a concession permit and the exploitation of sand and gravel extraction in the BNS (*law of 13 June 1969* and associated Royal Decrees).

4.3 Societal interest

The extraction of sand and gravel on the BCS has strongly increased over the past few years (figure 3). In 1976, a sediment volume of 29,000 m³ was extracted; this volume had risen to 3.2 million m³ in 2012. A maximum volume of approximately 4 million m³ was reached in 1997 due to the construction of submarine pipelines (Interconnector and NorFra) (*Goffin et al. 2007* [114225], *André et al. 2010* [200613], see also theme **Energy (incl. cables and pipelines)**).

Between 2003 and 2012 more than 75% of the sediment was extracted in zone 2 with a gradual shift from sectors 2A and 2B to 2C (*Roche et al. 2011* [208681]). Currently, a maximum of 15 million m³ of sediment may be extracted in the

Table 2. An overview of the concessionaires for sand extraction in the BNS with the maximum extraction volume for 2013 (Source: FPS Economy, Continental Shelf Service).

CONCESSIONAIRE	MAXIMUM EXTRACTION VOLUME FOR 2013
Charles Kesteleyn NV	100,000 m³
Dranaco NV	100,000 m³
CEI - De Meyer NV	140,000 m³
Satic NV	150,000 m³
De Hoop Handel BV c.o. Satic NV	150,000 m³
TV Zeezand Exploitatie NV	175,000 m³
Alzagri NV	200,000 m³
DC Industrial	300,000 m³
Vlaamse Overheid – Afdeling Maritieme Toegang	350,000 m³
DEME Building Materials NV	400,000 m³
Belmagri NV	500,000 m³
Nieuwpoortse Handelsmaatschappij NV	550,000 m³
Hanson Aggregates Belgium NV	600,000 m³
Vlaamse Overheid – Afdeling Kust	550,000 m³ and 2,000,000 m³ (Masterplan Coastal Safety)

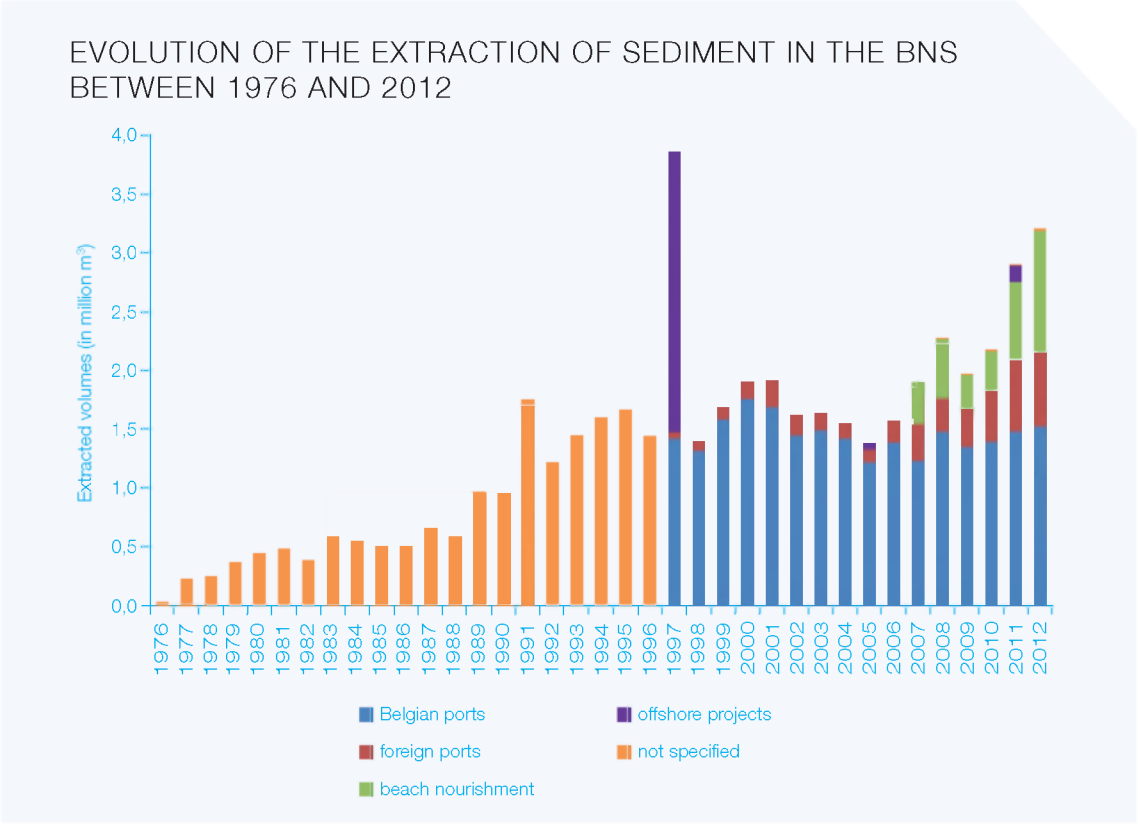

Figure 3. Evolution of the extraction of sediment in the BNS between 1976 and 2012. Remark: construction of submarine pipelines in 1991 and 1997 (Source: FPS Economy, Continental Shelf Service).

control zones over a period of 5 years. This sediment is mainly landed in Flanders, although some sediment is also unloaded in the harbours of France and the Netherlands (up to 16% in 2007) (*De Smet et al. 2009* [214491]).

The sediments on the BCS are used for coastal protection (beach nourishments) and other maritime works. Recently, new concession zones have been defined in the Hinder Banks region. These zones should provide 35 million m³ of sediment during the next 10 years in the context of the Masterplan Coastal Safety and the OW-plan in Ostend (*MER voor de extractie van mariene aggregaten in de exploratiezone van het BNZ, 2010* [214857], *Mathys et al. 2011* [208763], *Rumes et al. 2011* [208772]) (see theme **Safety against flooding**). On the other hand, the sediments in BNS constitute an important source of construction materials. Depending on the quality and the grain size, the sediment is used as a filling sand, as raw material for asphalt production or in the concrete industry (*Van De Kerckhove 2011* [209332]).

4.3.1 Employment

According to a study by Zeegra vzw concerning the economic importance of sand extraction in the BNS (*het economisch belang van de sector van zandwinning op zee in België (2004)* [127109]), 295 persons were employed in this sector in 2002. This is an increase of 18.5% compared to employment in 1998. 39.3% of employment in the sector of offshore sand extraction is situated in the province of West Flanders. The feasibility study of the Flanders Marine vzw (the current *Flanders Maritime Cluster*) indicates that in 2008, 0.7 % of total direct employment in the marine/maritime sector in the Flemish Region (50,195 jobs) was situated in the sector of raw materials extraction.

4.3.2 Turnover and gross value added

In 2002, the total turnover of 19 out of 22 companies, active in the offshore sand extraction sector was estimated at 264,931,000 euros. Over the period 1998-2002, the turnover of these 19 companies increased by 45.4%. The total gross value added of these 22 companies amounted to 31.245 million euros in 2002, representing an increase of 74.4% in comparison to 1998 (*Het economisch belang van de sector van zandwinning op zee in België (2004)* [127109]).

4.4 Impact

The most commonly used vessel for sand extraction is the trailing suction hopper dredger, which makes channels of 1-3 m wide and 0.2-0.5 m deep in the seabed (*Degrendele et al. 2010* [205558]). The *Royal Decree of 1 September 2004 – EIA*, stipulates the different effects of sand extraction on the marine environment that need to be taken into account in the environmental assessment report (tables 3 and 4).

Table 3. An overview of the effects of sand extraction on the environment.

ENVIRONMENTAL IMPACT	LITERATURE
Seabed and water (changes in the bathymetry, sedimentology, sediment plumes, turbidity, hydro-dynamic regime, etc.)	*de Groot 1996* [29247], *Seys 2003* [36257], *Verfaillie et al. 2005* [78298] (*GAUFRE project BELSPO*), *MER voor de extractie van mariene aggregaten op het BNZ, 2006* [101387], *Van Lancker et al. 2007* [126350] (*MAREBASSE project BELSPO*), *Vanaverbeke et al. 2007* [109297] (*SPEEK project BELSPO*), *Van den Eynde et al. 2008*, *Van Lancker et al. 2009* [211953] (*QUEST4D project BELSPO*), *Van den Eynde & Norro, 2009* [143265], *MER voor de extractie van mariene aggregaten in de exploratiezone van het BNZ, 2010* [214857], *Van Lancker et al. 2010* [205567], *Bellec et al. 2010* [205556], *Degrendele et al. 2010* [205558], *Van den Eynde et al. 2010* [205561], *Garel 2010* [205559], *Roche et al. 2011* [208681], *De Sutter & Mathys 2011* [208767]
Fauna, flora and biodiversity	*Seys 2003* [36257], *Verfaillie et al. 2005* [78298] (*GAUFRE project BELSPO*), *MER voor de extractie van mariene aggregaten op het BNZ, 2006* [101387], *Vanaverbeke et al. 2007* [109297] (*SPEEK project BELSPO*), *Hostens et al. 2008*, *MER voor de extractie van mariene aggregaten in de exploratiezone van het BNZ, 2010* [214857], *De Backer et al. 2010* [144695], *Bonne 2010* [205566], *De Backer et al. 2011* [208690], *De Sutter & Mathys 2011* [208767]
Air quality and climate	*MER voor de extractie van mariene aggregaten op het BNZ, 2006* [101387], *MER voor de extractie van mariene aggregaten in de exploratiezone van het BNZ, 2010* [214857], *De Sutter & Mathys 2011* [208767]
Noise and vibrations	*MER voor de extractie van mariene aggregaten op het BNZ, 2006* [101387], *MER voor de extractie van mariene aggregaten in de exploratiezone van het BNZ, 2010* [214857], *De Sutter & Mathys 2011* [208767]

Table 4. An overview of the effects of sand extraction on the other users.

IMPACT ON USERS	LITERATURE
Risks and safety (shipping, oil pollution, coastal protection, etc.)	*MER voor de extractie van mariene aggregaten op het BNZ, 2006* [101387], *Verwaest et al. 2008* [127215], *MER voor de extractie van mariene aggregaten in de exploratiezone van het BNZ, 2010* [214857], *De Sutter & Mathys 2011* [208767]
Seascape and cultural heritage	*MER voor de extractie van mariene aggregaten op het BNZ, 2006* [101387], *MER voor de extractie van mariene aggregaten in de exploratiezone van het BNZ, 2010* [214857], *De Sutter & Mathys 2011* [208767]
Interaction with other human activities (incl. coastal protection)	*Verfaillie et al. 2005* [78298] (*GAUFRE project BELSPO*), *Verwaest & Verelst 2006* [115450], *MER voor de extractie van mariene aggregaten op het BNZ, 2006* [101387], *Verwaest 2008* [127215], *MER voor de extractie van mariene aggregaten in de exploratiezone van het BNZ, 2010*, *De Sutter & Mathys 2011* [214857]
Cumulative effects (e.g. in combination with activities in the offshore wind farms)	*MER voor de extractie van mariene aggregaten in de exploratiezone van het BNZ, 2010* [214857], *De Sutter & Mathys 2011* [208767]

4.5 Sustainable use

Within the OSPAR region, all countries that extract sand and gravel on a large scale have to comply with the European *Directive 85/337/EEC* concerning the EIA of specific public and private projects as well as the European *Habitats Directive* (*92/43/EC*). With regard to the management of marine sediment extraction, the OSPAR countries have agreed to apply the directives as proposed by the International Council for the Exploration of the Sea (*ICES*) (see annex 10 of *Report of the Working Group on the effects of extraction of marine sediments on the marine ecosystem (ICES, WGEXT) 2003* [105425]). These directives also discuss nature conservation and spatial conflicts between users. Belgium, Denmark, Germany, the Netherlands and the United Kingdom have made the use of the 'black box' system which monitors the extraction in space and time mandatory. The effects of the sand and gravel extraction on the marine environment are followed up by the ICES working group *WGEXT*. Belgium is represented in this working group by *MUMM* and the Institute for Agricultural and Fisheries Research (*ILVO*).

At the European level, the impact on the marine environment caused by the extraction of sediments is also included in the *Marine Strategy Framework Directive* (*2008/56/EC*) (MSFD, see also *Royal Decree of 23 June 2010*). In the *MSFD*, several descriptors for a good environmental status (GES) relevant to the extraction of marine sediments are identified: seafloor integrity (more information: *Rice et al. 2010* [202490]), underwater noise and other forms of energy (more information: *Tasker et al. 2010* [202493]) and the permanent alteration of the hydrographical conditions. Furthermore, the selective extraction due to exploration and exploitation of living and non-living resources on the seabed and subsoil is listed among the pressures and impacts. The European *Habitats Directive* (see also *Royal Decree of 14 October*) offers a framework to protect ecologically important areas such as the gravel beds in the BNS against pressures such as sediment extraction (*Degrendele et al. 2008* [127262], *Houziaux et al. 2008* [140756], *Degraer et al. 2009* [143363]). The implications for the extraction in the Natura 2000 areas are discussed in *Raeymaekers et al. (2011)* [208734]. In the draft of the Marine Spatial Plan (*Ontwerp van koninklijk besluit tot vaststelling van het marien ruimtelijk plan, 2013* [227527]), as proposed by the Minister competent for the North Sea, measures are formulated with regard to the sand extraction activities in order to protect the Habitats Directive Areas.

The sand and gravel extraction in the BNS is monitored by the Continental Shelf Service (the FPS Economy), MUMM and ILVO (*Brochure Dienst Continentaal Plat 2008* [127213], *Roche et al. 2011* [208681], *De Backer et al. 2011* [208690], *Van Lancker et al. 2011* [208697]). Each concessionaire needs to pay a fee in proportion to the extracted volume. This fee is used to finance the ongoing research into the impact of exploitation and exploration activities on the marine environment and the seabed (*Degrendele 2008* [225416], *Brochure Dienst Continentaal Plat 2008* [127213]).

The extraction activities are controlled by means of the registers of the dredgers on the one hand and by means of the 'black box' system (Electronic Monitoring System, EMS) on the other. This system was introduced in 1996 and is managed by the MUMM, as commissioned by the Continental Shelf Service (*Degrendele 2008* [225416], *Roche et al. 2011* [208681]). Furthermore, the physical impact of extraction on the seabed is monitored by the Continental Shelf Service and MUMM. The sediment volumes in the control zone are followed up by means of the research vessel Belgica. In

this regard, a maximum of 5 m of sediment may be removed compared to the original level of the seabed (*Roche et al. 2011* [208681]). MUMM is responsible for monitoring the hydrodynamics and the sediment transport by means of models and measurements (*Van den Eynde et al. 2010* [205561], *Van Lancker et al. 2011* [208697]). The biological environment research group of ILVO examines the ecological impact of the extraction activities as well as the biological evolution after cessation of the activities (*De Backer et al. 2010* [144695], *De Backer et al. 2011* [208690]). In the exploitation zone 4, an elaborate 'base line' study was executed to estimate the impact of the extraction activities (*Mathys et al. 2011* [208763]).

Furthermore, specific studies and research projects such as BUDGET (*Lanckneus et al. 2001* [24845], *BUDGET project BELSPO*), *SPEEK* (*Vanaverbeke et al. 2007* [109297], *SPEEK project BELSPO*), *MAREBASSE* (*Van Lancker et al. 2007* [126350], *MAREBASSE project BELSPO*), *EUMARSAND* (*Van Lancker et al. 2010* [205548], EU-FP6-project) and QUEST4D (*Van Lancker et al. 2009* [211953], *QUEST4D project BELSPO*) contribute to a better understanding of the impact and a sustainable management of the sand and gravel extraction.

Legislation reference list

Table with European legislation. The consolidated version of this legislation is available on *Eurlex*.

EUROPEAN LEGISLATION			
Abbreviations (if available)	Title	Year	Number
Directives			
EIA Directive	Council Directive 85/337/EEC of 27 June 1985 on the assessment of the effects of certain public and private projects on the environment	1985	337
Habitats Directive	Directive on the conservation of natural habitats and of wild fauna and flora	1992	43
Marine Strategy Framework Directive	Directive establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive)	2008	56

Table with Belgian and Flemish legislation. The consolidated version of this legislation is available on *Belgisch staatsblad* and the *Justel-databases*.

BELGIAN AND FLEMISH LEGISLATION	
Date	Title
Laws	
Wet van 13 juni 1969	Wet inzake de exploratie en exploitatie van niet-levende rijkdommen van de territoriale zee en het continentaal plat
Wet van 20 januari 1999	Wet ter bescherming van het mariene milieu en ter organisatie van de mariene ruimtelijke planning in de zeegebieden onder de rechtsbevoegdheid van België
Royal Decrees	
KB van 12 augustus 2000	Koninklijk besluit tot instelling van de raadgevende commissie belast met de coördinatie tussen de administraties die betrokken zijn bij het beheer van de exploratie en de exploitatie van het continentaal plat en van de territoriale zee en tot vaststelling van de werkingsmodaliteiten en –kosten ervan
KB van 1 september 2004 – toekenningsprocedure	Koninklijk besluit betreffende de voorwaarden, de geografische begrenzing en de toekenningsprocedure van concessies voor de exploratie en de exploitatie van de minerale en andere niet-levende rijkdommen in de territoriale zee en op het continentaal plat
KB van 1 september 2004 – milieueffectenbeoordeling	Koninklijk besluit houdende de regels betreffende de milieu-effectenbeoordeling in toepassing van de wet van 13 juni 1969 inzake de exploratie en exploitatie van niet-levende rijkdommen van de territoriale zee en het continentaal plat
KB van 14 oktober 2005	Koninklijk besluit tot instelling van speciale beschermingszones en speciale zones voor natuurbehoud in de zeegebieden onder de rechtsbevoegdheid van België
KB van 23 juni 2010	Koninklijk besluit betreffende de mariene strategie voor de Belgische zeegebieden
Ministerial Decrees	
MB van 24 december 2010	Ministerieel besluit betreffende de afbakening van sectoren in exploratiezone 4 voor de exploratie en de exploitatie van de niet-levende rijkdommen van de territoriale zee en het continentaal plat

5

Energy (including cables and pipelines)

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Vanbavinckhove, G., Pirlet, H., 2013. Energy (including cables and pipelines). In: Lescrauwaet, A.K., Pirlet, H., Verleye, T., Mees, J., Herman, R. (Eds.), Compendium for Coast and Sea 2013: integrating knowledge on the socio-economic, environmental and institutional aspects of the Coast and Sea in Flanders and Belgium. Oostende, Belgium, p. 131-152.

5.1 Offshore wind energy

Europe is the world leader in the offshore wind energy sector. In 2011, 1,622 turbines have been installed and connected to the power grid, with a total installed capacity of 4,995 MW in the European seas. These windmills are spread over 55 wind farms in 10 different countries (*The European offshore wind industry, EWEA 2012* [225400]). The UK and Denmark are currently the main actors in Europe regarding offshore wind energy. In Belgium, two wind farms (C-Power and Belwind) were operational at the end of 2012 with 36 and 55 wind turbines and a total installed capacity of 214.5 MW and 165 MW respectively, which ranks us third in Europe (*Mathys et al. 2009* [144679] (*OPTIEP-BCP project BELSPO*), *The European offshore wind industry, EWEA 2012* [225400], *website C-Power*, *website Belwind*).

5.1.1 Policy context

Over the past 10 years, renewable energy has increasingly come from offshore wind farms. This development is largely driven by the policy that seeks to reduce the dependence on fossil fuels and the associated impact on the climate (*OSPAR QSR 2010* [198817]). The European *Directive 2001/77/EC* imposed on each Member State a target figure of the electricity's proportion to be produced by renewable sources by 2010. In the case of Belgium, this share was 6% of the total energy consumption. In 2008, the European Commission launched a new climate plan (*IP/08/80* [214781]), in which Europe committed itself to produce 20% of its total energy production from renewable energy sources by 2020 *(COM (2010) 639)*. Belgium has been obliged to incorporate 13% of renewable energy into its final energy consumption by 2020[1] (*Directive 2009/28/EC*, *het nationaal actieplan hernieuwbare energie 2010* [226574]). This objective embraces the entirety of green power, green heat and cooling, and biofuels. The European Commission emphasised in a number of communications (*COM (2008) 768, COM (2010) 677, COM (2010) 639, COM (2012) 271, COM (2012) 494*) the importance of offshore wind energy for achieving the renewable energy targets. A roadmap for the switchover in the long term to an energy system with low CO_2 emissions by 2050 has been outlined by Europe (*COM (2011) 112, COM (2011) 885*). Moreover, the potential of offshore wind energy has been recognised hereby (*Roadmap 2050 - technisch rapport* [214624], *Roadmap 2050 - beleidsaanbevelingen* [214623]). An overview of the EU and national electricity market legislation is available on the *CREG* and *FPS Economy* website.

At the European level, the policy with regard to energy is developed by the *Directorate-General for Energy*. Furthermore, the Directorate-General for Maritime Affairs (*DG MARE*) works on the so-called 'blue economy' (including offshore wind turbines) policy. In Belgium, the policy on renewable energy is in principle a competence of the regions (*Vlaamse beleidsnota energie 2009-2014* [225407]). However, the Belgian part of the North Sea (BNS) is placed under federal jurisdiction so that the policy on offshore wind energy is developed at the federal level by the Minister of Energy and the Minister of the North Sea (*FPS Economy, S.M.E.s, Self-employed and Energy*, for more information: *federale beleidsnota energie 2012* [226456], *het nationaal actieplan hernieuwbare energie 2010* [226574]).

5.1.2 Spatial use

Prior to the installation of the wind farms, a study has been conducted with regard to the seabed, wind supply and grid capacity in the available areas for an optimal development of the offshore wind energy (*Le Bot et al. 2004* [64266], *project BELSPO*). Such a survey is important for the choice of the foundations of the wind turbines (*Van de Walle 2011* [203247]). Besides, the spatial needs of other users of the sea should also be taken into account (*Maes et al. 2004* [70936] (*MARE-DASM project BELSPO*), *De Wachter & Volckaert 2005* [78285] (*GAUFRE project BELSPO*), *Verhaeghe et al. 2011* [206186], *MERMAID project*).

The coordinates of the designated space for the installation of wind farms in the BNS are established by the *Royal Decree of 20 December 2000* (as amended by the *Royal Decree of 3 February 2011*). In the draft of the Marine Spatial Plan (*Ontwerp van koninklijk besluit tot vaststelling van het marien ruimtelijk plan, 2013* [227527]), as proposed by the Minister competent for the North Sea, some spatial policy choices have been formulated concerning the wind farms in the BNS. In this plan, no additional area for the production of renewable energy has been indicated as the current concession area should first be made fully operational.

1 Target for the share of energy from renewable sources in gross final consumption of energy.

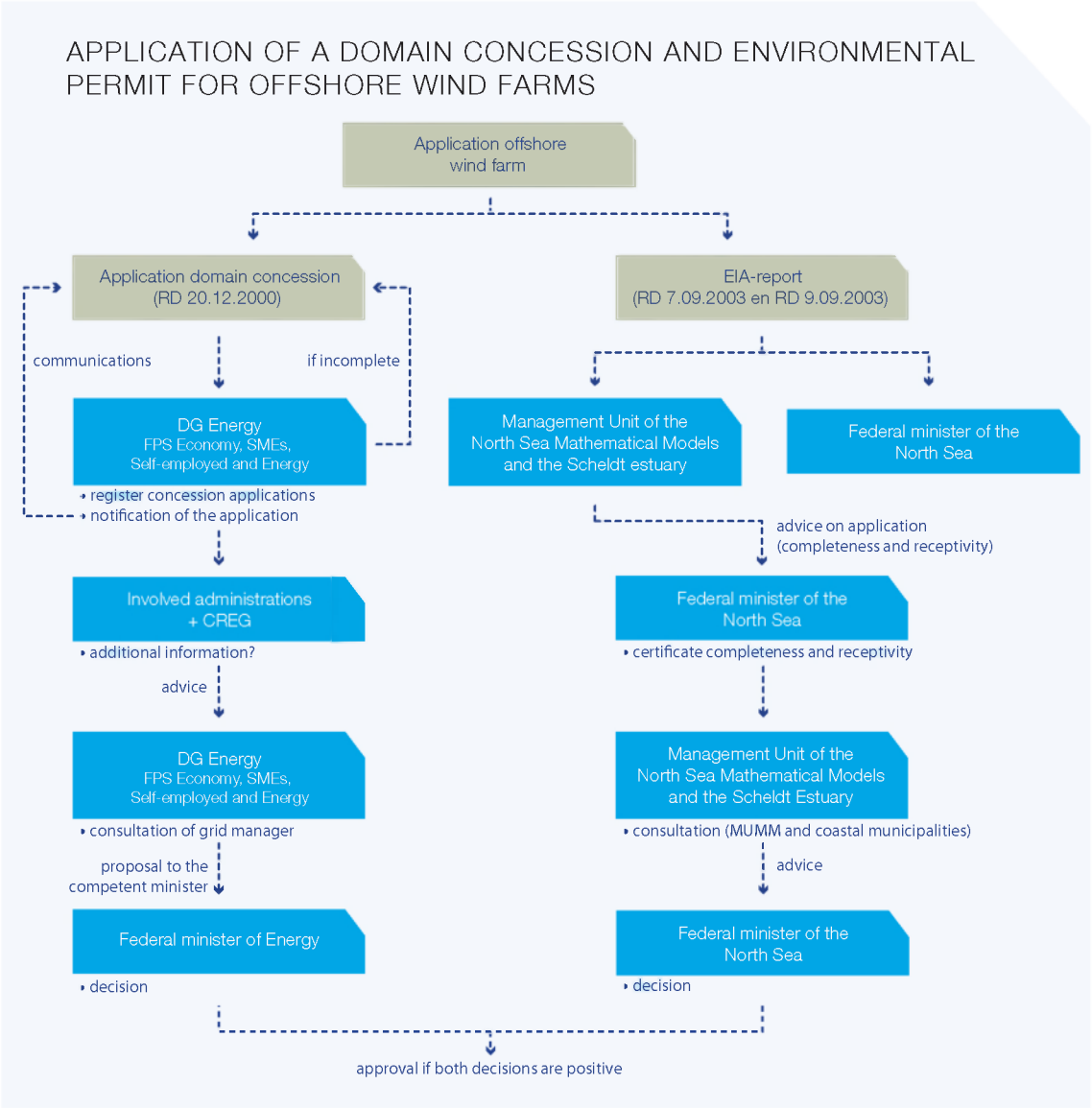

Figure 1. Flowchart for the application of a domain concession and environmental permit for offshore wind farms (*Royal Decree of 20 December 2000, Royal Decree of 9 September 2003*).

In order to actually realise an offshore wind farm, a project ought to have multiple permits. Currently the following federal permits are required:

- A Ministerial Decree for the granting, as a result of an environmental impact study, of a permit by the FPS Environment for the construction of the wind farm, the cabling and the operation;
- A Ministerial Decree for the granting of a concession zone by the DG Energy of the FPS Economy;
- (A Ministerial Decree for the granting of a permit for the installation of offshore cables by the DG Energy of FPS Economy (see also **Pipelines and cables**)).

ENVIRONMENTAL PERMIT

Each project must go through an environmental permit procedure in accordance with the law on the protection of the marine environment (*law of 20 January 1999*), the *Royal Decree of 7 September 2003* (procedure for the licensing and authorisation of certain activities in the BNS) and the *Royal Decree of 9 September 2003* (rules of the environmental impact assessment). The environmental impact assessment (EIA) is performed by the Management Unit of the North

Sea Mathematical Models (MUMM, RBINS) which subsequently advises the competent minister (*website MUMM*) (for more information: coastal codex, theme *EIA*).

DOMAIN CONCESSION

Each project should also pass the procedure for the designation of a domain concession for the proposed project area (see figure 1). The latter procedure and the conditions for granting a concession have been stipulated in the *Royal Decree of 20 December 2000*. As a result of the modification of the *Royal Decree of 28 September 2008*, applications for a domain concession for the construction and operation of offshore installations in the BNS should no longer be addressed to the Commission for the Regulation of Electricity and Gas (*CREG*). According to the new procedure, they have to be directed to and handled by the delegate of the Minister, who advises the Minister of Energy (see also the *Ministerial Decree of 16 March 2009*).

When additional permits are required by other legislation for installations in the domain concession (e.g. the environmental permits), the permit of the domain concession remains suspended until any additional license or authorisation has been granted. Moreover, a notification of this authorisation should be made in accordance to the applicable law. If any of the additional required permits or final permissions are refused, the domain concession expires on the date of notification of this refusal. In Belgium, 7 domain concessions have already been granted to different project developers (table 1, figure 2).

Table 1. An overview of the location and use of space of the various domain concessions for offshore wind farms in the BNS.

NAME PROJECT	LOCATION	USE OF SPACE	MORE INFORMATION
Mermaid	Above the Bligh Bank	28.39 km²	
Belwind	Bligh Bank	35.4 km²	*MER Offshore Windmolenpark Bligh Bank. Belwind NV 2007* [227510], *website Belwind*
Seastar	Between the Lodewijkbank (former Bank Zonder Naam) and the Bligh Bank	16 km²	*Website electrawinds, website 4c offshore*
Northwind (vroeger Eldepasco)	Lodewijkbank (former Bank Zonder Naam	14.5 km²	*MER – Offshore Windturbinepark Bank zonder Naam. Eldepasco NV 2008* [226564], *website Northwind*
Rentel	Southwest Schaar	18 km²	*Website electrawinds, website 4c offshore*
C-Power	Thorntonbank	13.79 km²	*MER voor een Offshore Windturbinepark op de Thorntonbank. Deel 2: Hoofddocument MER 2003* [226563] + *MER - Wijziging & uitbreiding offshore windturbinepark Thorntonbank. C-Power N.V. 2010* [227509], *website C-Power*
Norther / North Sea Power	South of the Thorntonbank	28.2 km² (38 km² including cables and pipelines)	*MER Norther project en wijzigingsMER, Website 4c offshore*

In Belgium, a ban on shipping has been established in the area of wind turbines and wind farms (*Verhaeghe et al. 2011* [206186], *Royal Decree of 11 April 2012*). From the operational phase onwards, a safety zone of five hundred meters is established around artificial islands, installations or infrastructure for the generation of energy from water, currents and winds (such as wind turbines and wind farms) (*Decree of 11 April 2012*) (figure 2).

5.1.3 Societal interest

THE ENERGY PRODUCTION OF OFFSHORE WIND FARMS

According to a study by the European Environment Agency (EEA), the economically feasible potential of offshore wind production amounts to 2,600 TWh in 2020 and 3,400 TWh in 2030. This corresponds to 60-70% of the total

Figure 2. The location of the different wind farms in the Belgian Part of the North Sea with an indication of the turbines that were already constructed in May 2013. The cables of C-Power and Belwind are indicated as well (*Continentaal Plat & Vlaamse Hydrografie 2013* [227521]).

European electricity demand in 2020 and 80% in 2030. The hypothetical (unlimited) technical potential for offshore wind energy in Belgian waters based on the average wind speed is 251 TWh (*studie energiepotentieel EMA* [206643]).

The total installed capacity that could be theoretically installed if all available area in the BNS was used for wind farms is 21 GW. In a more realistic approach, where only the available surface with a depth of less than 20 m and less than 40 km from the coast is considered, a potential capacity of 2.1 to 4.2 GW is calculated (*Mathys et al. 2009* [144679], *OPTIEP-BCP project BELSPO*) (it should be mentioned that some of the current wind turbines are situated in a water depth of more than 20 m and / or more than 40 km away from the coast). The total capacity of the projects which were already granted a domain concession in early 2011, is approximately 1.8 GW (table 2, for more information: *Brouwers et al. 2011* [225406]). At the end of 2012, two wind farms were partially operational with an installed capacity of 214.5 MW and 165 MW (*Mathys et al. 2009* [144679] (*OPTIEP-BCP project BELSPO*), *The European offshore wind industry, EWEA 2012* [225400], *website C-Power*, *website Belwind*) (figure 3). The production of the existing wind farms in 2009 amounted to 82 GWh; in 2010: 188 GWh (estimated); in 2011: 690 to 760 GWh (estimated) (Source: DG Energy, FPS Economy). The expected production of the first three wind farms should be about 2.8 TWh per year (estimated) at the end of 2014 (*brochure FOD Economie 2012* [225395]).

Table 2. An overview of the status, the number of turbines and the total capacity of the wind farms in the BNS.

NAME PROJECT	STATUS	NUMBER OF TURBINES	TOTAL CAPACITY	MORE INFORMATION
C-Power	36 turbines operational, 3th phase under construction	54	325 MW	*brochure FOD Economie 2012* [225395], *MER voor een Offshore Windturbinepark op de Thorntonbank. Deel 2: Hoofddocument MER 2003* [226563] + *MER - Wijziging & uitbreiding offshore windturbinepark Thorntonbank. C-Power N.V. 2010* [227509], *website C-Power*
Northwind (former Eldepasco)	Start construction in April 2013, financed	72	216 MW	*MER – Offshore Windturbinepark Bank zonder Naam. Eldepasco NV 2008* [226564], *website Northwind*
Belwind	55 turbines operational since December 2010 (first phase), 2nd phase: 2014	110	330 MW	*brochure FOD Economie 2012* [225395], *MER Offshore Windmolenpark Bligh Bank. Belwind NV 2007* [227510], *website Belwind*
Rentel	Planning / Concession and environmental permit granted	47-78	288-550 MW	*Milieueffectenrapport windmolenpark Rentel 2012* [225506], *Website electrawinds*, *website 4c offshore*
Norther / North Sea Power	Planning / Concession and environmental permit granted	100 (86-74-47)	300 (258-470 MW)	*MER Norther project en wijzigingsMER*, *Website 4c offshore*
Seastar	Planning / Concession granted	41	246 MW	*Website electrawinds*, *website 4c offshore*
Mermaid	Planning / Concession granted	49-73	449-490 MW	DG Energy, FPS Economy

EMPLOYMENT

In 2011, figures about the employment associated with three offshore wind projects in the BNS were as follows:

- C-Power: 1,036,650 man-hours (phase 1) and 1,400 man-years (phase 2 and 3) (*website C-Power*);
- Belwind: 1,300 man-years (*Website Belwind*);
- Northwind (former Eldepasco): 700 man-years (*Vergunningsaanvraag* Eldepasco).

Figures about employment in the offshore wind energy sector are also available in *Hutsebaut & De Decker (2010)* [225505].

THE ECONOMIC POTENTIAL OF OFFSHORE WIND ENERGY

The cost of offshore wind energy varies widely depending on the study. Indeed, there are several input parameters and factors that affect the price of a project: the size of the entire wind farm, the distance from the coast, the water depth, time of construction, etc. In addition, the profitability of offshore wind energy also depends on a number of other parameters: cost reductions over time by increasing experience and newer technology, fuel prices, raw material prices, CO_2 emission trading fees, the policy, the electricity price, capacity factor, interest rates, etc. (*Verrips et al. 2005* [108727]), *Mathys et al. 2009* [144679] (*OPTIEP-BCP project BELSPO*), *Van de Walle 2011* [203247].

The studies of *Le Bot et al. (2004)* [64266] (*project BELSPO*) and *Soens (2005)* [105575] estimate the cost of investment for state-of-the-art technology in 2005 between 1,500 and 2,400 euro/kW (installation of windmill + connection to land). According to these studies, the costs in 2015 should drop to 900 to 1,600 euro/kW as a result of technological innovation. The study *Mathys et al. (2009)* [144679] (*OPTIEP-BCP project BELSPO*) reports a range of the prices per installed capacity from about 1,000 euro/kW to 4,800 euro/kW. In the BNS, the C-Power project was estimated at 2,666 euro/kW and the RENTEL project at 3,472 euro/kW. The construction, production and damage costs for offshore wind energy are discussed in *Brouwers et al. (2011)* [225406] (table 3).

Table 3. The production costs and damage costs of offshore wind energy in 2010 in Flanders (Nijs et al. 2011 in *Brouwers et al. 2011* [225406]).

€ 2009/MWU	INVESTMENT AND FIXED COSTS	VARIABLE COSTS	FUEL COSTS	PRODUCTION COSTS	DAMAGE COSTS
Nearby offshore wind farm	74	0.7	0	74	2
Medium-distance offshore wind farm	79	0.7	0	80	2
Distant offshore wind farm	99	0.7	0	100	2

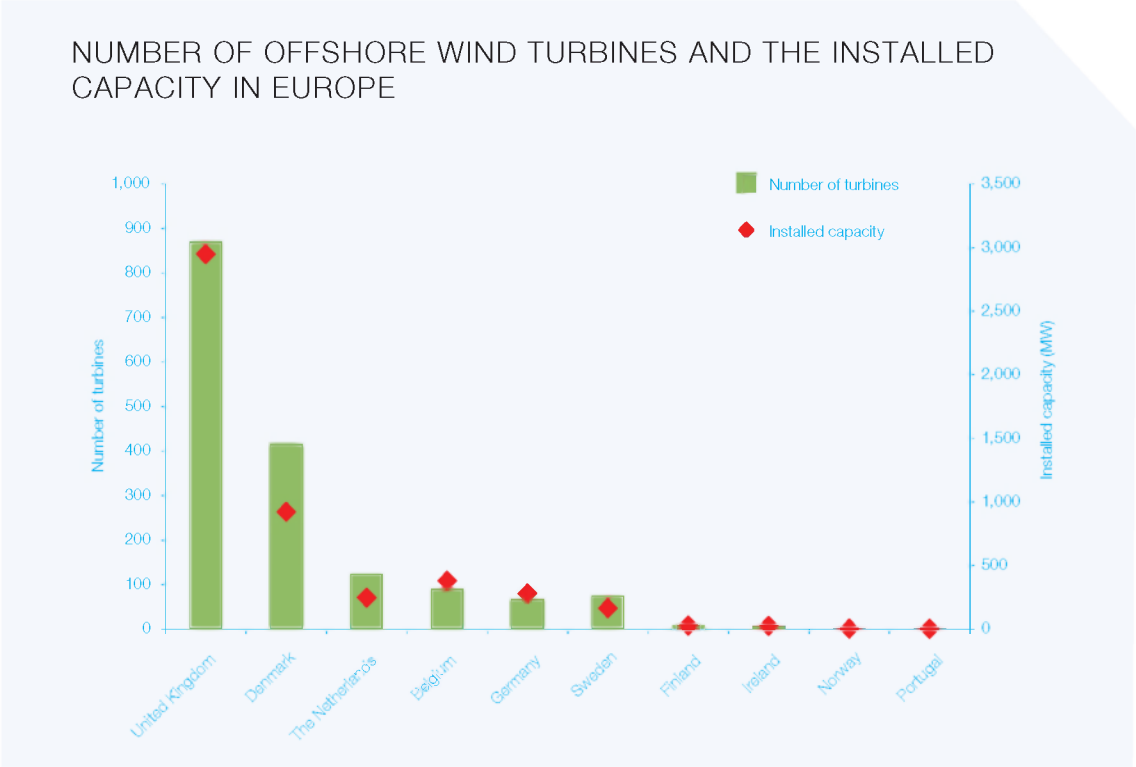

Figure 3. The number of offshore wind turbines and the installed capacity in Europe in 2012 (*The European offshore wind industry, EWEA 2012* [225400]).

5.1.4 Impact

The installation of wind farms in the BNS has a number of effects on the ecosystem and on the users of the sea (table 4 and 5). The impacts on the marine environment that should be addressed in the environmental impact assessment (EIA) have been stipulated in the *Royal Decree of 9 September 2003* on the environmental impact assessment. The EIAs and related documents are available on the website of *MUMM*. In addition, numerous scientific studies have been performed in order to elucidate the impact of wind turbines on the marine environment (table 4).

5.1.5 Sustainable use

MEASURES AS TO THE IMPACT ON THE MARINE ENVIRONMENT

At an international level, OSPAR has published a guide (*OSPAR Guidance on Environmental Considerations for Offshore Wind Farm Development* [206720]) in which the impact of wind turbines on the marine environment is discussed.

Table 4. An overview of the effects of offshore wind turbines on the environment.

ENVIRONMENTAL IMPACT	LITERATURE
Effects on the hydrodynamic regime	*MER voor een Offshore Windturbinepark op de Thorntonbank. Deel 2: Hoofddocument MER 2003* [226563] + *MER - Wijziging & uitbreiding offshore windturbinepark Thorntonbank. C-Power N.V. 2010* [227509], *MER Norther project en wijzigingsMER*, *De Wachter & Volckaert 2005* [78285] (*GAUFRE project BELSPO*), *MER Offshore Windmolenpark Bligh Bank. Belwind NV 2007* [227510], *MER – Offshore Windturbinepark Bank zonder Naam. Eldepasco NV 2008* [226564], *Vandeneynde et al. 2010* [199743], *Verhaeghe et al. 2011* [206186], *Milieueffectenrapport windmolenpark Rentel 2012* [225506]
Effects on the sediment transport and geomorphology	*MER voor een Offshore Windturbinepark op de Thorntonbank. Deel 2: Hoofddocument MER 2003* [226563] + *MER - Wijziging & uitbreiding offshore windturbinepark Thorntonbank. C-Power N.V. 2010* [227509], *MER Norther project en wijzigingsMER*, *De Wachter & Volckaert 2005* [78285] (*GAUFRE project BELSPO*), *MER Offshore Windmolenpark Bligh Bank. Belwind NV 2007* [227510], *MER – Offshore Windturbinepark Bank zonder Naam. Eldepasco NV 2008* [226564], *Vandeneynde et al. 2010* [199743], *Verhaeghe et al. 2011* [206186], *Milieueffectenrapport windmolenpark Rentel 2012* [225506]
Underwater noise	*MER voor een Offshore Windturbinepark op de Thorntonbank. Deel 2: Hoofddocument MER 2003* [226563] + *MER - Wijziging & uitbreiding offshore windturbinepark Thorntonbank. C-Power N.V. 2010* [227509], *MER Norther project en wijzigingsMER*, *De Wachter & Volckaert 2005* [78285] (*GAUFRE project BELSPO*), *MER Offshore Windmolenpark Bligh Bank. Belwind NV 2007* [227510], *MER – Offshore Windturbinepark Bank zonder Naam. Eldepasco NV 2008* [226564], *Haelters et al. 2009* [142995], *Norro et al. 2010* [199744], *Norro et al. 2011* [207277], *Verhaeghe et al. 2011* [206186], *Haelters et al. 2012* [218683], *Norro et al. 2012* [218684], *Milieueffectenrapport windmolenpark Rentel 2012* [225506]
Effects on the fish and benthos (introduction of hard substrate, habitat loss, disturbance, etc.)	*MER voor een Offshore Windturbinepark op de Thorntonbank. Deel 2: Hoofddocument MER 2003* [226563] + *MER - Wijziging & uitbreiding offshore windturbinepark Thorntonbank. C-Power N.V. 2010* [227509], *MER Norther project en wijzigingsMER*, *De Wachter & Volckaert 2005* [78285] (*GAUFRE project BELSPO*), *MER Offshore Windmolenpark Bligh Bank. Belwind NV 2007* [227510], *MER – Offshore Windturbinepark Bank zonder Naam. Eldepasco NV 2008* [226564], *Kerckhof et al. 2009* [142997], *Reubens et al. 2009a* [142998], *Reubens et al. 2009b* [142999], *Vandendriessche et al. 2009* [143001], *Kerckhof et al. 2010* [199745], *Reubens et al. 2010* [199747], *Coates & Vincx 2010* [199748], *Derweduwen et al. 2010* [199750], *Reubens et al. 2011a* [202018], *Kerckhof et al. 2011* [207279], *Reubens et al. 2011b* [207280], *Vandendriessche et al. 2011* [207288], *Coates et al. 2011* [207283], *Van Hoey et al. 2011* [207293], *Verhaeghe et al. 2011* [206186], *Kerckhof et al. 2012* [218676], *Coates et al. 2012* [218677], *Vandendriessche et al. 2012* [218679], *Derweduwen et al. 2012* [218680], *Milieueffectenrapport windmolenpark Rentel 2012* [225506]
Effects on seabirds	*Stienen et al. 2002a* [39505], *Stienen et al. 2002b* [39506], *MER voor een Offshore Windturbinepark op de Thorntonbank. Deel 2: Hoofddocument MER 2003* [226563] + *MER - Wijziging & uitbreiding offshore windturbinepark Thorntonbank. C-Power N.V. 2010* [227509], *MER Norther project en wijzigingsMER*, *De Wachter & Volckaert 2005* [78285] (*GAUFRE project BELSPO*), *Everaert & Stienen 2007* [117811], *Stienen et al. 2007* [111966], *MER Offshore Windmolenpark Bligh Bank. Belwind NV 2007* [227510], *MER – Offshore Windturbinepark Bank zonder Naam. Eldepasco NV 2008* [226564], *Vanermen et al. 2009* [138529], *Vanermen & Stienen 2009* [134402], *Brabant & Jacques 2009* [143009], *Vanermen et al. 2010* [199751], *Vanermen et al. 2011* [207290] *Verhaeghe et al. 2011* [206186], *Vanermen et al. 2012* [218681], *Brabant et al. 2012* [218682], *Milieueffectenrapport windmolenpark Rentel 2012* [225506]
Effects on marine mammals	*Stienen et al. 2002a* [39505], *MER voor een Offshore Windturbinepark op de Thorntonbank. Deel 2: Hoofddocument MER 2003* [226563] + *MER - Wijziging & uitbreiding offshore windturbinepark Thorntonbank. C-Power N.V. 2010* [227509], *MER Norther project en wijzigingsMER*, *De Wachter & Volckaert 2005* [78285] (*GAUFRE project BELSPO*), *MER Offshore Windmolenpark Bligh Bank. Belwind NV 2007* [227510], *MER – Offshore Windturbinepark Bank zonder Naam. Eldepasco NV 2008* [226564], *Evans 2008* [206639], *Haelters 2009* [143010], *Haelters et al. 2010* [199753], *Haelters et al. 2011* [207292], *Verhaeghe et al. 2011* [206186], *Haelters et al. 2012* [218683], *Milieueffectenrapport windmolenpark Rentel 2012* [225506]
Impact on the water and air quality	*MER voor een Offshore Windturbinepark op de Thorntonbank. Deel 2: Hoofddocument MER 2003* [226563] + *MER - Wijziging & uitbreiding offshore windturbinepark Thorntonbank. C-Power N.V. 2010* [227509], *MER Norther project en wijzigingsMER*, *Maes et al. 2004* [70936] (*MARE-DASM project BELSPO*), *De Wachter & Volckaert 2005* [78285] (*GAUFRE project BELSPO*), *MER Offshore Windmolenpark Bligh Bank. Belwind NV 2007* [227510], *MER – Offshore Windturbinepark Bank zonder Naam. Eldepasco NV 2008* [226564], *Verhaeghe et al. 2011* [206186], *Milieueffectenrapport windmolenpark Rentel 2012* [225506]

Table 5. An overview of the effects of offshore wind turbines on other users of the sea and coast.

IMPACT ON USERS	LITERATURE
Impact on the seascape	*MER voor een Offshore Windturbinepark op de Thorntonbank. Deel 2: Hoofddocument MER 2003* [226563] + *MER - Wijziging & uitbreiding offshore windturbinepark Thorntonbank. C-Power N.V. 2010* [227509], *MER Norther project en wijzigingsMER*, *De Wachter & Volckaert 2005* [78285] (*GAUFRE project BELSPO*), *MER Offshore Windmolenpark Bligh Bank. Belwind NV 2007* [227510], *MER – Offshore Windturbinepark Bank zonder Naam. Eldepasco NV 2008* [226564], *Di Marcantonio 2009* [143011], *Vanhulle et al. 2010* [199754], *Houthaeve & Vanhulle 2010* [206727], *Milieueffectenrapport windmolenpark Rentel 2012* [225506]
Maritime safety	*MER voor een Offshore Windturbinepark op de Thorntonbank. Deel 2: Hoofddocument MER 2003* [226563] + *MER - Wijziging & uitbreiding offshore windturbinepark Thorntonbank. C-Power N.V. 2010* [227509], *MER Norther project en wijzigingsMER*, *De Wachter & Volckaert 2005* [78285] (*GAUFRE project BELSPO*), *MER Offshore Windmolenpark Bligh Bank. Belwind NV 2007* [227510], *MER – Offshore Windturbinepark Bank zonder Naam. Eldepasco NV 2008* [226564], *van Iperen & van der Tak (2009)* [206730], *Verhaeghe et al. 2011* [206186], *Milieueffectenrapport windmolenpark Rentel 2012* [225506] (see also theme **Maritime transport, shipping and ports**)
Spatial impact (e.g. conflicts with other users)	*Seys 2001*, *MER voor een Offshore Windturbinepark op de Thorntonbank. Deel 2: Hoofddocument MER 2003* [226563] + *MER - Wijziging & uitbreiding offshore windturbinepark Thorntonbank. C-Power N.V. 2010* [227509], *MER Norther project en wijzigingsMER*, *Maes et al. 2004* [70936] (*MARE-DASM project BELSPO*), *De Wachter & Volckaert 2005* [78285] (*GAUFRE project BELSPO*), *MER Offshore Windmolenpark Bligh Bank. Belwind NV 2007* [227510], *MER – Offshore Windturbinepark Bank zonder Naam. Eldepasco NV 2008* [226564], *Vandendriessche et al. 2011* [207288], *Milieueffectenrapport windmolenpark Rentel 2012* [225506]

Within the context of the *ASCOBANS* agreement (on the conservation of small cetaceans), the impact of wind turbines on marine mammals has been evaluated (*Evans 2008* [206639]). In 2009, a *resolution* [206635] was issued against the negative effects on marine mammals of underwater noise during the construction of offshore energy installations.

At the European level, the *Marine Strategy Framework Directive* (*2008/56/EC*) (MSFD) provides a framework to reduce or avoid the impact of offshore wind farms on the environment. Underwater noise and other forms of energy are hereby identified as one of the descriptors for a good environmental status (GES) (*Tasker et al. 2010* [202493]). Other descriptors in the *MSFD* which are relevant for the installation of wind turbines at sea are the integrity of the seabed (*Rice et al. 2010* [202490]), non-indigenous species (*Olenin et al. 2010* [202485]) and the permanent alteration of hydrographic conditions.

At the Belgian level, a monitoring programme has been set up in the BNS to estimate the impact of wind turbines on the marine environment. This programme is coordinated by MUMM and has a twofold objective:

- To adjust, reduce or even stop the activities if extreme damage occurs to the marine environment;
- To gain insight into the impact of offshore wind turbines on the environment in order to support the policy, management and design of future wind turbines.

The monitoring programme examines both the physical, biological and socio-economic aspects of the marine environment (*Degraer & Brabant 2009* [142990], *Degraer et al. 2010* [199194], *Degraer et al. 2011* [207257], *Degraer et al. 2012* [218670]) compared to a reference condition (e.g. *De Maersschalck et al. 2006* [225398], *Henriet et al. 2006* [199011], *Van den Eynde 2005* [226451]).

Within the framework of the *Actieplan Zeehond* [216403], the windmills at sea are used as a laboratory for testing the effects of artificial reefs and artificial resting places in order to increase the biodiversity and productivity. The draft of the Marine Spatial Plan (*Ontwerp van koninklijk besluit tot vaststelling van het marien ruimtelijk plan, 2013* [227527]), as proposed by the Minister in charge of the North Sea, further elaborates on the multiple use of space in the wind farms (aquaculture (there is still feedback needed with regard to the ban on shipping, *Royal Decree of 11 April 2010*), development of nature, wave and tidal energy, etc.).

THE DEVELOPMENT OF OFFSHORE WIND ENERGY - CONFLICTS AND MEASURES

At the European level, a number of obstacles have been identified that hinder the development of offshore wind energy (*COM (2008) 768*):

- Offshore wind energy is facing particular industrial and technological challenges;
- A lack of integrated strategic planning and cross-border coordination (need for marine spatial planning, see also *COM (2007) 575* on an integrated maritime policy);
- A lack of knowledge and information sharing hampers a smooth application of the EU environmental legislation;
- Dealing with bottlenecks and power balancing in the onshore electricity grids.

In the European project *windspeed*, a policy-supporting tool (*Schillings et al. 2010* [226571]) and a roadmap (*Veum et al. 2011* [225503]) have been designed which take into account the spatial conflicts with other users, the grid capacity and ecological, technological and economic aspects of wind energy development in the central and southern part of the North Sea. In other European projects such as *MERMAID*, *TROPOS* and *H_2Ocean*, the multiple use of marine space and new technological developments in offshore wind farms have been investigated.

In Belgium, the production of renewable energy is supported through 'Green Current Certificates' (GSC). Regarding energy generated by offshore wind turbines (organised at the federal level), the network operator is obliged by the *Royal Decree of 16 July 2002* to purchase the 'green current certificates' from the offshore wind energy producer, at a minimum price of 107 euro/MWh for the production coming from the first 216 MW of installed capacity and 90 euros/MWh from an installed capacity above the first 216 MW. This purchase obligation must constitute a part of a contract between the concessionaire and the network operator and should be approved by the Commission for the Regulation of Electricity and Gas (CREG) (*website CREG*). Furthermore, the *Decree of 30 March 2009* regulates a tolerance system for the production anomalies of electricity from offshore wind energy.

Moreover, the *law of 29 April 1999* on the organisation of the electricity market stipulates that the transmission system operator has to finance a third of the cost of the submarine cable, up to a maximum amount of 25 million euros for a project of 216 MW or more. This funding of 25 million euros will be reduced proportionally if the project is less than 216 MW (*brochure FOD Economie 2012* [225395], see also **Pipelines and cables**).

The potential of wind energy in the BNS is currently limited by the available grid capacity of the electricity network. Both on land and offshore, there is a need for grid reinforcement. Depending on the study, the current grid capacity of the electricity network on land is estimated between 600 and 900 MW (*Soens 2005* [105575], *Mathys et al. 2009* [144679] (*OPTIEP-BCP project BELSPO*)). A single offshore connection for marine cables from the offshore wind farms is currently being created to reduce the number of cables (see also **Pipelines and cables**) (*visie Elia offshore grid 2012*, *brochure FOD Economie 2012* [225395]). In the future, the subsidy system described above will be revised, *inter alia* because of this offshore connection. In the future, the connection could be connected to the offshore North Sea grid (an integrated energy grid that connects offshore wind farms and other offshore renewable energy producers in the North Sea) (*Mathys et al. 2009* [144679] (*OPTIEP-BCP project BELSPO*), *Offshore Electricity Grid Infrastructure in Europe 2011* [225405]).

5.2 Natural gas installations in Zeebrugge

In Belgium, more than 17 billion m³ of natural gas is consumed each year and about 95 billion m³ of natural gas has been reserved in the long term for border-to-border transport. This includes Dutch and Norwegian gas for France and Spain, British gas for continental Europe, Russian gas for the UK, as well as natural gas for the Grand Duchy of Luxembourg. Zeebrugge plays an important role in the European gas market. The landing capacity at Zeebrugge corresponds to approximately 10% of the total border capacity which is needed to supply the European Union (*België als aardgasdraaischijf voor Noordwest-Europa: de weg vooruit 2010* [225394]).

5.2.1 Policy context

The European gas market is regulated by the so-called third European legislative package on energy that consists of *Directive 2009/73/EC* (common rules for the internal market in natural gas), *Regulation 715/2009* (conditions for access to the natural gas transmission networks) and *Regulation 713/2009* (establishing an Agency for the Cooperation of Energy Regulators).

The federal government (FPS Economy, SMEs, Self-employed and Energy) is responsible for the large infrastructures for energy storage, transportation and production, and sets the tariff policy for the managers (in this case, Fluxys and Fluxys LNG) (*federale beleidsnota energie 2012* [226456]). The transport of gaseous products is regulated by the federal *law of 12 April 1965* (the Gas Act) and by a number of Royal Decrees concerning rates and the more technical aspects of network access (code of conduct) (for more information: *website Fluxys*, *website CREG*, *website FPS Economy*, *Fluxys Jaarlijks financieel verslag 2010* [225401]). Furthermore, there is a federal regulator: the Commission for the regulation of electricity and gas (*CREG*). Flanders is competent for the public distribution of gas, which is managed by the so-called 'intercommunales', as well as for the rational use of energy (more information: *website fluxys*, *Fluxys Jaarlijks financieel verslag 2010* [225401]).

5.2.2 Spatial use

The LNG (Liquefied Natural Gas) terminal is located in the eastern harbour of the port of Zeebrugge. The peninsula on which the LNG terminal is located covers an area of approximately 32 ha (non-technical summary EIA Zeebrugge LNG terminal). There are currently plans for a new extension with a new storage tank, landing platform and additional transmission capacity (*Open season: second capacity enhancement of the Zeebrugge LNG terminal. Binding phase: offer description 2011* [226568]). In the draft of the Marine Spatial Plan (*Ontwerp van koninklijk besluit tot vaststelling van het marien ruimtelijk plan* [227527]), as proposed by the Minister of the North Sea, space will be provided for the development of the LNG terminal in the port of Zeebrugge. In addition, terminals of the Zeepipe and Interconnector gas pipelines are located in Zeebrugge (see **Pipelines and cables**).

5.2.3 Societal interest

Zeebrugge is a cornerstone in the supply chain of natural gas to Northwest Europe with the LNG terminal and the terminals of the Zeepipe and Interconnector gas pipelines (see **Pipelines and cables**). Furthermore, the Zeebrugge Hub is one of the leading short-term markets in Europe (*België als aardgasdraaischijf voor Noordwest-Europa: de weg vooruit 2010* [225394], *Brouwers et al. 2011* [225406]). In 2010, a total of 62 billion m^3 of gas was traded in the Zeebrugge Hub (*Open season: second capacity enhancement of the Zeebrugge LNG terminal. Binding phase: offer description 2011* [226568]).

The installations of the LNG terminal in Zeebrugge are equipped for the reception of ships carrying liquefied natural gas (LNG). Since 2008, there are four active storage tanks with a total handling capacity of 9 billion m^3 of natural gas per year, equaling 110 LNG ships with a capacity of up to 217,000 m^3 of liquefied natural gas. At present there are plans for an additional storage tank of 160,000 m^3 of LNG (*website Fluxys*, *Fluxys Jaarlijks financieel verslag 2011* [225402], *Open season: second capacity enhancement of the Zeebrugge LNG terminal. Binding phase: offer description 2011* [226568], *Brouwers et al. 2011* [225406]). Fluxys has opted for a model of cooperation for the development of an LNG terminal in Dunkirk and participates for 25% in this project. A pipeline connection between the two terminals is being prepared through a new interconnection point in Alveringem and Maldegem. Fluxys LNG, the owner and operator of the LNG terminal in Zeebrugge, recorded a net profit of 17.0 million euro in 2011 (15.8 million euro in 2010) (*Fluxys Jaarlijks financieel verslag 2011* [225402]).

5.2.4 Impact

The installation of an LNG terminal, at a small distance from the nearest habitation on the seawall of Heist, entails a number of environmental effects that are addressed in the EIA (non-technical summary EIA Zeebrugge LNG terminal). These include noise and vibration, air pollution, wastewater production, pollution of soil and groundwater, disturbance of fauna and flora, disruption of the landscape, production of light, heat and radiation, etc.

5.2.5 Sustainable use

In the EIA, a number of measures to mitigate or avoid the impact of the LNG terminal on the environment have already been listed (non-technical summary EIA Zeebrugge LNG terminal). In accordance with the Kyoto Protocol, the peak-shaving installation in Zeebrugge was closed down in 2010. Furthermore, the construction of an 'open rack vaporiser' at the LNG terminal was started in order to reduce the energy consumption and the emissions of NO_x and

CO_2 (*Fluxys Jaarlijks financieel verslag 2011* [225402]). Much attention is also given to safe operation. Because of the amount of natural gas, the LNG terminal is regarded as a Seveso installation, which must comply with specific safety requirements (*Fluxys Jaarlijks financieel verslag 2011* [225402]). Furthermore, LNG vessels must undergo a ship clearance procedure in order to load or unload at the LNG terminal in Zeebrugge (*website Fluxys*).

5.3 Pipelines and cables

In the OSPAR area, the 1,300 oil and gas platforms are connected with a pipeline network of more than 50.000 km (*OSPAR QSR 2010* [198817]). In the Belgian part of the North Sea (BNS), there are 3 gas pipelines with a total length of 163 km (*Verfaillie et al. 2005* [78284], *GAUFRE project BELSPO*):

- The Zeepipe pipeline connects the Distrigaz terminal in the port of Zeebrugge to a pipeline on the Norwegian shelf and has a total length of 814 km;
- The Interconnector pipeline is 215 km long and is located between Zeebrugge and Bacton (south coast, UK);
- The Norfra pipeline (now also called Franpipe) is a 840 km long pipeline between the Norwegian shelf and the port of Dunkirk which partially crosses the BNS (*Maes et al. 2000* [18619]).

In addition, the North Sea and the North Atlantic Ocean are intersected by telecommunication and power cables. Telecommunication cables are mainly situated in the southern part of the North Sea, in the Celtic Seas and in the

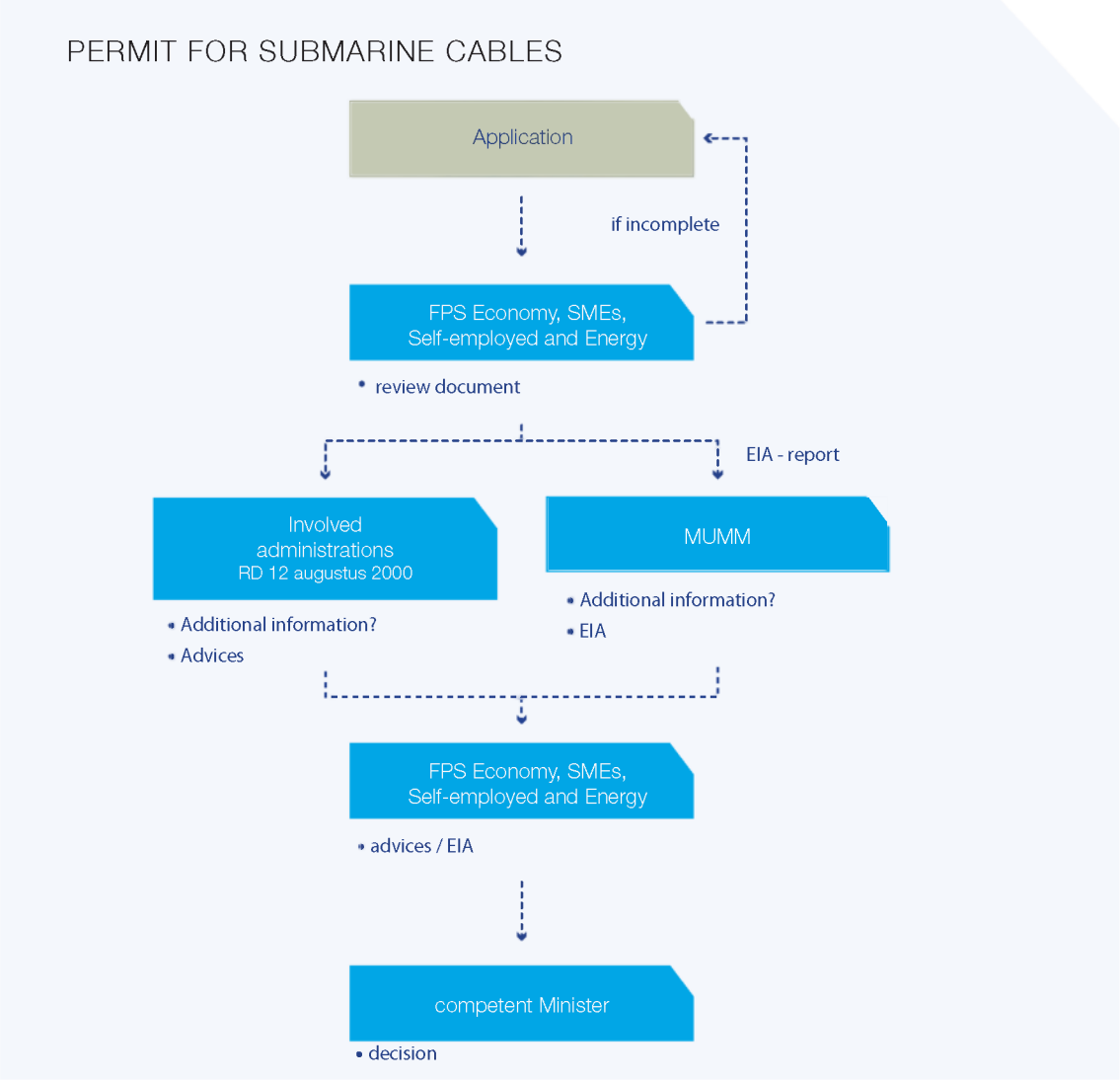

Figure 4. Flowchart of the permit for submarine cables (*Royal Decree of 12 March 2002*).

trans-Atlantic corridor. Power cables can be found in the North Sea and Celtic Seas (*OSPAR QSR 2010* [198817]). On the Belgian Continental Shelf (BCS), there are 27 telecommunication cables, 16 of which are in use, with a total length of 914 km (*Verfaillie et al. 2005* [78284], *GAUFRE project BELSPO*). In the future, the share of electricity cables will expand due to the installation of offshore wind turbines (see **Offshore wind energy**). In early 2013, four cable licenses had already been delivered (2 C-Power cables, 2 Belwind cables, 1 Northwind cable and 2 Norther cables) of which three cables are in use (2 for C-Power and 1 for Belwind).

5.3.1 Policy context

The procedure for the installation of electric cables in the BCS has been stipulated in the *Royal Decree of 12 March 2002* (see also *Ministerial Decree of 8 May 2008*) (figure 4). The applications are sent to the Minister of Energy or his delegate. The documents for the application are submitted to the Minister. The dossier is accompanied by the evaluation of the impact on the environment and the advice of all administrations involved. The granting of the permit is motivated by a Ministerial Decree that specifically takes into account the conclusions of the environmental impact assessment (EIA). The EIA is performed by the Management Unit of the North Sea Mathematical Models (MUMM) (more information: coastal codex, themes *EIA* and *cables and pipelines*).

The procedure for the construction of pipelines is determined by the *law of 12 April 1965* on the transport of gas and other gaseous products by pipeline. This law was supplemented by various Royal Decrees. One of those decrees concerns the safety of facilities for gas transport, namely the *Royal Decree of 11 March 1966*, on the measures to be taken during the construction and operation of gas transport by means of pipelines. The *Royal Decree of 11 March 1966* is currently being reviewed. Technological progress and the use of international standards are taken into account, as well as certain elements which have been brought to the attention as a result of the disaster in Ghislenghien, and the need for administrative simplification. There are also similar decrees for the transport of other substances.

5.3.2 Spatial use

In the draft of the Marine Spatial Plan (*Ontwerp van koninklijk besluit tot vaststelling van het marien ruimtelijk plan, 2013* [227527]), as proposed by the Minister competent for the North Sea, some spatial policy choices have been formulated with regard to cables and pipelines in the BNS. New cables and pipelines should be bundled as much as possible in corridors, so to create the shortest possible connection between departure and arrival points. The plan provides no specific routes but takes into account an area for a new power cable between Belgium and Britain (the NEMO

Table 6. An overview of the use of space around cables (*Royal Decree of 12 March 2002*).

CABLES		PIPELINES (not legally defined)	
Protected area (250 m on either side)	Reserved area (50 m on either side)	Protected area (1,000 m on either side)	Reserved area (500 m on either side)
Anchoring prohibited	No installation, no cable or pipeline construction	No sand extraction	No other infrastructures unless they cross the pipeline
No activity that puts the cable at risk (except the installation of a cable under certain conditions).		No other pipelines	
Exception: interventions of the owner for operation	*Exception:* unipolar cables on the same safety switch, arrival of cables from and departure of cables to a wind turbine in parallel with others, point of arrival from and departure to an infrastructure with one or more cables, convergence point of several cables that are part of the same mechanism to return to the mainland, repaired cables		*Exception:* maintenance dredging and interventions of the owner for operation

project, see **Sustainable use**). Furthermore, additional cables and power stations (the single offshore connection for wind farms, see **Sustainable use**) are expected in view of the development of a European energy grid and a new pipeline between Zeebrugge and Norway. Ostend (Sluikens) and Zeebrugge have been selected as landing points on the coast.

The spatial restrictions around the power cables in the BNS are determined by the *Decree of 12 March 2002* (table 6). The spatial use around pipelines is not legally defined.

The agreement between Norway and Belgium with regard to the Norfra pipeline has been formalised in the *law of 13 May 2003* and in the *law of 19 September 1991* concerning the Zeepipe pipeline. The agreement related to the transport of gas in the Interconnector pipeline between Britain, Northern Ireland and Belgium has been formalised in the *law of 26 June 2000*. For a complete overview of the legislation on the pipelines in the BNS, see coastal codex, theme *cables and pipelines*.

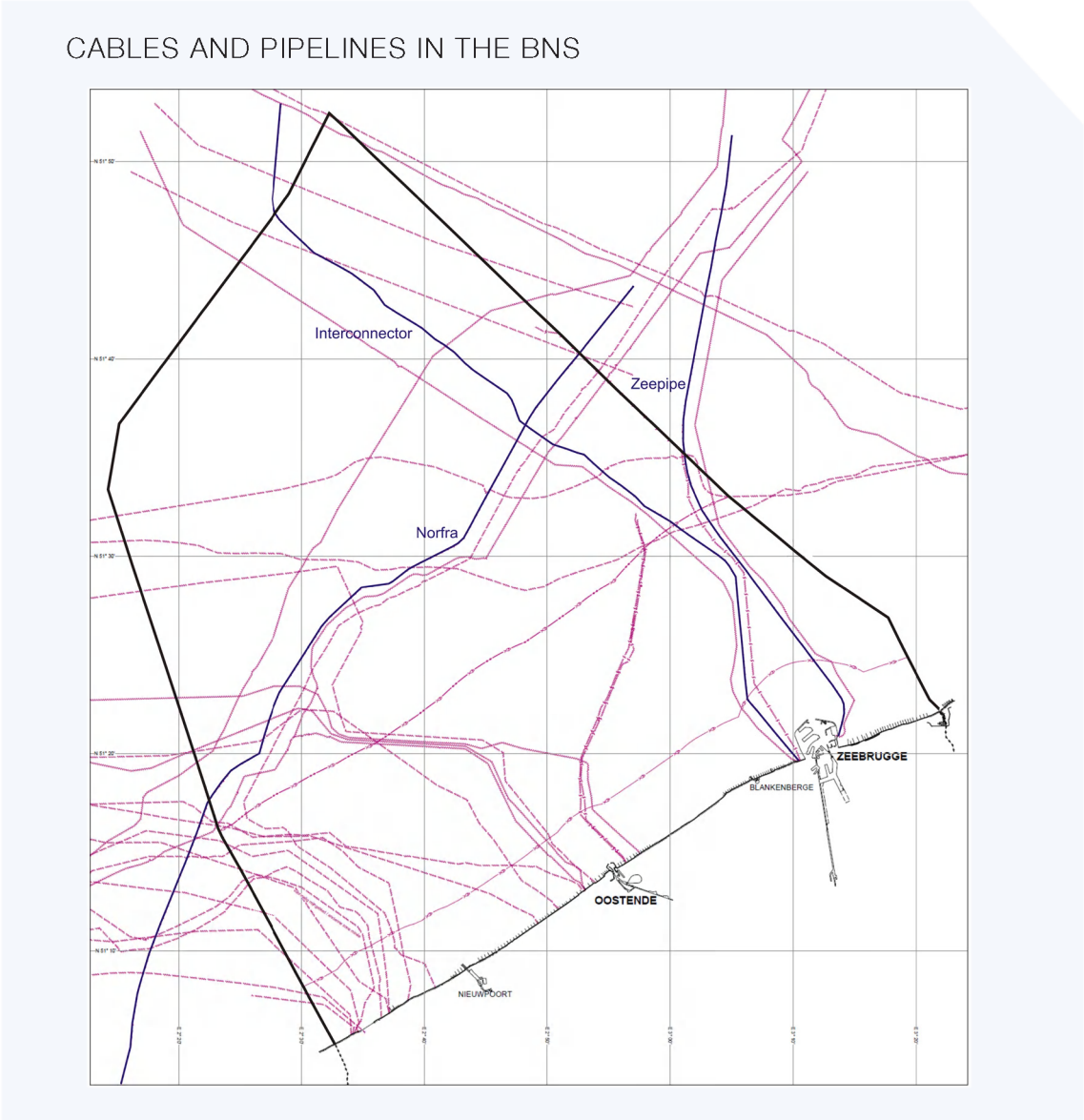

Figure 5. The cables and pipelines (in blue) in the BNS (*Continentaal Plat & Vlaamse Hydrografie 2013* [227521]).

5.3.3 Societal interest

Due to the increasing importance of offshore wind turbines, there is a growing demand for submarine power cables for the transport of energy to the mainland. In addition, submarine cables are also important for transnational energy and communication networks (*OSPAR QSR 2010* [198817]).

The transport of gaseous products to our country via submarine pipelines:

- The Zeepipe is managed by Statoil and transports approximately 13 billion m³ of gas per year with a daily capacity of 41 million m³;
- The Norfra pipeline has been operational since 1998 and transports 40 million m³ of gas per day between Dunkirk and the Norwegian shelf. The pipeline has a capacity of 15 billion m³ per year;
- The Interconnector pipeline has been operational since October 1998 between the south coast of England and Zeebrugge. This pipeline is bidirectional and can thus be used for the import / export of gas from / to England. In winter there is import from England with a capacity of 8.5 billion m³ per year and in summer there is export to England with a capacity of 20 billion m³ per year.

(*Verfaillie et al. 2005* [78284] (*GAUFRE project BELSPO*), *Brouwers et al. 2011* [225406])

5.3.4 Impact

The construction and operation of pipelines and cables has some (local) impact on the marine environment. The effects are described in table 7.

Table 7. An overview of the effects of the construction and operation of cables and pipelines on the (marine) environment.

IMPACT	LITERATURE
Toxic pollution due to the pipeline's zinc coating	*Maes et al. 2004* [70936] (*MARE-DASM project BELSPO*)
Introduction of hard substrate on the bottom (pipeline) => non-indigenous species	*Maes et al. 2004* [70936] (*MARE-DASM project BELSPO*), *OSPAR QSR 2010* [198817]
Sediment disturbance during the construction and removal of cable / substrate (including increased turbidity and release of pollutants adsorbed by soil particles)	*MER voor een Offshore Windturbinepark op de Thorntonbank. Deel 2: Hoofddocument MER 2003* [226563] + *MER - Wijziging & uitbreiding offshore windturbinepark Thorntonbank. C-Power N.V. 2010* [227509], *MER Norther project en wijzigingsMER, MER Offshore Windmolenpark Bligh Bank. Belwind NV 2007* [227510], *MER – Offshore Windturbinepark Bank zonder Naam. Eldepasco NV 2008* [226564], *Milieueffectenrapport windmolenpark Rentel 2012* [225506], *Milieueffectenrapport - NEMO LINK 2012* [227877]
Effect on the temperature of the surroundings	*MER voor een Offshore Windturbinepark op de Thorntonbank. Deel 2: Hoofddocument MER 2003* [226563] + *MER - Wijziging & uitbreiding offshore windturbinepark Thorntonbank. C-Power N.V. 2010* [227509], *MER Norther project en wijzigingsMER, MER Offshore Windmolenpark Bligh Bank. Belwind NV 2007* [227510], *MER – Offshore Windturbinepark Bank zonder Naam. Eldepasco NV 2008* [226564], *OSPAR QSR 2010* [198817], *Milieueffectenrapport windmolenpark Rentel 2012* [225506], *Milieueffectenrapport - NEMO LINK 2012* [227877]
Electromagnetic field around the cables	*MER voor een Offshore Windturbinepark op de Thorntonbank. Deel 2: Hoofddocument MER 2003* [226563] + *MER - Wijziging & uitbreiding offshore windturbinepark Thorntonbank. C-Power N.V. 2010* [227509], *MER Norther project en wijzigingsMER, MER Offshore Windmolenpark Bligh Bank. Belwind NV 2007* [227510], *MER – Offshore Windturbinepark Bank zonder Naam. Eldepasco NV 2008* [226564], *OSPAR QSR 2010* [198817], *Milieueffectenrapport windmolenpark Rentel 2012* [225506], *Milieueffectenrapport - NEMO LINK 2012* [227877]

IMPACT (continuation)	LITERATURE
Underwater noise when installing cables / pipelines	*MER voor een Offshore Windturbinepark op de Thorntonbank. Deel 2: Hoofddocument MER 2003* [226563] + *MER - Wijziging & uitbreiding offshore windturbinepark Thorntonbank. C-Power N.V. 2010* [227509], *MER Norther project en wijzigingsMER, MER Offshore Windmolenpark Bligh Bank. Belwind NV 2007* [227510], *MER – Offshore Windturbinepark Bank zonder Naam. Eldepasco NV 2008* [226564], *Milieueffectenrapport windmolenpark Rentel 2012* [225506], *Milieueffectenrapport - NEMO LINK 2012* [227877]
Impact on other users	*Verfaillie et al. 2005* [78284] (*GAUFRE project BELSPO*), *Milieueffectenrapport - NEMO LINK 2012* [227877]

5.3.5 Sustainable Use

MEASURES AS TO THE IMPACT ON THE MARINE ENVIRONMENT

At present there are no common programmes or measures to address the impact of pipelines and cables on the marine environment at an international level (*OSPAR QSR 2010* [198817]).

At the European level, the *Marine Strategy Framework Directive* (*2008/56/EC*) (MSFD) can be regarded as a framework to address the impact of submarine cables and pipelines. This directive comprises the following descriptors of a good environmental status of the marine environment: underwater noise and other forms of energy (*Tasker et al. 2010* [202493]), the integrity of the seafloor (*Rice et al. 2010* [202490]) and non-indigenous species (*Olenin et al. 2010* [202485]).

At a Belgian level, the effects of power lines on the marine environment are briefly addressed in the monitoring programme for offshore wind farms (*Degraer & Brabant 2009* [142990], *Degraer et al. 2010* [199194], *Degraer et al. 2011* [207257]) and in the EIA of offshore wind farms (*website MUMM*).

A SINGLE OFFSHORE CONNECTION FOR POWER CABLES

The individual connection of the various offshore wind farms to the power stations on the coast would eventually lead to an inefficient use of materials. Such a network of cables is also expensive (cost multiplied by the number of connections), harmful to the environment (accumulation of cables on the seabed and in the coastal zone near the power stations on land) and technically not optimal (e.g. in terms of operational safety). Therefore, a solution that is technically, economically and environmentally viable has been taken into consideration. This reflection process has led to the vision of Elia, which intends to gradually build a meshed offshore grid. In such a scenario, the various wind farms are connected to each other in power stations on offshore platforms that are close to the various concessions. The offshore grid is subsequently integrated into the network managed by Elia on the mainland.

The latter process may lead to the establishment of two platforms in the BNS, alpha and beta, which will be interconnected and connected by cables of 220 kV to the Stevin station, situated close to the port of Zeebrugge. The two platforms will be gradually developed, so that each phase constitutes a part of the overall solution. The connections to the onshore grid are Zeebrugge and Stevin. On each of these offshore platforms, a high-voltage power station of the GIS type will be installed, with the transformers necessary to receive cables of 66 kV or 220 kV from the nearby offshore wind farms (for more information: *visie Elia offshore grid 2012* [213665], *brochure FOD Economie 2012* [225395]).

THE NEMO PROJECT

The NEMO project is a two-way submarine cable between Zeebrugge and Richborough (United Kingdom) of approximately 1,000 MW DC. Economic studies have shown the usefulness of such a connection. The application has been completed and the construction should take place in 2017/2018. For the grid connection on the Belgian side, the available capacity created by the Stevin project between Zeebrugge and Zomergem would be partly used (Source: DG Energy, FPS Economy, *Milieueffectenrapport - NEMO LINK 2012* [227877]).

Furthermore, an offshore North Sea grid (an integrated energy grid that connects offshore wind farms and other offshore renewable energy producers in the North Sea) is also being considered (*Mathys et al. 2009* [144679] (*OPTIEP-BCP project BELSPO*), *Offshore Electricity Grid Infrastructure in Europe 2011* [225405]). An overview of the policy framework, the technical and economic aspects is given in the *Offshore Electricity Grid Infrastructure in Europe (2011)* [225405]. European plans to develop an offshore network are addressed in the blueprint for an integrated European energy network (*COM (2010) 677*).

5.4 Tidal and wave energy and energy storage

The potential of wave energy is impressive. According to *Cruz et al. (2008)* [120366] and *Brouwers et al. (2011)*[225406], the total available wave power of all coastlines in the world is comparable to the current world electricity consumption. The importance of further research into offshore renewable energy technologies other than wind energy has been highlighted in the European Communication on Blue Growth (*COM (2012) 494*). Currently there are no wave energy converters at the Belgian coast, however, research is being conducted with regard to the wave climate in the Belgian part of the North Sea (BNS) (*Mathys et al. 2009* [144679] (*OPTIEP-BCP project BELSPO*), *De Backer et al. 2008* [124316], *Beels 2010* [143250], *Fernandez et al. 2010* [203824], *Mathys et al. 2012* [202292] (*BOREAS project BELSPO*)). In addition, the appropriate wave energy converters are also studied (*De Backer et al. 2008* [124316], *Beels 2010* [143250], *De Backer 2004* [199170], *De Backer & Mertens 2006* [100270], *De Backer 2009* [143261], *Mathys et al. 2009* [144679] (*OPTIEP-BCP project BELSPO*), *Mathys et al. 2012* [202292] (*BOREAS project BELSPO*)). Within the framework of the *FlanSea project* [206722] ('Flanders Electricity from the Sea'), a wave energy converter is being developed specifically for moderate wave climates such as in the BNS (*Brouwers et al. 2011* [225406]). The energy platform *Power-Link* provides for a valorisation phase for the *FlanSea project* [206722] between 2015 and 2018 through the creation of a micro production park. The THV MERMAID has included 20 MW FlanSea-wave energy converters between the windmills in its application to obtain a domain concession.

In addition to the extraction of energy from waves, research on tidal power is also conducted. The studies *Mathys et al. (2009)* [144679] (*OPTIEP-BCP project BELSPO*) and *Mathys et al. (2012)* [202292] (*BOREAS project BELSPO*) provide an overview of the different tidal energy converters. In addition, the potential of tidal energy in the BNS is estimated on the basis of numerical hydrodynamic models.

A *study* by the Environmental and Energy Technology Innovation Platform of the Flemish government examined the feasibility of energy storage in a so-called energy atoll in the BNS. It is a hydro-electric power station that serves as an energy buffer to counter the discontinuity or unpredictable variability of the energy production from renewable energy sources such as wind and solar energy.

In the draft of the Marine Spatial Plan (*Ontwerp van koninklijk besluit tot vaststelling van het marien ruimtelijk plan, 2013* [227527]), as proposed by the Minister competent for the North Sea, a reservation zone has been provided for research on alternative forms of energy and energy storage. In the first place, such tests may be accommodated in the windmill zone. Furthermore, new concession zones for energy atolls in front of De Haan and Blankenberge and/or Zeebrugge have been planned. These islands would also have a function with regard to nature development.

5.5 Renewable energy in the coastal zone

The coastal zone has a number of natural features that make it an interesting region for some forms of renewable energy. A study about the average wind speeds in Flanders (*Windplan voor Vlaanderen* [214785]) has concluded that the coast has a significantly higher wind range (see also *Dehenauw 2002* [26621]). In our wind climate, a production factor of ± 11% in the inland, ± 23% near the coast and ± 34% at sea is taken into account (*Brouwers et al. 2011* [225406]). On the other hand, measurements revealed that the sunshine duration in the coastal zone is on average 1,700 hours per year compared to 1,550 hours in Uccle (inland). The differences are greatest during summer when the coast receives up to 20 hours more sunshine per month (*Dehenauw 2002* [26621]). Hence, the coastal zone has an increased potential for solar energy. Of course, other forms of energy production are also present in the coastal zone (e.g. biomass, biogas, etc.). However, as the coast does not constitute a specific climate for these energy forms, they will not be further discussed here.

At the European level, the policy on energy is developed by the *Directorate-General for Energy*. The promotion of energy from renewable energy sources is mainly covered by *Directives 2001/77/EC* and *2009/28/EC* (see also *COM*

(2011) 31). Unlike offshore energy production, renewable energy on land is a Flemish competence (*Environment, Nature and Energy Department*, *Vlaamse beleidsnota energie 2009-2014* [225407]). The Flemish Energy Agency (VEA) implements this policy (*website VEA*). A comprehensive overview of the laws and regulations on renewable energy can be found on the *website of VEA* .

On 1 January 2012, there were 48 large wind turbines present in the coastal zone in Zeebrugge (harbour), Bruges, Gistel, Diksmuide and Middelkerke. These account for an installed capacity of 54.46 MW or 16% of the capacity of the Flemish large windmills (*website VEA*).

In addition to the photovoltaic panels for electricity generation from sunlight by private individuals, a number of solar parks are present in the coastal zone. In early 2013, there were approximately 300 manufacturing plants of more than 10 kW present in the coastal zone, for a total installed capacity of nearly 50 MW. Most of these installations are located in municipalities in the hinterland (Source: *Flemish Regulator of the Electricity and Gas, VREG*).

Legislation reference list

Table with international agreements, conventions, etc.

INTERNATIONAL AGREEMENTS, CONVENTIONS, ...			
Abbreviations (if available)	Title	Year of conclusion	Year of entering into force
ASCOBANS	Agreement on the conservation of small Cetaceans of the Baltic, North East Atlantic, Irish and North Seas	1991	1994

Table with European legislation. The consolidated version of this legislation is available on *Eurlex*.

EUROPEAN LEGISLATION			
Abbreviations (if available)	Title	Year	Number
Directives			
	Directive on the promotion of electricity produced from renewable energy sources in the internal electricity market	2001	77
Marine Strategy Framework Directive	Directive establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive)	2008	56
	Directive 2009/28/EC on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC	2009	28
	Directive concerning common rules for the internal market in natural gas and repealing Directive 2003/55/EC	2009	73
Regulations			
	Regulation establishing an Agency for the Cooperation of Energy Regulators	2009	713
	Regulation on conditions for access to the natural gas transmission networks and repealing Regulation (EC) No 1775/2005	2009	715
Other (Decisions, Communications, White Papers, etc.)			
	Communication from the Commission (COM): An Integrated Maritime Policy for the European Union	2007	575
	Communication from the Commission (COM): Offshore Wind Energy: Action needed to deliver on the Energy Policy Objectives for 2020 and beyond	2008	768
	Communication from the Commission (COM): Energy 2020 - A strategy for competitive, sustainable and secure energy	2010	639
	Communication from the Commission (COM): Energy infrastructure priorities for 2020 and beyond - A Blueprint for an integrated European energy network	2010	677
	Communication from the Commission (COM): Renewable Energy: Progressing towards the 2020 target	2011	31
	Communication from the Commission (COM): A Roadmap for moving to a competitive low carbon economy in 2050	2011	112
	Communication from the Commission (COM): Energy Roadmap 2050	2011	885
	Communication from the Commission (COM): Renewable Energy: a major player in the European energy market	2012	271
	Communication from the Commission (COM): Blue Growth opportunities for marine and maritime sustainable growth	2012	494

Table with Belgian and Flemish legislation. The consolidated version of this legislation is available on *Belgisch staatsblad* and the *Justel-databanken*.

BELGIAN AND FLEMISH LEGISLATION	
Date	Title
Laws	
Wet van 12 april 1965	Wet betreffende het vervoer van gasachtige producten en andere door middel van leidingen.
Wet van 19 september 1991	Wet houdende goedkeuring van de overeenkomst tussen de regering van het Koninkrijk België en de regering van het Koninkrijk Noorwegen inzake het vervoer per pijpleiding van gas van het Noorse Continentaal Plat en uit andere gebieden naar het Koninkrijk België, en van wisseling van brieven inzake de uitlegging van artikel 2, §2 van deze overkomst, ondertekend te Oslo op 14 april 1988
Wet van 20 januari 1999	Wet ter bescherming van het mariene milieu en ter organisatie van de mariene ruimtelijke planning in de zeegebieden onder de rechtsbevoegdheid van België
Wet van 29 april 1999	Wet betreffende de organisatie van de elektriciteitsmarkt, inzonderheid op artikel 6
Wet van 26 juni 2000	Wet houdende instemming met de Overeenkomst tussen de Regering van het Koninkrijk België en de Regering van het Verenigd Koninkrijk van Groot-Brittannië en Noord-Ierland inzake het vervoer van aardgas door middel van een pijpleiding tussen het Koninkrijk België en het Verenigd Koninkrijk van Groot-Brittannië en Noord-Ierland, ondertekend te Brussel op 10 december 1997
Wet van 13 mei 2003	Wet houdende instemming met de Overeenkomst tussen de Regering van het Koninkrijk België en de Regering van het Koninkrijk Noorwegen inzake het leggen van de « Norfra » gaspijpleiding op het Belgische continentaal plat, en de Bijlagen 1, 2 en 3, ondertekend te Brussel op 20 december 1996
Royal Decrees	
KB van 11 maart 1966	Koninklijk besluit betreffende de te nemen maatregelen bij de oprichting en de exploitatie van installaties voor gasvervoer door middel van leidingen
KB van 20 december 2000	Koninklijk besluit betreffende de voorwaarden en de procedure voor de toekenning van domeinconcessies voor de bouw en de exploitatie van installaties voor de productie van elektriciteit uit water, stromen of winden, in de zeegebieden waarin België rechtsmacht kan uitoefenen overeenkomstig het internationaal zeerecht
KB van 12 maart 2002	Koninklijk besluit betreffende de nadere regels voor het leggen van elektriciteitskabels die in de territoriale zee of het nationaal grondgebied binnenkomen of die geplaatst of gebruikt worden in het kader van de exploratie van het continentaal plat, de exploitatie van de minerale rijkdommen en andere niet-levende rijkdommen daarvan of van de werkzaamheden van kunstmatige eilanden, installaties of inrichtingen die onder Belgische rechtsmacht vallen
KB van 16 juli 2002	Koninklijk besluit betreffende de instelling van mechanismen voor de bevordering van elektriciteit opgewekt uit hernieuwbare energiebronnen
KB van 7 september 2003	Koninklijk besluit houdende de procedure tot vergunning en machtiging van bepaalde activiteiten in de zeegebieden onder de rechtsbevoegdheid van België
KB van 9 september 2003	Koninklijk besluit houdende de regels betreffende de milieu-effectenbeoordeling in toepassing van de wet van 20 januari 1999 ter bescherming van het mariene-milieu in de zeegebieden onder de rechtsbevoegdheid van België
KB van 28 september 2008	Koninklijk besluit tot wijziging van het koninklijk besluit van 20 december 2000 betreffende de voorwaarden en de procedure voor de toekenning van domeinconcessies voor de bouw en de exploitatie van installaties voor de productie van elektriciteit uit water, stromen of winden, in de zeegebieden waarin België rechtsmacht kan uitoefenen overeenkomstig het internationaal zeerecht
KB van 30 maart 2009	Koninklijk besluit betreffende productieafwijkingen op installaties voor de productie van elektriciteit uit wind in de zeegebieden
KB van 3 februari 2011	Koninklijk besluit tot wijziging van het koninklijk besluit van 20 december 2000 betreffende de voorwaarden en de procedure voor de toekenning van domeinconcessies voor de bouw en de exploitatie van installaties voor de productie van elektriciteit uit water, stromen of winden, in de zeegebieden waarin België rechtsmacht kan uitoefenen overeenkomstig het internationaal zeerecht
KB van 11 april 2012	Koninklijk besluit tot instelling van een veiligheidszone rond de kunstmatige eilanden, installaties en inrichtingen voor de opwekking van energie uit het water, de stromen en de winden in de zeegebieden onder Belgische rechtsbevoegdheid

BELGIAN AND FLEMISH LEGISLATION (continuation)	
Date	Title
Decrees	
Decreet van 8 mei 2009	Decreet houdende algemene bepalingen betreffende het energiebeleid (het Energiedecreet)
Ministerial Decrees	
MB van 8 mei 2008	Ministerieel besluit houdende aanstelling van ambtenaren bedoeld in artikel 25 van het koninklijk besluit van 12 maart 2002 betreffende de nadere regels voor het leggen van elektriciteitskabels die in de territoriale zee of het nationaal grondgebied binnenkomen of die geplaatst of gebruikt worden in het kader van de exploratie van het continentaal plat, de exploitatie van de minerale rijkdommen en andere niet-levende rijkdommen daarvan of van de werkzaamheden van kunstmatige eilanden, installaties of inrichtingen die onder Belgische rechtsmacht vallen
MB van 16 maart 2009	Ministerieel besluit houdende aanwijzing van de ambtenaren die ermee belast zijn de Minister te vertegenwoordigen en toe te zien op de toepassing van het koninklijk besluit van 20 december 2000 betreffende de voorwaarden en de procedure voor de toekenning van domeinconcessies voor de bouw en de exploitatie van installaties voor de productie van elektriciteit uit water, stromen of winden, in de zeegebieden waarin België rechtsmacht kan uitoefenen overeenkomstig het internationaal zeerecht

6 Fisheries

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Citation:

Polet, H., Torreele, E., Pirlet, H., 2013. Fisheries. In: Lescrauwaet, A.K., Pirlet, H., Verleye, T., Mees, J., Herman, R. (Eds.), Compendium for Coast and Sea 2013: integrating knowledge on the socio-economic, environmental and institutional aspects of the Coast and Sea in Flanders and Belgium. Oostende, Belgium, p. 153-166.

In 2011, 90.4 million tons of fish were caught worldwide, of which 78.9 million tons were sea fish (*State of World Fisheries and Aquaculture, FAO 2012* [216886]). The fleet of the European Union (EU) is responsible for 6% of the global fish capture, about half of which is caught by Denmark, the United Kingdom, France and Spain. Belgian fisheries constitute a small share of these European figures. In 2009, the total of Belgian fisheries equalled 0.43% of the European total (*Facts and figures on the Common Fisheries Policy, 2012* [225357]). In 2011, the Belgian fisheries fleet accounted for 0.1% of the total European fleet with a tonnage and engine capacity which are 0.9 and 0.8% of the European total (*Facts and figures on the Common Fisheries Policy, 2012* [225357]).

6.1 Policy context

The European fisheries efforts are mainly regulated by the *Common Fisheries Policy* (CFP) (*Regulation 2371/2002*) proposed by the Directorate-General for Maritime Affairs and Fisheries (*DG MARE*) of the European Commission (EC) (more information: *handleiding voor het GVB, 2009* [140508], *overview European legislation concerning the CFP*) to the Council of Ministers and to the European Parliament. The *CFP* has been developed within a sustainable development context as stated by the EU strategy for Sustainable Development (*COM (2001) 264*) and in the *World Summit on Sustainable Development in Johannesburg (2002)* [214763] (see **Sustainable use**). An important institutional development within the *CFP* concerns the establishment of regional advisory councils (RACs); two thirds of its representatives are stakeholders from the fisheries sector and one third are other stakeholders (see *Council Decision 2004/585/EC*) (*website DG MARE*, *manual to the CFP, 2009* [140508]). In preparation of the reform of the *CFP* (Green Paper *CFP* reform (*COM (2009) 163*)), a consultation on the reform was organised (*SEC (2010) 428*, *COM (2011) 417*), which influenced the reform proposals presented to the Council of Ministers and the European Parliament. When developing the European policy, a number of national services and international authorities have been consulted, such as the Scientific, Technical and Economic Committee for Fisheries (STECF) of the EC and the International Council for the Exploration of the Sea (*ICES*) (*Adriansens 2009* [202009], *handleiding voor het GVB, 2009* [140508]) (see **Sustainable use**).

The regional Flemish Government has the exclusive authority with regard to sea fisheries. The regulation for recreational fishing is stipulated by the *Royal Decree of 14 August 1989* and the *Ministerial Decree of 21 December 2012*. The policy for commercial fishing is developed by the Flemish Ministry of Agriculture and Fisheries (*Beleidsnota landbouw, visserij en plattelandsbeleid 2009-2014* [214778]). The *Agriculture and Fisheries Department* is responsible for the preparation of the policy on the Flemish and European level. Within this department, the *Agriculture and Fisheries Policy Division* is responsible for the implementation of the European policy, the formulation of policy proposals, the development of regulations, as well as for the implementation of the fisheries policy. This concerns the implementation of the European (European Fisheries Fund, EFF) and Flemish (*Financieringsinstrument voor de Vlaamse Visserij- en aquacultuursector, FIVA*) policy for investments and actions in support of fisheries. In this regard a management authority has been established in the context of the *Operational programme in implementation of the National Strategic Plan for the Belgian fisheries sector 2007-2013* [196136]. The implementation of the policy also implies: policing activities, data collection and the reporting of the data in yearly reports. The *Sea fisheries service* is part of the latter section and guarantees the coordination, implementation and enforcement of the fisheries policy.

The policy is also supported by the Institute for Agricultural and Fisheries Research (*ILVO*) and the Flanders' Agricultural Marketing Board (*VLAM*). The Strategic Advisory Council of Agriculture and Fisheries (*SALV*) council advises the Flemish government and the Flemish parliament concerning the policy and the development regulations on the economic, ecological, social and societal aspects of the (agriculture and) fisheries policy. This advice is prepared by the *Technische Werkcommissie Visserij* committee of SALV. The *Milieu- en Natuurraad van Vlaanderen* (*Minaraad*) provides advice in a number of fisheries-related cases as well. *Rederscentrale* is recognised as the organisation of producers of fisheries products and as the professional association representing the employers. The Foundation for Sustainable Fishery Development (*SDVO*) aims to represent the interests of the Belgian sea fisheries cluster and to support them in all domains that contribute to sustainable fisheries. *Redercentrale* as well as SDVO are represented in the RACs that are relevant for Belgian fisheries. The Belgian fisheries policy is discussed in more detail in *Vanderperren & Polet (2009)* [203234] (CLIMAR project *phase 1* and *phase 2* BELSPO), the *National Strategic Plan for the Belgian fisheries sector 2007-2013* [196135], the *Operational Programme in implementation of the National Strategic Plan for the Belgian fisheries sector 2007-2013* [196136] and *Visserijrapport (VIRA) (2012)* [224957]. An extensive overview of the legislation concerning fisheries is given in the coastal codex, theme *fisheries*.

6.2 Spatial use

The *CFP* is valid in the Belgian fisheries zone (*law of 10 October 1978*), the borders of which correspond to the exclusive economic zone (EEZ, *law of 22 April 1999*). In this zone, the performance of fisheries activities is subject to Belgian jurisdiction (although fisheries is a Flemish competence, see above); however, the rights of foreign vessels in the context of the *CFP* and the relevant international regulations are taken into account (*Maes et al. 2004* [70936] (*MARE-DASM project BELSPO*)). Hence, the Belgian fisheries zone gives unlimited access to all EU Member States, except for Spain, Portugal and Finland, which may only catch unrestricted fish species and species without quota (*Douvere & Maes 2005* [78296], *GAUFRE project BELSPO*).

THE DEMARCATION OF THE FISHERIES ZONES AND THE LOCATIONS WHERE FISHERIES ACTIVITIES ARE PROHIBITED, WITHIN THE BNS

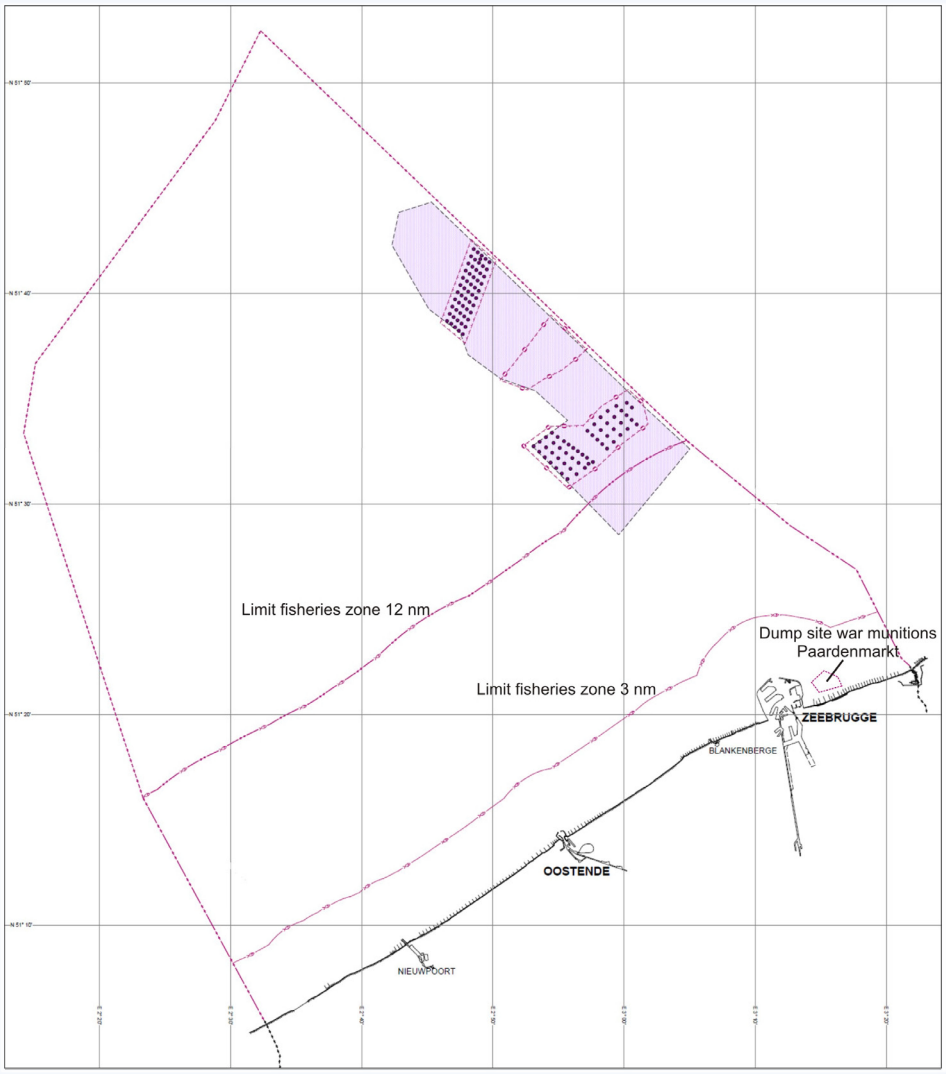

Figure 1. The demarcation of the fisheries zones and the locations where fisheries activities are prohibited, within the BNS (Source: *Continentaal Plat & Vlaamse Hydrografie 2013* [227521]).

In the territorial waters (the zone from the baseline to 12 nautical miles (nm)[1] offshore), fisheries are regulated by the national legislation (*law of 19 August 1891*). This legislation defines that fishing ships, fishing between 0 and 12 nm, cannot have engines with a power over 221 kW and, when fishing between 0 and 3 nm, ships need to remain below 70 GT (with a possible extension of this zone to 4.5 nm in the context of the marine spatial plan, see below). In the territorial waters, fisheries are exclusively reserved for Belgian fishermen, even though under certain conditions, French and Dutch fishermen are allowed as well as a result of multilateral conventions (*Douvere & Maes 2005* [78296], *GAUFRE project BELSPO*):

- The Treaty establishing the Benelux Economic Union (1958) attributes unlimited rights to Dutch fishermen for fishing in the Belgian territorial zone;
- The Belgian-French convention on '*ijle haring*' fisheries (herring suitable for marinades, caught between December and April) and European sprat in the French and Belgian territorial waters (1975) allows French fishing boats to catch sprat and herring in the zone between 3 and 12 nm from the baseline, under certain conditions.

Fishing is forbidden at the Paardenmarkt site, where war ammunition is stored (*Maes et al. 2000* [18619]). Furthermore, the *Royal Decree of 11 April 2012* forbids shipping (and therefore also fisheries) in a safety zone of 500 m around wind farms. The compatibility of wind farms at sea and passive fisheries and mariculture has been investigated in the context of the MARIPAS-project (*Verhaeghe et al. 2011* [206186]).

In the draft of the Marine Spatial Plan (*Ontwerp van koninklijk besluit tot vaststelling van het marien ruimtelijk plan* [227527]), as proposed by the Minister competent for the North Sea, measures have been proposed in 4 zones in the Habitats Directive Area 'Vlaamse Banken' (Flemish Banks) to stimulate alternative, sustainable fisheries (see also theme **Nature and environment**). Furthermore, fishing is prohibited for vessels with a gross tonnage of over 70 GT within the zone of 4.5 nautical miles from the coastline (see **Belgian fishing fleet**).

Belgian fishermen are also active outside the BNS in the Southern and Central North Sea as well as in the Western waters. In the context of the *CFP* and through multilateral conventions, Belgian fishing boats have acquired access to the coastal waters of a few other European Member States (*Visserijrapport (VIRA) (2012)* [224957]). Furthermore, Belgian fishermen have access to limited quota in Norwegian waters and in a few ICES-areas. A detailed list of the sea areas is given in *Visserijrapport (VIRA) (2012)* [224957]. A map with the historical fishing grounds (1929-1999) can be consulted on the website '*A century of sea fisheries in Belgium*' of the Flanders Marine Institute (VLIZ).

6.3 Societal interest

6.3.1 Employment

Employment in the fisheries sector has declined due to the crisis that has affected the fisheries sector (see **Sustainable use**). In 2012, the fisheries sector in Belgium consisted of 439 authorised sea fishermen. In addition, approximately 1,040 people worked in the fish-processing industry and 5,000 people in related sectors (*Visserijrapport (VIRA) (2012)* [224957]). The promotion of the attractiveness of the sector, especially towards the younger end of the workforce, remains one of the most important challenges. Efforts are made to improve the inflow of young persons into the sector, for example by means of the *Fund for young shippers* (*SALV advice 23 March 2012* [226542] and *advice of 20 March 2013* [226541]).

6.3.2 Belgian fishing fleet

In the *Ministerial Decree of 16 December 2005*, the fishing fleet is divided into 3 segments:

- Large Fleet Segment: All fishing vessels with an engine power capacity between 221 kW and 1,200 kW;
- Small Fleet Segment: All fishing vessels with an engine power capacity of 221 kW or less, except for the coastal fleet segment;
- A Coastal Fleet Segment: All fishing vessels with an engine power capacity of 221 kW or less and a tonnage of maximum 70 GT, which take part in sea trips of maximum 48 hours with the start and end situated in a Belgian port. The affiliation to the coastal fleet segment takes place on a voluntary basis.

In 2011, the Belgian sea fishing fleet consisted of 88 ships with a total engine power of 44,025 kW and a gross tonnage of 15,733 GT (*officiële lijst van de Belgische vissersvaartuigen 2013* [225388]). The past 50 years, the number of fishing

1 1 nautical mile = 1,852 meters

boats has strongly decreased (figure 2). This trend accelerated due to the increase of the oil prices, which affected the profitability of the fishing fleet. In the early fifties, there were more than 450 fishing vessels, followed by a large fleet depletion in the seventies. Since 2009, the number of shipping boats has mainly decreased due to the temporary scrappage measures executed by the Flemish government, following the *EU Regulation 744/2008*, in order to deal with the profitability problems of the Belgian fishing fleet (see *Ministerial Decree of 2 June 2009*, see **Sustainable use**) (see regulation on fleet adaptation in *Visserijrapport (VIRA) (2012)* [224957]). The total engine power capacity, however, does not reveal a comparable decrease. This is due to the trend towards larger vessels with aggregations of engine capacities (*Operational Programme in implementation of the National Strategic Plan for the Belgian fisheries sector 2007-2013* [196136]). The dynamics of the Belgian fishing fleet with changing owners, immatriculation numbers, ports of registration and technological equipment can be consulted in a database on the website '*A century of sea fisheries in Belgium*' of the Flanders Marine Institute (VLIZ) and in a review article (*Lescrauwaet et al. 2013* [218497]).

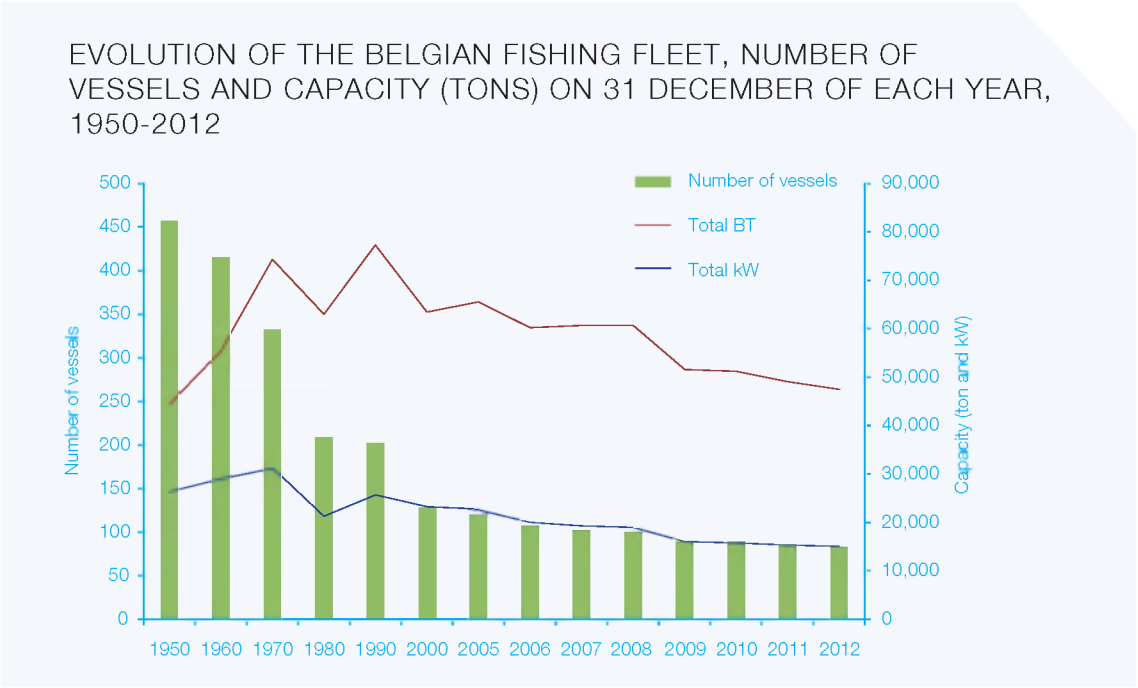

Figure 2. Evolution of the Belgian fishing fleet, number of vessels and capacity (tons) on 31 December of each year, 1950-2012 (*Visserijrapport (VIRA) 2012*).

Another important challenge with regard to the development of the sector is the age of the Belgian fleet, with an average age which has increased to 24 years (*Visserijrapport (VIRA) 2012* [224957]). This ageing is especially pronounced in the small fleet segment with vessel ages that can amount to 40-50 years. Other figures of each fleet segment can be found in *Tessens & Velghe (2012)* [217751]. In *Visserijrapport (VIRA) (2012)* [224957] the profitability, labour costs, fuel costs, etc. of the fishing fleet are discussed as well.

6.3.3 Landings and value

The landings of the Belgian sea fisheries vessels between 1929 and 1999 have been collected for each species and for each fishing area on the website '*A century of sea fisheries in Belgium*' of VLIZ (figure 3). Landings peaked after the Second World War, when more than 70,000 tons of fish was landed in the Belgian ports each year. Since then, the supply decreased constantly to about 20,000 tons in the past few years (*Tessens & Velghe 2012* [217751]). The evolution of the landings can be largely explained by a change in the species composition of the catch (*Visserijrapport (VIRA) 2012* [224957]), but the fuel crisis, declining fish stocks, the declining fishing fleet, limiting quota and the fishing effort limits also contribute to lower landing numbers (see **Sustainable use**). In 2011, the landing amounted to 20,138 tons of which 16,905 tons were landed in Belgian ports and 3,233 tons in foreign ports. In 2011, the port of Zeebrugge covered 66.7% of the landings in Belgian ports, Ostend 31.2% and Nieuwpoort 2.1%. Plaice, sole and ray remain the most important species in 2011 in terms of landing volume (*Tessens & Velghe 2012* [217751]).

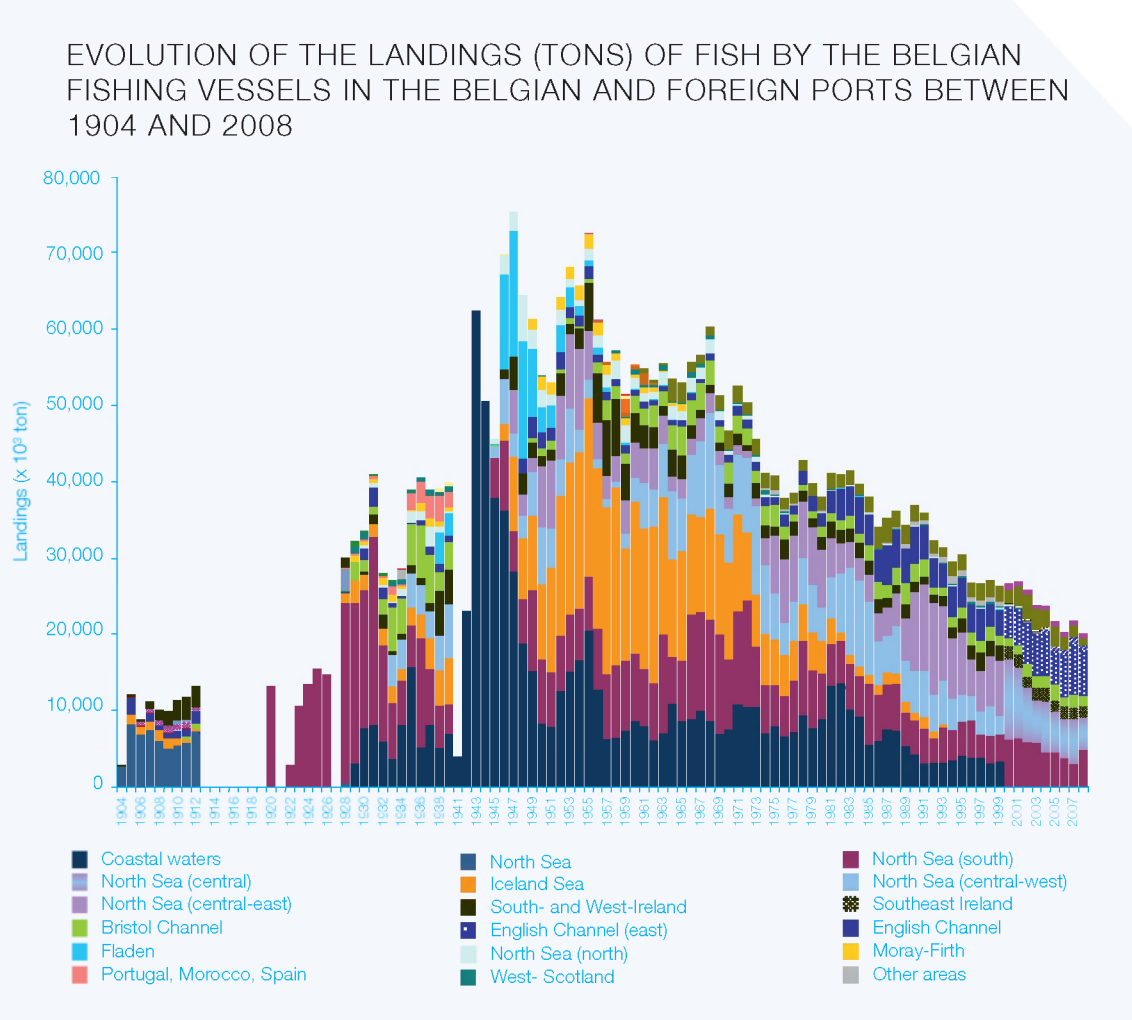

Figure 3. Evolution of the landings (tons) of fish by the Belgian fishing vessels in Belgian and foreign ports between 1904 and 2008, sorted by fishing ground (*A century of sea fisheries in Belgium*, VLIZ).

The value of landings or turnover is the yield of landed fish and fish products sold by public auction (calculated on the total of both traded and non-traded products). The total value of landings of fish by Belgian fisheries vessels increased almost constantly after the Second World War from approximately 80 million euros (indexed value with respect to the reference year 2007) to peaks of approximately 130 million euros at the end of the eighties and in the early nineties (website '*A century of sea fisheries in Belgium*', VLIZ). This was followed by a decrease to 68.367 million euros in 2009, followed by an increase to 79.437 million euros in 2011. Sole remains the most important fish species for Belgian fisheries with 47% of the value of landings in 2011. (*Tessens & Velghe 2012* [217751]). The value of landings of each species between 1929 and 1999 is kept at the website '*A century of sea fisheries in Belgium*' (VLIZ). The recent value of landings for each species can be found in *Tessens & Velghe (2012)* [217751].

6.3.4 Trade and consumption of fish products

In Belgium there are three active fish auctions: Zeebrugge, Ostend and Nieuwpoort; Zeebrugge and Ostend are assigned to the '*Vlaamse Visveiling*' auction. The average prices of fish caught by Belgian fisheries vessels have increased almost constantly with a peak of 4.48 euros per kilo in 2006. After 2006, a decrease occurred to 3.66 euros per kilo in 2009, followed by an increase to 4.09 euros per kilo in 2011 (*Tessens & Velghe 2012* [217751]).

Figures from the GfK Panel Services Benelux for VLAM reveal that in 2011, Belgians bought on average 10.2 kilos of fish, molluscs and crustaceans per capita, for a total amount of 106.5 euros.

The degree of self-sufficiency for fish, molluscs and crustaceans in Belgium and Luxemburg from fisheries and aquaculture amounted to 14.6% in 2008 (Source: VLAM). In 2011, the value of imported fish products amounted to 1.67 billion euros (45% from outside the EU), while the export value totalled 928 million euros (98% was exported to EU Member States) (*Visserijrapport (VIRA) 2012* [224957]).

6.3.5 Fisheries communities

The social dimension of the fisheries sector (training, employment, wellbeing, safety, etc.) is discussed in detail in *Visserijrapport (VIRA) (2012)* [224957]. The impact of the *CFP* on the social and economic aspects of fisheries communities was investigated in a European study: '*Regional social and economic impacts of change in fisheries-dependent communities 2011* [225598]' including a case study in Ostend (*Assessment of the status, development and diversification of fisheries-dependent communities. Oostende Case Study Report 2010* [225599]). The *GiFS project* investigates the socio-economic and cultural importance of inshore fisheries for coastal communities. Within the institute for Agricultural and Fisheries Research (*ILVO*), the *VISEO group* [226546] aims to gather knowledge about techniques, ecosystem and society by means of specific and integrated social scientific research, meeting the needs of ILVO-Fisheries, the fisheries sector as well as the policy. The research topics include *inter alia* business economics research, supply chain research, international market research and research on the impact of the policy on the competitiveness of the sector and the environment.

6.4 Impact

Fisheries activities unmistakeably have an impact on the marine ecosystem, although the precise impact is still a matter of debate. Besides the extraction of marine organisms, fisheries techniques entail a certain degree of seabed disturbance. The use of energy by fishing vessels and waste production have an impact on the environment as well (*Visserijrapport (VIRA) 2012* [224957]). An overview of the impact of fisheries activities is discussed in *Polet & Depestele 2010* [204067] and in the *Strategic Environmental Assessment of the National Operational Plan for the Belgian fisheries sector, 2007 - 2013* [131093]. Below, the effects are discussed in more detail.

6.4.1 Overfishing[2] and illegal, unreported and unregulated fishing

A structural imbalance between the catch capacity and the biological potential of fish stocks has led to overfishing of fish stocks that are important for the Belgian fisheries sector (such as cod) (*Operational Programme in implementation of the National Strategic Plan for the Belgian fisheries sector 2007-2013* [196136]). This overfishing may result in a reduced reproductive capacity and finally in the collapse of the fish stocks. Hence, fisheries can irreversibly modify the structure of the communities and the food web (*Pauly et al. 1998* [38926], *Polet et al. 2008* [127555], *OSPAR QSR 2010* [198817]). The effect on the marine biological communities is amplified by illegal, unreported and unregulated fishing (IUU-fishing) (*handbook on IUU-regulation, 2010* [222390], *website Dienst Zeevisserij*, *website DG MARE*) as well as by illegal practices such as 'high-grading', i.e. the discarding of non-target species (so-called by-catch) or economically less interesting species in order to maximise the value of the catch (more information: *Vandendriessche et al. 2008* [126732], *handleiding voor het GVB, 2009* [140508]).

In 2010, *ICES* introduced the principle of maximum sustainable yield (MSY) in order to test the condition of the fish stock. A healthy MSY condition means that the biomass of the concerned fish stocks is sufficiently high to guarantee a maximum sustainable yield (*Visserijrapport (VIRA) 2012* [224957]). According to *Moreau (2012)* [221529], there is a positive evolution in the number of commercial fish stocks in the North Sea reaching a good MSY, although this is not the case for important species such as sole and cod. In other areas (e.g. Bristol Channel, Celtic Sea, ICES areas VIIf and g) the sole and cod population show signs of recovery (*ICES advices*).

6.4.2 Impact of fishing gear

The impact of fisheries activities on the ecosystem and the biological communities strongly depends on the fishing gear used, although factors such as the mesh size of the nets, the time and place of fishing and the knowledge of the fisherman also play an important role. The recent European project *BENTHIS* investigates the impact of fisheries

2 *Goethel et al. (2012)* [226133] gives a historical overview of the term overfishing.

Table 1. An overview of the impact of the most common fishing gear in Belgian fisheries.

FISHING GEAR	IMPACT ON THE ECOSYSTEM	LITERATURE
Beam trawling (targeting fish and/ or shrimp)	Seabed disturbance and associated effect on benthos and habitat	*Lindeboom & De Groot 1998 (Impact II)* [6412], *Operationeel Programma in uitvoering van het Nationaal Strategisch Plan voor de Belgische visserijsector 2007-2013* [196136], *Houziaux et al. 2008* [140756] (*Project BELSPO*), *Polet et al. 2008* [127555], *Rabaut et al. 2008* [117452], *Depestele et al. 2008* [122687], *Polet et al. 2010* [200444], *Polet & Depestele 2010* [204067], *Depestele et al. 2012* [214303] (*WAKO-II project BELSPO*), *Van Lancker et al. 2012* [213684] (*QUEST-4D project BELSPO*)
	By-catch and discards	*Operationeel Programma in uitvoering van het Nationaal Strategisch Plan voor de Belgische visserijsector 2007-2013* [196136], *Polet et al. 2008* [127555], *Depestele et al. 2008* [122687], *Vandendriessche et al. 2008* [126732], *Polet et al. 2010* [200444], *Polet & Depestele 2010* [204067], *Depestele et al. 2011* [204031], *Depestele et al. 2012* [2114303] (*WAKO-II project BELSPO*), *Verschueren et al. 2012* [225355]
	Shifts in the nutritional habits of seabirds caused by discards of by-catch	*Depestele et al. 2012* [214303] (*WAKO-II project BELSPO*), *Sotillo et al. 2012* [213293]
	Use of fuels and resources	*Depestele et al. 2007* [122712], *Operationeel Programma in uitvoering van het Nationaal Strategisch Plan voor de Belgische visserijsector 2007-2013* [196136], *Polet et al. 2008* [127555], *Polet et al. 2010* [200444], *Polet & Depestele 2010* [204067]
Trammel net (a type of gillnetting)	By-catch of sea birds and marine mammals	*Haelters & Kerckhof 2004* [67586], *Depestele et al. 2006* [106430], *Depestele et al. 2008* [122687], *Haelters & Camphuysen 2009* [139890], *Depestele et al. 2012* [214303] (*WAKO-II project BELSPO*)
	Ghost fishing	*Depestele et al. 2006* [106430], *Depestele et al. 2008* [122687], *Depestele et al. 2012* [214303] (*WAKO-II project BELSPO*)
	By-catch and discards	*Depestele et al. 2012* [214303] (*WAKO-II project BELSPO*)

on benthic ecosystems in detail. One case study of the project focuses on the North Sea. Table 1 gives an overview of the impact of the most commonly used fishing gear in Belgian fisheries. It should be mentioned that over the past few years, otter trawling has become more common. However, the current Belgian research on the impact of this technique is limited.

6.4.3 The impact on other users

The spatial impact of the fisheries activities on other users of the marine environment is discussed in the *GAUFRE project BELSPO*. A problem analysis of the professional fisheries was conducted in *Maes et al. (2004)* [70936] (*MARE-DASM project BELSPO*). The compatibility with other users in the BNS is discussed in the draft of the Marine Spatial Plan (*Ontwerp van koninklijk besluit tot vaststelling van het marien ruimtelijk plan* [227527]), as proposed by the Minister competent for the North Sea.

6.4.4 Recreational fisheries

In the BNS, recreational fisheries mainly consist of sea anglers (about 2,000 recreational fishermen are registered with the association *Vlaamse Vereniging van Hengelsportverbonden*) and shrimp and flatfish fisheries with small trawl nets. On a smaller scale, passive beach fishing occurs with fixed nets and through angling on the beach, on the piers and on the breakwaters (*Visserijrapport (VIRA) 2012* [224957]). Except for passive fisheries with fixed nets, recreational fisheries in the BNS do not require any authorisation. Hence, little is known about the scale of these fisheries (*Goffin et al. 2007* [114225]). Moreover, the impact of these fisheries has not been investigated in a detailed way. According to an estimation in a pilot study (*pilootstudie in opdracht van de Dienst Zeevisserij (ILVO, 2007)* [190665]), catches of cod by recreational fishermen are at least of the same magnitude as catches by professional fisheries. The impact of the fleet of recreational fishermen using beam trawls (<3 m wide) as fishing gear in order to catch shrimps and flatfish remains to be elucidated.

In Oostduinkerke there are 12 active horseback shrimp fishermen and 2 guilds of shrimp fishermen ("*kruwersverenigingen*") who manually trawl along the coastline; they have an important folkloric value (see *www.paardevissers.be* and *Province of West Flanders 2008* [126150], see theme **Maritime and coastal heritage**).

6.5 Sustainable use

6.5.1 The Common Fisheries Policy (CFP)

The most important goal of the *Common Fisheries Policy* (CFP) (*Regulation 2371/2002*) is sustainable fisheries with a balance between the ecological, economic and social aspects in order to conserve fish stocks for future generations. To achieve this goal, the EU introduced a number of conservation measures, which can be divided into 4 groups (*Adriansens 2009* [202009], *website DG MARE*, *handleiding voor het GVB, 2009* [140508]):

- Europe defines the Total Allowable Catch (TAC) of specific fish stocks within a certain period. These TACs are divided among the Member States by means of quotas. The Flemish quotas are available on the following website: *website Dienst Zeevisserij* (see also *Wintein & Brouckaert 2011* [225392], drafted by the quota commission of *Rederscentrale*). The quotas can be swapped among the Member States. During the *World summit on sustainable development in Johannesburg (2002)* [214763], the international community committed itself to adopting a new management system for fish stocks based upon the MSY concept, at the latest by 2015 (*Adriansens 2009* [202009], *handleiding voor het GVB, 2009* [140508]). At this moment, the MSY for certain species such as ray cannot be determined. *ICES* gives quantitative advice to Europe based upon all available information for all fish stocks without a management plan or MSY-value. Therefore, ICES classifies all available scientific information in 6 categories in order to apply advisory rules to them (source: *www.ices.dk*).
  The current Belgian fleet mainly focuses on mixed fisheries, catching species from sustainable fish stocks as well as non-targeted species. In order to face this challenge, fisheries management is evolving towards 'multi-species management'. This issue is discussed in *the ICES Working Group on Mixed Fisheries Advice for the North Sea (WGMIXFISH)*. On the other hand, attention is paid to the effects of excessive selective fishing and balanced harvesting of fish stock is advocated, corresponding to their natural occurrence (*Garcia et al. 2012* [213612]).
- Technical measures have been introduced, such as a minimal mesh size, selective fishing gear, closed areas, minimal sizes for the landings of fish and a gradual introduction of a ban on discards.
- The fishing effort is limited by restricting the number of days when fishing boats can fish at sea. In addition, the fishing effort is reoriented by closing certain zones (temporarily) for fishing activities. In this regard, the Irish Sea was temporarily closed for the Belgian fishing fleet in January 2013, in line with the advice of the quota commission (*Ministerial Decree of 21 December 2012*).
- Fleet measures have been set, defining the number and the type of vessels that are allowed to fish as well as the reference levels. However, the efficiency of the EU measures dealing with the overcapacity of the fishing fleet is questioned in the following study: *studie van de Europese Rekenkamer (2011)* [225386].

The EC aims for long-term management, in which specific multi-annual plans are drawn up for important commercial fish species. Europe is also tackling the problem of discards (*handleiding voor het GVB, 2009* [140508]). An overview of European legislation concerning the *CFP* is provided on the *Eurlex website*. The ecological, economic, social and governance impacts of the *CFP* were investigated in the following study: *European studie (2010)* [225596].

In order to help finance these measures, Europe founded the European Fisheries Fund (EFF) for the 2007-2013 period (*Regulation 1198/2006*) (*handleiding voor het GVB, 2009* [140508]). The fund is financed by European money and funds

from Member States (in this case Flanders, the Walloon region and local administrations). An overview of the interim national evaluation report of the EFF is given in *'Interim evaluation of the European Fisheries Fund (2007-2013)'* [225385].

Since 1 January 2010, the control of compliance with the *CFP* is settled by *Regulation 1224/2009* which relates to *Regulation 1005/2008* to prevent, deter and eliminate IUU-fisheries. The fishing activities of all fishing vessels except for small traditional vessels (<12 m) can be monitored by means of a satellite tracking system (the so-called 'Vessel Monitoring System'). All ships also have to be equipped with an electronic logbook, in which fishermen need to report the date, place and size of the catch, per species (*Visserijrapport (VIRA) 2012* [224957], *website DG MARE*). The European Fisheries Control Agency (EFCA) was founded in Vigo in 2006 to organise the collaboration and coordination between the Member States on the control and inspection of fisheries (*handleiding voor het GVB, 2009* [140508]).

6.5.2 The CFP reform

The EC has developed reform proposals that need to generate a radical switch in the fisheries policy after 2013 (see Green Paper reform *CFP* (*COM (2009) 163*) prior to the reform proposals, consultation *CFP* reform (*SEC (2010) 428*, *COM (2011) 417*)). Some of the elements included in the reform proposals, concern a landing obligation (ban on discards), achieving a MSY of the fish stocks by 2015, the implementation of transferable fishing concessions (choice of implementation by the Member States), and the focus on regional management (*Visserijrapport (VIRA) 2012* [224957], *website DG MARE*). The anticipated ecological, economic, social and governance impacts of this reform were investigated in the following study: *Europese studie (2010)* [225597].

6.5.3 The Marine Strategy Framework Directive - MSFD

In addition to the *CFP*, the *MSFD* (*2008/56/EC*) offers a framework to reduce or avoid the impact of fisheries on the marine environment. A number of descriptors have been developed in order to define a good environmental status (GES), which relate directly or indirectly to fisheries:

- Populations of all commercially exploited fish and shellfish are within safe biological limits, exhibiting a population age and size distribution that is indicative of a healthy stock (more information: *Piet et al. 2010* [202482]).
- All elements of the marine food webs, to the extent that they are known, occur at normal abundance, diversity and levels capable of ensuring the long-term abundance of the species and the retention of their full reproductive capacity (more information: *Rogers et al. 2010* [202488]).
- Sea-floor integrity is at a level that ensures the structure and functions of the ecosystems are safeguarded and benthic ecosystems, in particular, are not adversely affected (more information: *Rice et al. 2010* [202490]).
- Contaminants in fish and other seafood for human consumption do not exceed levels established by community legislation or other relevant standards (more information: *Swartenbroux et al. 2010* [199553]).

The physical damage to the seabed due to fisheries activities and the selective extraction of species, including incidental non-target catches, has also been included in the indicative list of pressures and impacts. Furthermore, the need for a monitoring program for the chemical pollution of commercial fish species has been highlighted.

The *MSFD* has been implemented in Belgian legislation by the *Royal Decree of 23 June 2010*. The elaboration of the environmental goals and indicators for each descriptor for the BNS is given in the following publication: *de Omschrijving van de Goede Milieutoestand & vaststelling van Milieudoelen voor de Belgische mariene wateren (2012)* [220232]. In this regard, a monitoring program will be implemented (2014), allowing to monitor the evolution of the condition of the environment, and to evaluate this in the context of a 6-yearly report (see theme **Nature and environment**).

6.5.4 Data collection in Europe and Belgium

In-depth research and scientific information is needed to underpin the *CFP*. On the European level, the fisheries research is regulated by detailed directives (*Data Collection Framework, DCF*) stipulating which information Member States should gather. The current regulation is valid until the end of 2013. In 2014, the DCF will be replaced by the Data Collection Multi-Annual Programme (DCMAP), complementing the new *CFP*. The DCMAP is a 7-yearly program, combining several activities carried out in the Member States, such as control, data collection and studies. The funding of the new DCMAP is covered by the European Maritime and Fisheries Fund (EMFF). This new fund will

replace the current European Fisheries Fund (EFF) and a few other tools. Advice regarding the *CFP* on the basis of scientific information is provided by several organisations (more information: *handleiding voor het GVB, 2009* [140508]):

- The International Council for Exploration of the Sea (*ICES*) gives biological advice for proper management of fisheries in Europe, by means of international collaboration with fisheries biologists. The conclusions of the ICES working groups dealing with fish stock evaluations are processed in the deliberations of the Advisory Committee (ACOM).
- The *Scientific, Technical and Economic Committee for Fisheries* (STECF) is the regular advisory body of the EC with regard to fisheries. This committee was founded in 1993 (*93/619/EC*) and renewed in 2005 (*2005/629/EC*) and consists of a group of independent scientists, established in order to advise the EC on all aspects of the fisheries policy.

In Belgium the research group fisheries biology of the *ILVO* gives advice on the condition and management of Belgian and European fisheries. This research group also conducts research on fisheries biology, stock assessment methods, marine ecosystem dynamics and the potential consequences of fisheries management on the fish stocks and fisheries *in se*. In order to realise these general objectives, the research activities mainly focus on data collection concerning the size of fish stocks and the exploitation pattern of the commercially important species. This results in scientific advice supporting the implementation and execution of the *CFP*.

A number of important challenges include: the evolution from a 'single species' towards a 'multi species' approach within the context of the ecosystem approach, the development and implementation of a *métier* oriented programme and the promotion of collaboration between the fisheries sector and scientists by means of Fisheries-Science Partnerships.

6.5.5 A sustainable fisheries sector

Fisheries have gone through various years of crisis. The government has tried to respond to this crisis with specific measures. The Flemish fisheries sector has been striving for a more sustainable approach, *inter alia* by means of investments in higher profitability, energy-saving techniques in a broad sense (engine, auxiliary engine, fishing gear, equipment, etc.), alternative, environmentally friendly or more selective fishing techniques, scrapping programmes to balance the catch capacity of the fleet and quotas, emphasis on other target species, changes in landing volumes, improvement of the quality of fish products, improved working conditions and safety of the crew and the development of a sustainable aquaculture sector in Flanders (*Visserijrapport (VIRA) 2012* [224957]).

A number of initiatives to achieve a (more) sustainable fisheries sector are listed below:

Within the context of the EFF (*Regulation 1198/2006*), every Member State needs to develop a national strategic plan for the fisheries sector (*National Strategic Plan for the Belgian fisheries sector 2007-2013* [196135], *Strategic Environmental Assessment of the National Operational Plan for the Belgian fisheries sector, 2007 - 2013* [131093] – *Royal Decree of 18 May 2008*, the *Operational Programme in implementation of the National Strategic Plan for the Belgian fisheries sector 2007-2013* [196136]). For the Belgian fisheries sector, 5 priorities have been defined:

- Axis 1 – Measures for the adaptation of the fisheries fleet;
- Axis 2 – Aquaculture, inland fisheries, processing and marketing of fisheries and aquaculture products;
- Axis 3 – Measures of common interest;
- Axis 4 – Sustainable development of fisheries areas;
- Axis 5 – Technical assistance.

Within *Axis 4 (sustainable development of fisheries areas)* of the national operational programme, the EFF provides funds in order to strengthen Belgian sea fisheries on a local level. Specific attention is paid to sustainable fishing methods, quality-oriented fish and fish chain management, a more sustainable market, more diversification, expansion and innovation, attention for e.g. equal opportunities, economic viability and sustainable management of the coast and the marine environment (*ontwikkelingsstrategie EVF as 4 Belgisch Kustgebied, 2011* [214765]). The allocation of the funds is decided on and managed by the Local Group, a partnership encompassing a broad range of socio-economic actors from the fisheries sector, NGOs and administrations.

To be able to face the profitability problems of the fisheries fleet, the Flemish government has developed a *global action and restructuring plan (Task Force Fisheries 2006)* [106527], aiming towards sustainable Flemish fisheries by means of structural changes. This plan is part of the Belgian implementation procedure of the *European Regulation 744/2008*,

which allowed temporary support for a scrapping programme and a modernisation scheme. These measures were financed by Flemish public resources from the *FIVA* (*Decree of 13 May 1997*).

- In 2005, the maximum engine capacity was raised to 1,200 kW and three fleet segments were defined. The scrapping of vessels was temporarily supported by governmental intervention (*Ministerial Decree of 2 June 2009* – see **Societal interest: the Belgian fleet**);
- The adapted Flemish quota policy (in force since 1 February 2006) should contribute to an optimal and efficient quota use (more information: *Adriansens 2009* [202009]);
- Research on alternative fishing techniques is carried out in order to transform the remaining vessels into a sustainable fleet.

The *ILVO* conducts research on sustainable fishing techniques. In this context, the design of the beam trawl was modified to reduce seabed disturbance, towing resistance and thus fuel use (*Depestele et al. 2007* [122712], *Stouten et al. 2007* [122709]). Experimental modifications of fishing gear have also been tested to decrease discards of undersized fish and non-commercial organisms. It is expected that research with regard to a better species and length selection will remain necessary due to the proposed discard ban (e.g. *Depestele et al. 2011* [214689]). In addition, research is carried out on alternative fishing techniques such as handline fishing, gillnets, Scottish seining and the 'Hovercran' (*Polet 2004* [59399], *Van Craeynest 2009* [225390], *Verhaeghe et al. 2011* [206186], *Verschueren et al. 2012* [225355], *Depestele et al. 2012* [214303] (*WAKO-II project BELSPO*)).

Within the fisheries sector, a *societal covenant for sustainable fisheries (2011)* [214777] was developed. This covenant is based on three main principles: profitability, environmental care and the social aspect of fisheries. The Flemish Government has developed an Action Plan on selective fishing in order to react pro-actively to the reform of the Fisheries policy. In this action plan, 10 priorities are proposed, leading to more sustainable fisheries. In the publication *activiteitenverslag van de rederscentrale 2010 (Wintein & Brouckaert 2011)* [225384], reference is made to a few initiatives aiming at sustainability.

Legislation reference list

Table with European legislation. The consolidated version of this legislation is available on *Eurlex*.

EUROPEAN LEGISLATION			
Abbreviations (if available)	Title	Year	Number
Directives			
Habitats Directive	Directive concerning the conservation of natural habitats and of wild fauna and flora	1992	43
Marine Strategy Framework Directive	Directive establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive)	2008	56
Regulations			
Common Fisheries Policy	Regulation on the conservation and sustainable exploitation of fisheries resources under the Common Fisheries Policy	2002	2371
	Regulation on the European Fisheries Fund	2006	1198
	Regulation instituting a temporary specific action aiming to promote the restructuring of the European Community fishing fleets affected by the economic crisis	2008	744
	Regulation establishing a Community system to prevent, deter and eliminate illegal, unreported and unregulated fishing	2008	1005
	Regulation establishing a Community control system for ensuring compliance with the rules of the common fisheries policy	2009	1224
Other (Decisions, Communications, White Papers, etc.)			
	Commission Decision relating to the institution of a Scientific, Technical and Economic Committee for Fisheries	1993	619
	Communication from the Commission (COM): A Sustainable Europe for a Better World: A European Union Strategy for Sustainable Development	2001	264
	Communication from the Commission (COM): A Sustainable Europe for a Better World: A European Union Strategy for Sustainable Development	2002	179
	Council Decision establishing Regional Advisory Councils under the Common Fisheries Policy	2004	585
	Commission Decision establishing a Scientific, Technical and Economic Committee for Fisheries	2005	629
	Green Paper (COM): Reform of the Common Fisheries Policy	2009	163
	Commission Staff Working Document (SEC) Synthesis of the Consultation on the Reform of the Common Fisheries Policy	2010	428
	Communication from the Commission (COM): Reform of the Common Fisheries Policy	2011	417

Table with Belgian and Flemish legislation. The consolidated version of this legislation is available on *Belgisch staatsblad* and the *Justel-databases*.

BELGIAN AND FLEMISH LEGISLATION	
Date	Title
Laws	
Wet van 19 augustus 1891	Wet betreffende de zeevisserij in de territoriale zee
Wet van 10 oktober 1978	Wet houdende vaststelling van een Belgische visserijzone
Wet van 22 april 1999	Wet betreffende de exclusieve zone van België in de Noordzee.
Royal Decrees	
KB van 14 augustus 1989	Koninklijk besluit tot vaststelling van aanvullende nationale maatregelen voor de instandhouding en het beheer van de visbestanden en voor controle op de visserijactiviteiten
KB van 18 mei 2008	Koninklijk besluit tot vaststelling van het feit dat een beoordeling van de gevolgen op het milieu vereist is voor het nationaal operationeel programma voor de visserijsector en dat een beoordeling van de gevolgen op het milieu niet vereist is voor het nationaal strategisch plan voor de visserijsector
KB van 23 juni 2010	Koninklijk besluit betreffende de mariene strategie voor de Belgische zeegebieden
Decrees	
Decreet van 13 mei 1997	Decreet houdende oprichting van een Financieringsinstrument voor de Vlaamse visserij- en aquacultuursector
Ministerial Decrees	
MB van 16 december 2005	Ministerieel besluit tot de instelling van een visvergunning en houdende tijdelijke maatregelen voor de uitvoering van de communautaire regeling inzake de instandhouding en de duurzame exploitatie van de visbestanden
MB van 2 juni 2009	Ministerieel besluit tot toekenning van een beëindigingspremie voor de definitieve onttrekking van vissersvaartuigen aan de zeevisserijactiviteit in het kader van een vlootaanpassingsregeling
MB van 21 december 2012	Ministerieel besluit houdende tijdelijke aanvullende maatregelen tot het behoud van de visbestanden in zee

7

Aquaculture

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Citation:

Delbare, D., Nevejan, N., Sorgeloos, P., Pirlet, H., 2013. Aquaculture. In: Lescrauwaet, A.K., Pirlet, H., Verleye, T., Mees, J., Herman, R. (Eds.), Compendium for Coast and Sea 2013: integrating knowledge on the socio-economic, environmental and institutional aspects of the Coast and Sea in Flanders and Belgium. Oostende, Belgium, p. 167-176.

Aquaculture is globally the fastest growing food production sector with an annual growth of 6.6 % (compared to an annual growth of the human population of 1.8 %) and provides for half of the food deriving from fish worldwide (*State of World Aquaculture, FAO 2006* [107068]). In 2011, the total global production of aquaculture amounted to 62.3 million tons, of which 19.3 million tons originates from marine aquaculture (figure 1) (*State of World Fisheries and Aquaculture, FAO 2012* [216886]). In 2009, the aquaculture sector of the European Union (EU) produced 1.3 million tons, which is 20.4% of the total volume of the fish production in the EU. This share increased to 25 % in 2012. This increase can mainly be attributed to enhanced import of breeding species, given the reduction in the European volume of breeding species in spite of the initiatives taken by the European Commission (EC) to support the aquaculture sector.

The importance of the Belgian aquaculture production is rather limited and amounts to 0.04 % of the European production volume and 0.12 % in terms of value (*Facts and figures on the Common Fisheries Policy, 2012* [225357]).

In the current text, we will primarily focus on marine aquaculture (offshore aquaculture) in the Belgian Part of the North Sea (BNS), as well as on developments with regard to aquaculture in the coastal zone.

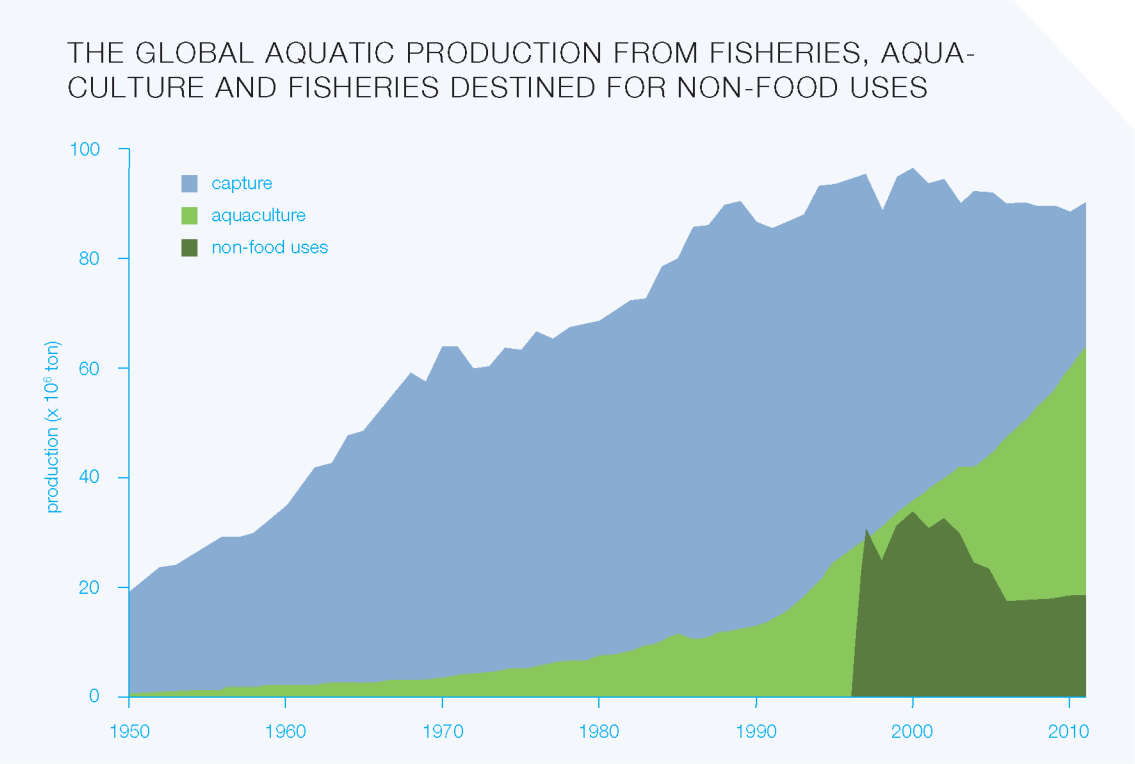

Figure 1. The global aquatic production from fisheries (blue), aquaculture (light green) and fisheries destined for non-food uses (dark green – animal food, cosmetics, etc.) (*State of World Fisheries and Aquaculture, FAO 2012* [216886]).

7.1 Policy context

On the European level, the policy concerning aquaculture (incl. mariculture) is included in the *Common Fisheries Policy* (CFP) (*Regulation 2371/2002*, more information: *handleiding voor het GVB (2009)* [140508] and *overview European legislation concerning CFP*). In 2013 a reform of the *CFP* is scheduled (Green Paper reform *CFP* (*COM (2009) 163*), consultation reform *CFP* (*SEC (2010) 428*, *COM (2011) 417*). In September 2012, the European Commission (EC) published a communication (*COM (2002) 511*) concerning the strategy for a sustainable development of European aquaculture. In 2009, this communication was renewed by communication (*COM (2009) 162*) concerning a new impetus for the strategy for the sustainable development of European aquaculture. Furthermore, the European Fishery Fund (EFF) (*Regulation 1198/2006*) considers sustainable aquaculture as one of the main priorities (website *EFF*, *Nationaal Strategisch Plan voor de Belgische visserijsector 2007-2013* [196135]).

Considering that mariculture is an offshore activity, the latter is a federal competence (Minister competent for the North Sea / *FPS Health, Food Chain Safety and Environment*). Aquaculture on land, however, is a Flemish competence. In this regard, the Agricultural and Fisheries Policy Division (*Afdeling Landbouw en Visserijbeleid*) of the Department of Agriculture and Fisheries (*Departement Landbouw en Visserij*) is the management authority of the Operational Programme in implementation of the National Strategic Plan for the Belgian fisheries sector (2007-2013) (*het Operationeel Programma in uitvoering van het Nationaal Strategisch Plan voor de Belgische visserijsector 2007-2013* [196136]), which also includes measures to support aquaculture. The regulations and competent authorities for mariculture and aquaculture are discussed on the following website: *Flemish Platform for Aquaculture* (more information: *Coppens & Stoop 2003* [162770]).

In 2011, a first attempt was made to develop a Flemish aquaculture policy (*Visserijrapport (VIRA) 2012* [224957]). In this context, the existing initiatives were mapped and a vision note was drafted by the Flemish government to better disclose the sector and the relevant research. In 2012, a *platform for aquaculture* was established to create sufficient support from policy and research and to raise awareness to create synergies within research actors and to stimulate sustainable aquaculture.

7.2 Spatial use

7.2.1 Oyster farming in the Sluice Dock of Ostend

In the Belgian coastal zone, aquaculture can be found in the Sluice Dock of Ostend where the European flat oyster (*Ostrea edulis*) and the Pacific oyster (*Crassostrea gigas*) are farmed. The Sluice Dock is an artificial water basin of 85 ha in which the aquaculture activities occupy 4 and 5 ha (website *Oostendse Spuikom*).

Given that several users, whose activities are often not compatible, are present in the Sluice Dock, a management commission '*Spuikom*' has been established (website *Oostendse Spuikom*). Each activity and each administration concerned is represented in the commission. The consultation platform '*Spuikom*' constitutes a direct contact point and has the responsibility of reaching a consensus between the different users. Furthermore, it provides advice to the actual administrator / owner which is the Flemish government and more specifically the *Coastal Division* of the Department for Maritime Services and Coast (MD&K). In addition to the 'organised users', such as nature, aquaculture and recreation, the anglers and the surrounding community are invited to the consultation platform as well. The permits for aquaculture and in the future for the potential production of energy are directly granted by the *Coastal Division*.

7.2.2 Restocking in the North Sea

In 1998, a zone was demarcated (51°12'00 N and 02°45'60 E) where fishing was prohibited, because of the release of farm-raised turbot in the context of restocking. In 2000, a similar zone was defined in the coastal waters between Nieuwpoort and Bredene, east of the *Stroombank* sandbank, for the restocking of sole (*De Wachter & Volckaert 2005* [78303], *GAUFRE project BELSPO*). The restocking of cultured turbot was continued in the *GAUFRE project (BELSPO)*, in which the impact of the quality of the turbot on the restocking success in the North Sea was evaluated. Although the results were positive, both restocking programmes were stopped as most of the restocked animals were fished outside the BNS and by fishermen from other nationalities. This experience shows that this kind of restocking programmes need to be dealt with on a European level. Hence, a European 'Ecosystem- based Stock Enhancement Workshop' was organised in Bruges in 2007.

7.2.3 Mussel farming

After the experimental use of the '*Buiten Ratel*' area, a permit for the production of bivalve molluscs in 4 zones (table 1 and figure 2) in the BNS was granted on 7 October 2005 (*Ministerial Decree of 7 October 2005*). This permit was based on the environmental impact assessment (EIA) that had been published as stipulated by the *law of 20 January 1999* and two Royal Decrees (the *Royal Decree of 7 September 2003* and the *Royal Decree of 9 September 2003*). In this context, the *Ministerial Decree of 8 July 2005* defines a simplified procedure and model form for this EIA.

Table 1. Overview of the areas allocated to shellfish production (*Milieu-effectenbeoordeling Mosselcultuur, 2005* [114817] and *Report of the Working Group on Marine Shellfish Culture (ICES WGMASC), 2011* [225359]).

ZONE	Z1	Z2	Z3	Z4
Total surface (km²)	0.21	0.27	0.23	277.14
Total culture surface (km²)	0.21	0.27	0.23	0.25
Distance to the harbour (km)[1]	10	25	32	24 – 58
Depth (m)	8	7	11	12 – 30
Use	commercial	experimental	experimental	none

[1] distance to Nieuwpoort for Z1, Z2 and Z3 or Zeebrugge for Z4

The four areas reserved for shellfish production are situated in the so-called Natura 2000 areas (see theme **Nature and environment**). Europe has published guidelines in the publication: *Guidance on aquaculture and Natura 2000 (2012)* [221708], to analyse what aquaculture activities can be executed in these Natura 2000 areas.

The four areas were planned as shellfish production areas based on the presence of obstacles (Z1: wreck, Z2 and Z3: towers, Z4: windmills) that may hinder the other operators in their activities. At the start of the construction of the C-Power wind farm on the Thornton Bank, the Foundation for Sustainable Fishery Development (*SDVO*) and the Management Unit of the North Sea Mathematical Models (*MUMM*) (RBINS) decided in mutual consultation to remove the experimental cage in location Z4, in order not to hinder the construction of the wind farm. In 2011, all shellfish production activities were stopped.

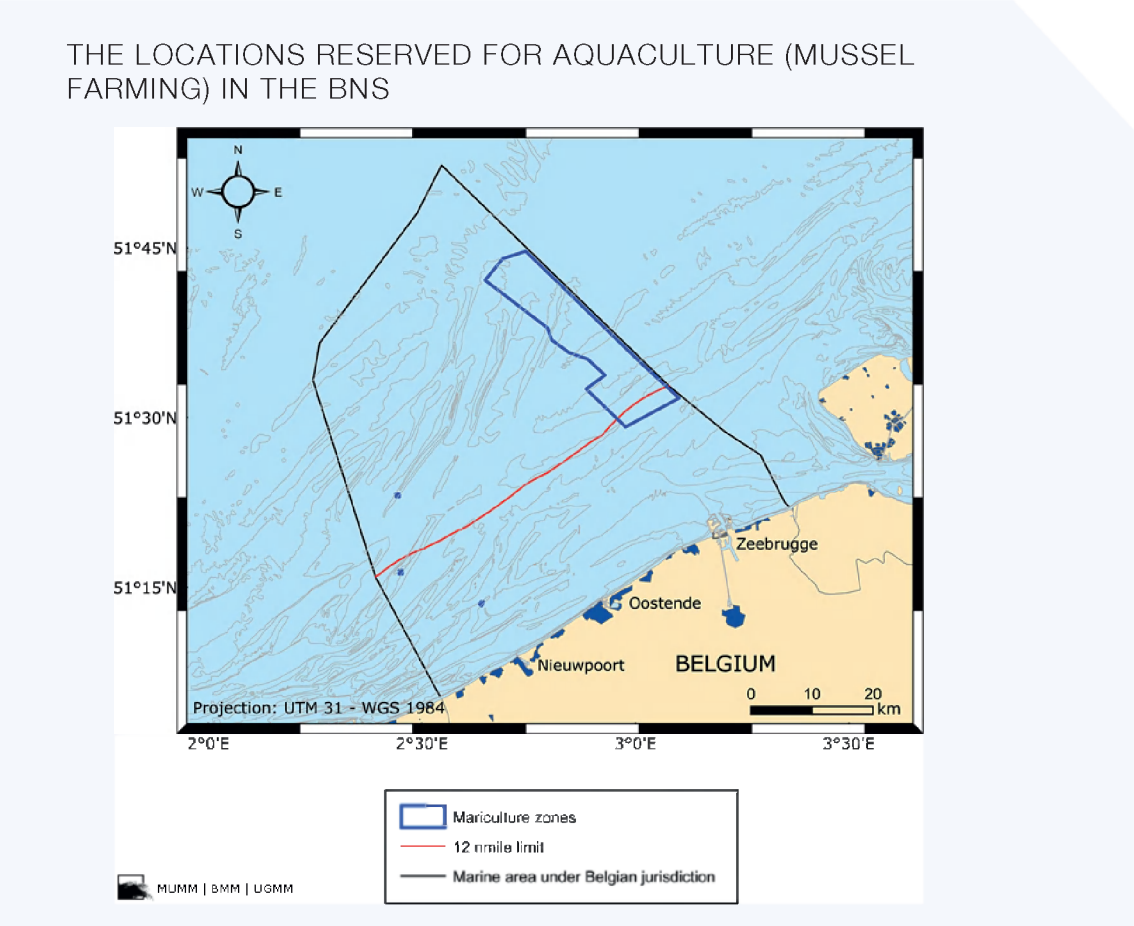

Figure 2. The locations reserved for aquaculture (mussel farming) in the BNS (Source: *Direction Natural Environment, Royal Belgian Institute of Natural Sciences (RBINS)*).

7.2.4 Marine Spatial Plan

The possibility for integrated mariculture (under strict conditions) in the wind farms Belwind I and C-Power has been formulated in the draft of the Marine Spatial Plan (*Ontwerp van koninklijk besluit tot vaststelling van het marien ruimtelijk plan* [227527]), as proposed by the Minister competent for the North Sea (see theme **Energy (incl. cables and pipelines)**). The compatibility of mariculture and passive fisheries in the wind farms was already investigated in the context of the MARIPAS Project (*Verhaeghe et al. 2011* [206186]). No other areas have been designated for mariculture as there is no demand for it. This situation may change during the next revision of the Marine Spatial Plan.

7.3 Societal interest

Within the EU, 90 % of the aquaculture enterprises are SMEs, which account for 70,258 jobs (*EU Data Collection Framework*). The importance of the aquaculture sector in Belgium is limited. In 2007, 150 persons worked in the Belgian aquaculture sector (*Globaal actie- en herstructureringsplan voor een duurzame Vlaamse zeevisserijsector, Task Force Visserij 2006* [106527]). The *FPS Economy, SMEs, Self-Employed and Energy* monitors the annual production of aquaculture (both aquaculture on land and mariculture) in Belgium, as commissioned by the *Food and Agriculture Organisation (FAO)* (*Regulation 762/2008*). In the period from 2006 to 2008 an average annual production of 127 tons was reported (figure 3). In 2009, the production increased to 575.9 tons. This strong increase can be attributed to one additional aquaculture enterprise, namely a tilapia farm that closed down in 2010. Although no official data are known yet, the production probably decreased to the level before 2009 (*Visserijrapport (VIRA) 2012* [224957]).

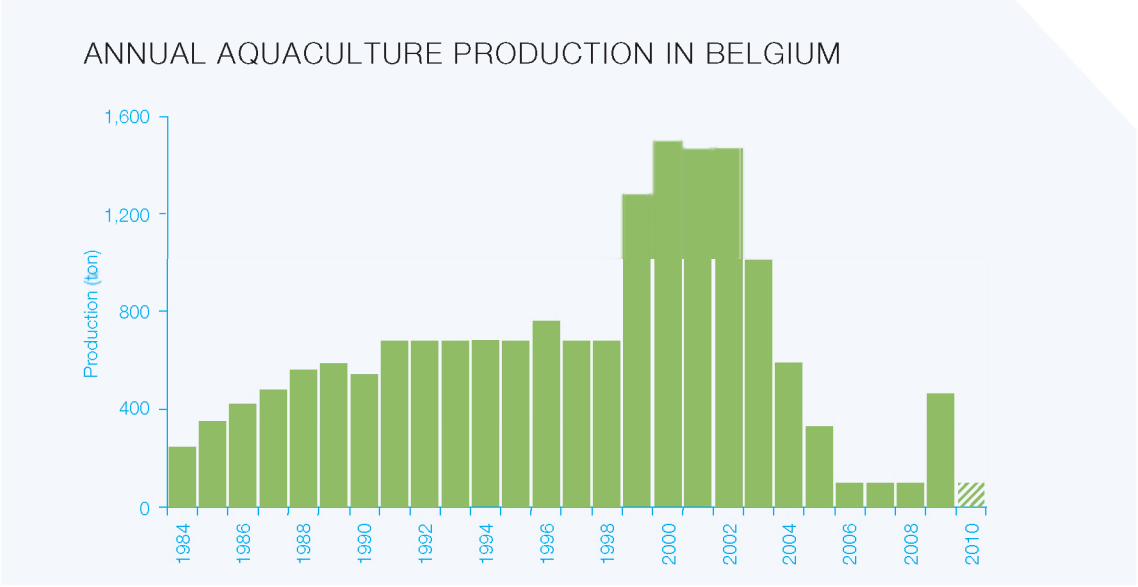

Figure 3. The annual aquaculture production in Belgium (Source: FAO - Fisheries and Aquaculture Information and Statistics Service - 25/06/2012).

In 2003, the total value of the Belgian export of important aquaculture species (such as mussels, oysters, sea bass and sea bream, trout, salmon) amounted to 0.37 million dollar (figure 4). However, the main part of this export is the result of prior import. The Belgian import of these species represented a value of 214.70 million dollar (source: FAO FISHSTAT Plus, 2005 in *Rana 2007* [113540]).

The Belgian aquaculture sector is mainly situated in Wallonia and is not discussed further in the current text. The Flemish aquaculture sector is rather small (17 enterprises) and the main species are the common carp, sturgeon (mainly production of caviar), shellfish, fish for anglers and ornamental fish. An overview of the aquaculture enterprises in Flanders is listed on the website of the *Flemish Platform for Aquaculture*. Only one company is situated in the coastal area, namely the oysterfarm in the Sluice Dock of Ostend.

From a historical perspective, the oyster farms along our coast had a significant commercial importance. In particular the '*Ostend Oyster*' (*l'Ostendaise* or *Royal Ostendaise*) has known worldwide fame. Prior to the First World War,

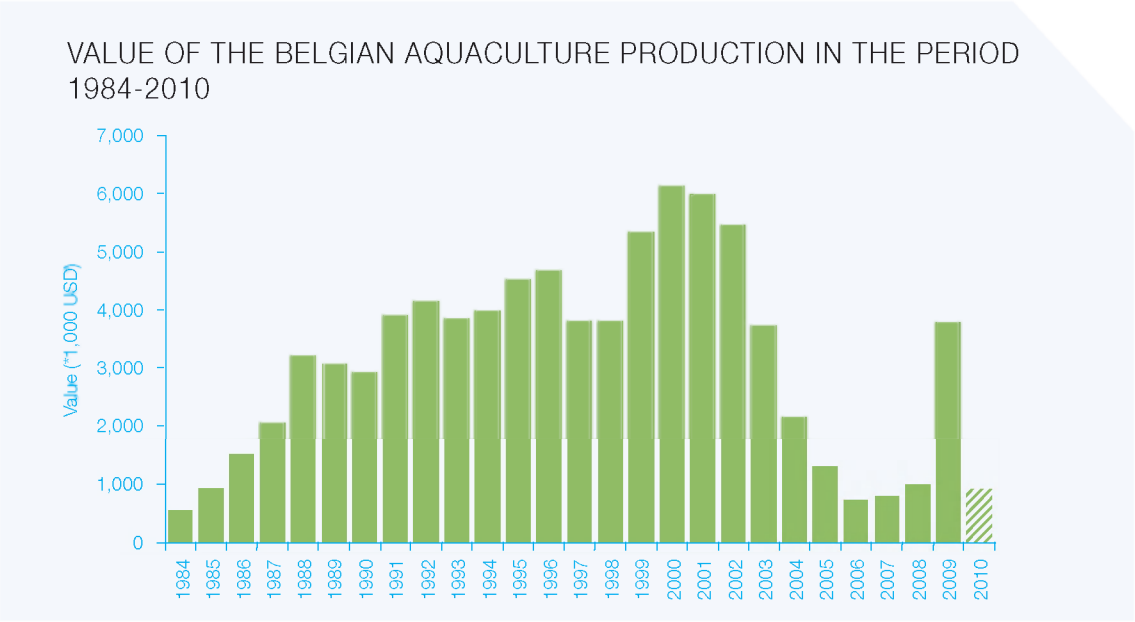

Figure 4. The value of the Belgian aquaculture production in the period 1984-2010 (Source: FAO - Fisheries and Aquaculture Information and Statistics Service - 25/06/2012).

oyster farming reached a peak with 26 oyster farms along the Belgian coast. Every year, 30-35 million oysters were imported from England and further cultivated in the Belgian oyster farms (*Halewyck & Hostyn 1978* [64754], *Polk 2002* [24883]). An overview of the history of the Belgian oyster farms is presented on the following website: *http://www.vliz.be/wiki/Historiek_van_de_Belgische_oesterkweek* (more information: *Pirlet 2012* [222245]). Since 1996, oysters have been commercially farmed in the Sluice Dock of Ostend (*Curé et al. 2000* [24888]). Currently 2 parks of 4 and 5 ha are in use (*website Spuikom*).

In the BNS, some initiatives were taken to start some offshore aquaculture activities such as the production of bivalve molluscs by means of hanging structures (*Milieu-effectenbeoordeling Mosselcultuur, 2005* [114817], *Delbare 2005* [73746], *Report of the Working Group on Marine Shellfish Culture (ICES WGMASC), 2011*) [225359] and the restocking of sole and turbot (*De Wachter & Volckaert 2005* [78303], *GAUFRE project BELSPO*). Furthermore, a study was conducted to assess the possibilities of a turbot farm off the Belgian coast (*Dierckens et al. 2004* [68778], *project BELSPO*).

7.4 Impact

Mariculture has a number of effects on the environment and the users of the sea (*Milieu-effectenbeoordeling Mosselcultuur, 2005* [114817], *De Wachter & Volckaert 2005* [78303] (*GAUFRE project BELSPO*), *Goffin et al. 2007* [114225], *Strategische Milieubeoordeling van het Nationaal Operationeel Plan voor de Belgische visserijsector, 2007 - 2013* [131093]). In the environmental impact report, drafted prior to the installation of the offshore mussel cages, the following specific (local) effects on the marine ecosystem and users of the sea were listed:

- Effect on the quantity of suspended matter: mussels feed on suspended particles;
- Effect on the primary production: consumption of the phytoplankton;
- Effect on the secondary production: competition with other organisms;
- Modifications in the natural nutrients flux: excretion of organic nitrogen compounds (ammonium compounds);
- Transfer of material from the planktonic towards the benthic food web and the organic enrichment of sediments: excrements of mussels;
- Accumulation of mussel shells below the farm;
- Presence of a fouling community that settles on artificial hard structures;
- Attraction of birds, fishes and parasites;
- Diseases;
- Loss of parts of the mussel farm;
- Danger to shipping due to mariculture structures.

(*Milieu-effectenbeoordeling Mosselcultuur, 2005* [114817])

The impact of aquaculture on the ecosystem and other users strongly depends on the used technique. The potential effects are discussed in publications such as *State of World Aquaculture (FAO 2006)* [107068], *OSPAR QSR (2010)* [198817] and *Report of the Global Conference on Aquaculture 2010 (FAO 2012)* [216587] and *inter alia* include:

- Eutrophication due to nutrient enrichment by food and excretion products of aquaculture organisms;
- Introduction of non-indigenous species;
- The demand for wild fish;
- Pollution of the bottom due to accumulation of organic material;
- Competition of escaped aquaculture species with wild fish;
- Use of chemicals;
- The impact on wild fish, seals, birds and other fauna as a result of the measures to prevent predation of aquaculture species;
- The alteration and destruction of natural habitats and ecosystem functions;
- Competition for the use of fresh water;
- Competition with livestock for food;
- Impact due to the collection of seed;
- The potential spreading of diseases and parasites in cultivated and wild stocks.

7.5 Sustainable use

7.5.1 Mitigation of the impact on the environment

In *COM (2009) 162*, the European Commission (EC) committed itself to guarantee an environmentally friendly aquaculture. The EC promised to emphasise the importance of an ecologically sustainable development of aquaculture in its policy and measures. Furthermore, Europe imposes directives for an aquaculture-friendly environment in order to guarantee the health of the aquatic animals and the safety and quality of the aquaculture products. The European legislation that is relevant in this context is listed in table 2 (not exhaustive).

Table 2. A selection of relevant European legislation with regard to a sustainable aquaculture.

EUROPEAN LEGISLATION	SUBJECT
Directive 91/676/EC	'Nitrates Directive'. The protection of water against pollution caused by nitrates from agricultural sources
Directive 92/43/EC	'Habitats Directive'. The conservation of natural habitats and of wild fauna and flora
Directive 2000/60/EC	The 'Water Framework Directive' establishing a framework for Community action in the field of water policy
Directive 2006/88/EC	Animal health requirements for aquaculture animals and products thereof, and the prevention and control of certain diseases in aquatic animals
Directive 2006/113/EC	The quality required of shellfish waters
Regulation (EC) 708/2007	The use of alien and locally absent species in aquaculture
Regulation (EC) 762/2008	The submission by Member States of statistics on aquaculture
Directive 2008/56/EC	'Marine Strategy Framework Directive'. A framework for community action in the field of marine environmental policy
Directive 2008/1/EC	Integrated pollution prevention and control
Directive 2009/147/EC	'Birds Directive'. The conservation of wild birds

On the Belgian level, the mariculture activities have to comply with the *law of 22 April 1999* (the EEZ law) concerning the exclusive economic zone (EEZ) of Belgium in the North Sea and the *law of 22 April 1999* concerning the protection of the marine environment and the organisation of marine spatial planning in the BNS (see theme **Nature and environment**). Associated with these laws, a number of Royal Decrees are of specific importance for mariculture such as the *Royal Decree of 9 September 2003* in context of the EIA, the *Royal Decree of 7 September 2003* concerning the permit procedure, the *Royal Decree of 23 June 2010* concerning the marine strategy and the *Royal Decree of 23 June 2010* concerning the achievement of a good condition of the surface water. The *Royal Decree of 18 May 2008* stipulates that in the context of the National Operational Plan, a strategic EIA is required with regard to the mariculture

activities in the BNS. For certain offshore activities, such as the production of bivalve molluscs by means of hanging structures, a simplified procedure may be applied (*Ministerial Decree of 8 July 2005*).

A list of the Belgian/Flemish regulations to minimise the environmental impact of aquaculture and mariculture installations is given in *Coppens & Stoop (2003)* [162770] and *Wettelijke Europese en Belgische regelgeving voor aquacultuurinrichting (2008)* [226537] (website *www.aquacultuurvlaanderen.be*).

7.5.2 A sustainable development of aquaculture

In recent publications, the FAO discusses the large contribution of environmentally friendly extractive aquaculture in Asia (removal of organic material by shellfish culture, removal of inorganic nutrients by macro algae culture) to the total aquaculture production. Furthermore, FAO highlights the possibilities of integrated (multitrophic) mariculture systems that aim for a more sustainable aquaculture and a reduction of the impact on the ecosystem (*Soto 2009* [196519], *Report of the Global Conference on Aquaculture 2010 (FAO 2012)* [216587]).

In *COM (2009) 162*, the European Commission (EC) intends to give a new impetus for a sustainable development of European aquaculture. 3 priorities were stipulated:

- Increasing the competitiveness of the sector by means of support to research and development, better spatial planning in coastal regions and river basins as well as more specific support via the fisheries market policy;
- Guaranteeing sustainability by maintaining environmentally friendly production methods and high demands for animal health and welfare and consumer protection (see above);
- Better governance and an enterprise-friendly environment on all levels (local, national and European) so that the sector can optimise its potential.

The sustainable development and installation of aquaculture facilities at sea and in the coastal area are discussed in the context of the *Integrated Maritime Policy* (*COM (2007) 575*) as well.

In the Operational Programme in implementation of the National Strategic Plan for the Belgian fisheries sector (2007-2013) (*het Operationeel Programma in uitvoering van het Nationaal Strategisch Plan voor de Belgische visserijsector 2007-2013* [196136]), the development of a sustainable aquaculture, the diversification of the species and of the markets as well as the modernisation of existing enterprises in the aquaculture sector are listed among the main priorities. To achieve these targets a number of measures are discussed in the Operational Programme. The intention is that by 2015 the aquaculture production will increase to 5.440 tons, 5 new aquaculture enterprises will be active and 2 new species will be cultivated. The establishment of hatcheries and the valorisation of the efforts of renowned Belgian research institutes will be explored (*Operationeel Programma in uitvoering van het Nationaal Strategisch Plan voor de Belgische visserijsector 2007-2013* [196136]).

Several groups and institutes conduct research on the sustainable development of aquaculture in Flanders and in the BNS (see the list on the website *Flemish Aquaculture Platform* and *Visserijrapport (VIRA) 2012* [224957]). A specific example is the MARIPAS project, which investigated the compatibility of mariculture and offshore wind farms (*Verhaeghe et al. 2011* [206186]).

7.5.3 Monitoring in the BNS

A monitoring programme has been elaborated to review the environmental impact of the mussel farming installations. In this programme the following parameters have been studied (*Milieu-effectenbeoordeling Mosselcultuur, 2005* [114817]):

- Upstream-downstream water sampling to quantify the transfer of material from the planktonic to the benthic food web and the modifications of natural nutrients flux;
- Impact on the composition of the phytoplankton and organic enrichment of the benthic habitat;
- Accumulation of mussel shells due to farming;
- Presence of a fouling community;
- Attraction of fishes.

The latter monitoring programme was not retained in the permit and was therefore not executed. Furthermore, one of the stations for the monitoring of the chemical quality in the context of the OSPAR monitoring programme is situated at the location of the mussel farm (*André et al. 2010* [200613]).

Legislation reference list

Table with European legislation. The consolidated version of this legislation is available on *Eurlex*.

EUROPEAN LEGISLATION			
Abbreviations (if available)	Title	Year	Number
Directives			
Nitrates Directive	Council Directive concerning the protection of waters against pollution caused by nitrates from agricultural sources	1991	676
Habitats Directive	Council Directive on the conservation of natural habitats and of wild fauna and flora	1992	43
Water Framework Directive	Directive 2000/60/EC establishing a framework for Community action in the field of water policy	2000	60
	Council Directive on animal health requirements for aquaculture animals and products thereof, and on the prevention and control of certain diseases in aquatic animals	2006	88
	Directive on the quality required of shellfish waters	2006	113
	Directive concerning integrated pollution prevention and control	2008	1
Marine Strategy Framework Directive	Directive 2008/56/EC establishing a framework for community action in the field of marine environmental policy	2008	56
Birds Directive	Directive on the conservation of wild birds	2009	147
Regulations			
Common Fisheries Policy	Council Regulation (EC) on the conservation and sustainable exploitation of fisheries resources under the Common Fisheries Policy	2002	2371
	Council Regulation (EC) on the European Fisheries Fund	2006	1198
	Council Regulation (EC) concerning use of alien and locally absent species in aquaculture	2007	708
	Regulation (EC) on the submission by Member States of statistics on aquaculture and repealing Council Regulation (EC) No 788/96	2008	762
Other (Decisions, Communications, White Papers, etc.)			
	Communication from the Commission to the Council and the European Parliament - A strategy for the sustainable development of European aquaculture	2002	511
	Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions - An Integrated Maritime Policy for the European Union	2007	575
	Communication from the Commission to the European Parliament and the Council - Building a sustainable future for aquaculture - A new impetus for the Strategy for the Sustainable Development of European Aquaculture	2009	162
	Green Paper - Reform of the Common Fisheries Policy	2009	163
	Synthesis of the Consultation on the Reform of the Common Fisheries Policy	2010	428
	Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions - Reform of the Common Fisheries Policy	2011	417

Table with Belgian and Flemish legislation. The consolidated version of this legislation is available on *Belgisch staatsblad* and the *Justel-databases*.

BELGIAN AND FLEMISH LEGISLATION	
Date	Title
Laws	
Wet van 20 januari 1999	Wet ter bescherming van het mariene milieu en ter organisatie van de mariene ruimtelijke planning in de zeegebieden onder de rechtsbevoegdheid van België
Wet van 22 april 1999	Wet betreffende de exclusieve zone van België in de Noordzee.
Royal Decrees	
KB van 7 september 2003	Koninklijk besluit houdende de procedure tot vergunning en machtiging van bepaalde activiteiten in de zeegebieden onder de rechtsbevoegdheid van België
KB van 9 september 2003	Koninklijk besluit houdende de regels betreffende de milieu-effectenbeoordeling in toepassing van de wet van 20 januari 1999 ter bescherming van het mariene-milieu in de zeegebieden onder de rechtsbevoegdheid van België
KB van 18 mei 2008	Koninklijk besluit tot vaststelling van het feit dat een beoordeling van de gevolgen op het milieu vereist is voor het nationaal operationeel programma voor de visserijsector en dat een beoordeling van de gevolgen op het milieu niet vereist is voor het Nationaal Strategisch Plan voor de visserijsector
KB van 23 juni 2010	Koninklijk besluit betreffende de vaststelling van een kader voor het bereiken van een goede oppervlaktewatertoestand
KB van 23 juni 2010	Koninklijk besluit betreffende de mariene strategie voor de Belgische zeegebieden
Ministerial Decrees	
MB van 8 juli 2005	Ministerieel besluit betreffende de bepaling van een activiteit van publicitaire en commerciële ondernemingen onderworpen aan de vereenvoudigde procedure en de vaststelling van het modelformulier voor de opstelling van het milieueffectenrapport
MB van 7 oktober 2005	Ministerieel besluit houdende verlening aan de AG haven Oostende van een vergunning voor de productie van tweekleppige weekdieren door middel van hangstructuren in de zones Z1, Z2, Z3 en Z4 in de zeegebieden onder rechtsbevoegdheid van België

8 Agriculture

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Citation:

Van Bogaert, T., Platteau, J., Pirlet, H., 2013. Agriculture. In: Lescrauwaet, A.K., Pirlet, H., Verleye, T., Mees, J., Herman, R. (Eds.), Compendium for Coast and Sea 2013: integrating knowledge on the socio-economic, environmental and institutional aspects of the Coast and Sea in Flanders and Belgium. Oostende, Belgium, p. 177-186.

Agriculture constitutes an important economic sector in the coastal zone[1] and is, from a historical perspective, responsible for land reclamation. Over the last few years, the importance of agriculture as an employer in the European coastal regions has gradually decreased. Agriculture in the coastal zone is under pressure, mainly due to the urban expansion. Between 1990 and 2000, 2,000 km² of farming land disappeared in the European coastal areas (first 10 km). In Belgium, the agricultural area decreased by 1.85% (*European Environment Agency (EEA) 2006* 100281). Nevertheless, as an integral part of the agro-nutrition system, agriculture remains an important source of employment (*Landbouwrapport 2012* 221711). Agriculture also has an impact on the marine environment *inter alia* due to the supply of nutrients such as nitrogen and phosphorus that can cause eutrophication of the coastal waters. Especially in the southern part of the North Sea and the Channel, eutrophication constitutes a problem. 60% of the effluent nitrate and 31% of the effluent phosphorus derives from agriculture (*OSPAR QSR 2010* 198817). However, these nutrients originate from the entire country and not only from agriculture in the coastal zone. Measurements by the Flemish Environment Agency (VMM) indicate a reduction of the nitrate and phosphorus concentration in the surface water in Flanders over the last few years. A further reduction of these nutrients from all sources remains important in order to achieve a good status of the surface water and coastal waters (see theme **Nature and environment**) (*Voortgangsrapport Mestbank 2012* 226552).

8.1 Policy context

An important part of the agricultural policy is determined at the European level by the Common Agricultural Policy (CAP) of the *Directorate-General for Agriculture and Rural development* of the European Commission (EC) (more information: *Het GLB uit de doeken gedaan 2009* 214678). In 2012, the CAP is characterised by two policy lines. The first policy line is generally described as 'Pillar I' policy and includes market and price support as well as direct support towards the farmer. The second policy line ('Pillar II policy') concerns the policy with regard to rural development (*Landbouwrapport 2012* 221711). In June 2013, an agreement was reached about the *CAP reform* that should enter into force on 1 January 2014. At the Flemish level, the agricultural policy is developed by the Flemish Minister of Agriculture and Fisheries. The Agriculture and Fisheries Department (*Departement Landbouw en Visserij*) is responsible for the preparation and evaluation of the policy (*beleidsnota landbouw, visserij en plattelandsbeleid* 214778). The Agriculture and Fisheries Agency (*Agentschap voor Landbouw en Visserij*) implements the policy under the direct authority of the minister, but has operational autonomy. The policy is supported by the Institute for Agricultural and Fisheries Research (*ILVO*), Flanders' Agricultural Marketing Board (*VLAM*) and the Strategic Advisory Council for Agriculture and Fisheries (*SALV*). The province plays an important role in the education and innovation with regard to agriculture. The provincial authorities also have 'indirect competences' concerning the permit policy, spatial planning and the maintenance of non-navigable waters of the 2nd category (*provinciale beleidsnota landbouw 2007-2012* 225408). Furthermore, the agricultural policy is linked to other policy domains and authorities such as the Flemish environment and spatial policy and the Federal Agency for the Safety of the Food Chain (FASFC). The developments in the international/European and Flemish agricultural policy are discussed in detail in the following publication: *Landbouwrapport 2012* 221711. A broader overview of the legal context with regard to agriculture is provided in the coastal codex theme *agriculture*.

8.2 Spatial use

In Flanders, the areas reserved for agricultural purposes are registered in the Flemish spatial structure plan (*RSV*) as the 'agricultural structure'. The regulations of the RSV demand that the Flemish Region demarcates a specific area for agriculture (750,000 ha), nature and forest in the regional spatial structure plans or in the regional spatial implementation plans. Regional plans have been reaffirmed when a consensus between the nature, forest and agriculture sector was present. In addition to the demarcation in the RSV and the reaffirmation of the agricultural area, it is possible to further refine this demarcation through the spatial implementation plans (RUPs). However, this process has a serious delay.

The process of the demarcation of the agricultural areas in the region Coast-Polders-Westhoek started in 2004. During this demarcation phase, a new integrated approach was used which took agriculture, nature and forest simultaneously into account. In consultation with the municipalities, provinces and stakeholders a spatial vision (*ruimtelijke visie* 108942) was drafted which indicates the most important structures: connected areas prohibited for

1 Unless stated otherwise, the coastal zone consists of the 10 coastal municipalities (Blankenberge, Bruges, Knokke-Heist, Bredene, De Haan, Middelkerke, Ostend, De Panne, Koksijde and Nieuwpoort) and the 9 hinterland municipalities (Damme, Jabbeke, Zuienkerke, Diksmuide, Lo-Reninge, Gistel, Oudenburg, Alveringem and Veurne).

agriculture, valleys for nature development, etc. The consultation process finally resulted in 95,100 ha of reaffirmed agricultural area in the region Coast-Polders-Westhoek (*Danckaert 2013* [225409]). The regional spatial implementation plans (GRUPs) for agriculture, nature and forest in this region can be consulted on the website of the *RSV*.

Parts of the agricultural structure are described in the spatial structure plan of the province of West Flanders (*PRS-WV*). The 'coast' and 'the polder area' (parts of the spatial structure in the PRS-WV) are important for the research area of the current document. Few agricultural activities are still present in the coastal zone due to the strong urban pressure, the economic developments (e.g. harbour of Zeebrugge) and increased nature protection.

The polders are a homogeneous agricultural area with few built-up areas. In Zeebrugge this area is significantly interrupted by the port activities. In the transition zone to the coastal municipalities and the agglomeration of Bruges, agriculture is under significant pressure due to urbanisation. To support agriculture, areas have been demarcated in the provincial spatial implementation plans in the western and eastern polder area where building is prohibited (*PRS-WV*).

The instrument of land exchange consolidation has been invented to achieve a solid agricultural structure, as described in the spatial planning (see above). In Flanders, the Flemish Land Agency (*VLM*) is responsible for these land exchange consolidation projects (more information: *website VLM*). The purpose of this instrument is to improve the economic exploitation of the agricultural enterprises as well as to improve the areas for nature and recreational purposes. Almost 20% of the total agricultural area of West Flanders has been subject to land exchange consolidation. In the Polder region, a high concentration of land exchange consolidations is present: approximately 28,700 ha of which the majority constitutes a connected area from the south of Ostend towards Veurne (*PRS-WV*). An overview of the spatial projects can be found in the *database on the VLM-website*.

The agricultural area in the coastal zone constitutes a total surface of 70,761 ha (figures 1 and 2). This corresponds to 11.5% of the total agricultural area in Flanders (Source: Agriculture and Fisheries Department based on the FPS Economy - *Algemene Directie Statistiek en Economische Informatie* (ADSEI)). The polders are characterised by the large size of the agricultural enterprises. The largest enterprises of West Flanders are present in this area. In 1996, the average size of an agricultural enterprise was approximately 28 ha (West Flanders: 20 ha). In comparison with 1986, the surface of an average agricultural enterprise increased by 26% (West Flanders: 33%). Besides the land exchange consolidations (see above), the further automation and the relative decrease in land prices, the increase in scale can be largely attributed to the decline of the number of farmers resulting in lands being absorbed by other enterprises (*PRS-WV*). All parcels registered by the Agriculture and Fisheries Agency and their culture can be downloaded in GIS format on the website of the Flemish Geographical Information Agency (*FGIA*).

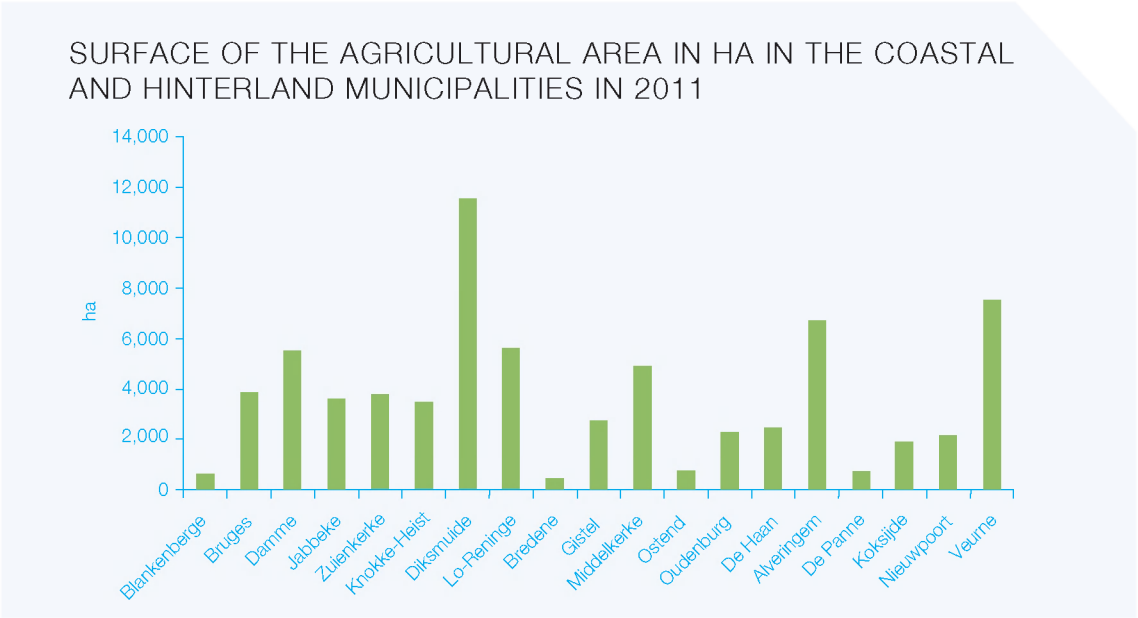


Figure 1. Surface of the agricultural area in ha in the coastal and hinterland municipalities (2011) (Source: Agriculture and Fisheries Department, based on FPS Economy - ADSEI).

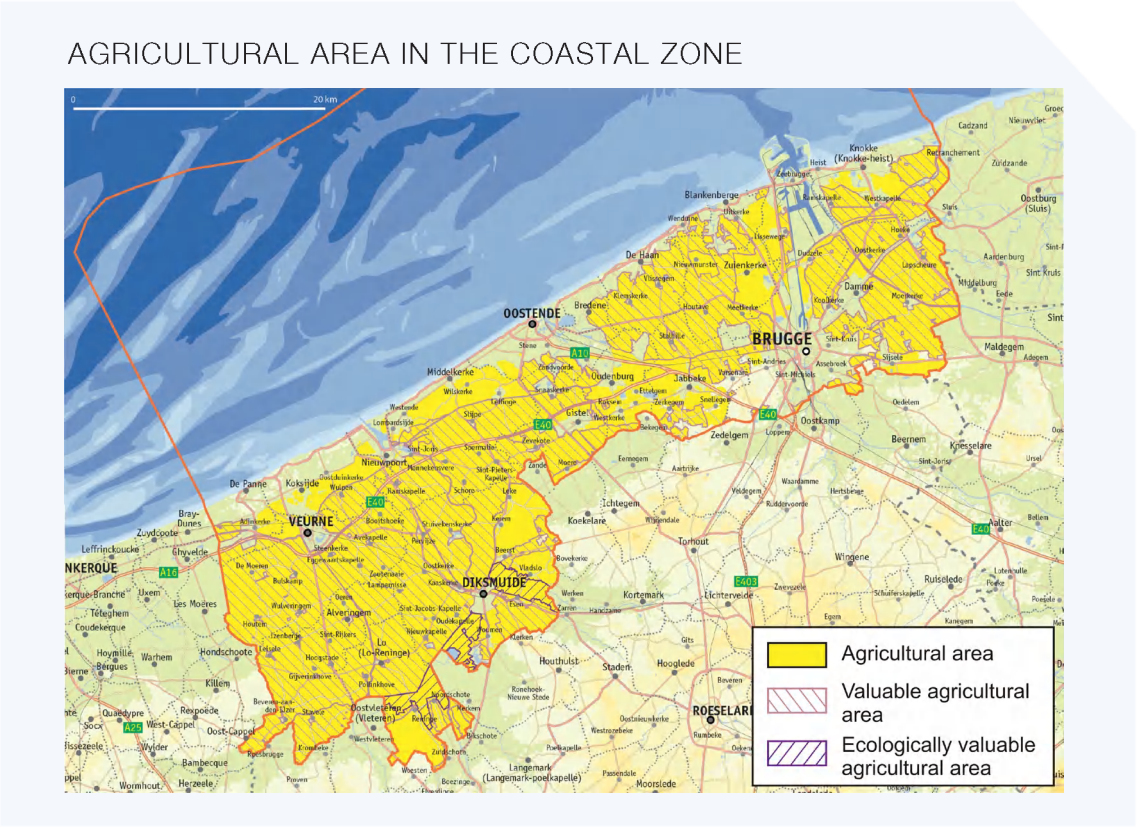


Figure 2. The agricultural area in the coastal zone (*Coastal Atlas*).

8.3 Societal interest

In 2011, 4,280 persons (3,146 full-time employees) were employed in 2,249 agricultural enterprises in the coastal and hinterland municipalities. This figure corresponds to 8.7% of all agricultural enterprises in Flanders. The majority of the enterprises and employment in the coastal zone is located in the hinterland municipalities (figure 3). The specialisation of these enterprises concerns primarily the cultivation of crops and the rearing of cattle, pigs and poultry (table 1) (Source: Agriculture and Fisheries Department, based on FPS Economy – ADSEI, see also the specific theme agriculture and horticulture in the publication: *West-Vlaanderen ontcijferd 2012* [226504]).

Table 1. Number of enterprises in the coastal area in 2011 divided by specialisation (Source: Agriculture and Fisheries Department, based on FPS Economy - ADSEI).

SPECIALISATION	NUMBER OF ENTERPRISES IN THE COASTAL ZONE (2011)
1) agriculture	453
2) horticulture	81
3) milk production	254
4) beef production	352
5) mixed cattle breeding	198
6) other grazing livestock (sheep, etc.)	108
7) pigs and poultry	354
8) mixed enterprises	258
9) mixed cattle breeding enterprises	191
Total of enterprises	**2.249**

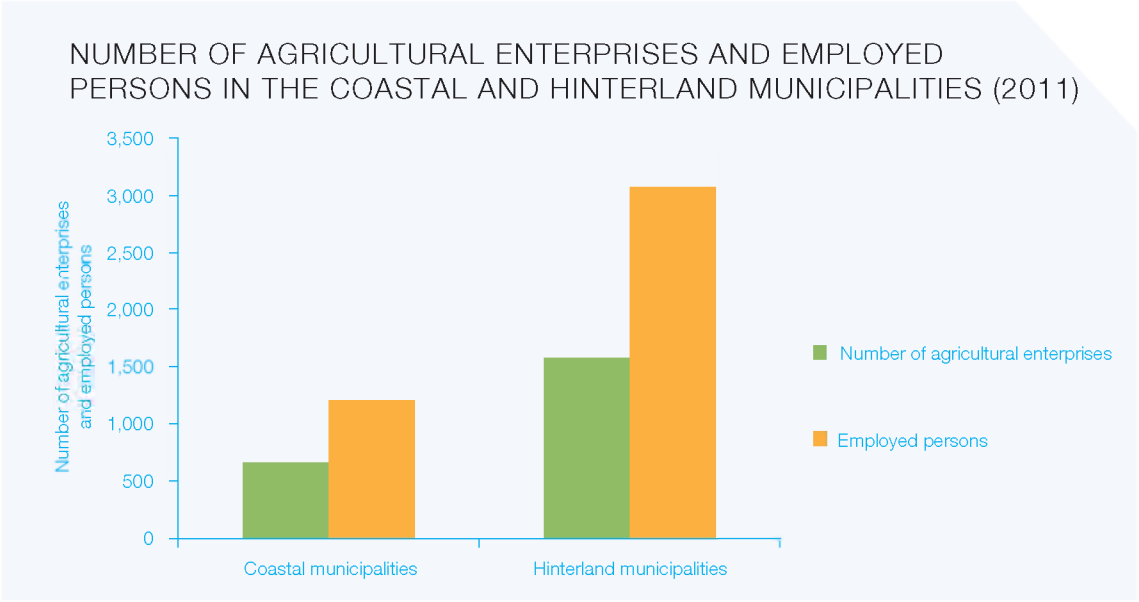


Figure 3. Number of agricultural enterprises and employed persons in the coastal and hinterland municipalities in 2011 (Source: Agriculture and Fisheries Department, based on FPS Economy - ADSEI).

The soil suitability of the polders is remarkably homogeneous: the complete area is 'very suitable' or 'suitable' for agriculture and grazing land (*PRS-WV*). For example, the cultivation of beets in 2011 accounted for 5.2% of the agricultural area in the coastal zone compared to 3.3% in Flanders (Source: Agriculture and Fisheries Department - AMS, based on FPS Economy - ADSEI). In general, the area is not suitable for the remaining cultivation groups, except for the cultivation of fruits for which local areas of moderate suitability are present. The polders differ from other regions due to the high amount of cereals in the agricultural area: about 28% (West Flanders: 19%). Not much horticulture is present in the polders (*PRS-WV*).

The agricultural enterprises in the coastal zone account for 140,984 cows, 9,597 sheep, 2,760 goats and 1,809,905 heads of poultry (Source: Agriculture and Fisheries Department, based on FPS Economy – ADSEI).

Besides the economic importance, agriculture also contributes to landscape creation, the management of open space (see also theme **Nature and environment**) and certain ecosystem services (e.g. water regulation, recharge of ground water, etc.) in the coastal zone.

8.4 Impact

In the section 'impact', the (general) effects of agricultural activities on the ecosystem are discussed, as well as the indirect effects of these activities on the marine environment (eutrophication). Also, the phenomenon of salinisation is discussed. Although salinisation is mainly caused by other human activities, it has a considerable effect on the agricultural activities in the coastal zone.

8.4.1 Effects on the ecosystem

The different effects of the agricultural activities on the environment in Flanders (not specific for the coastal area) are listed in the publications *Wustenberghs et al. (2009)* [214735], *Van Steertegem (2012)* [138542] and *Landbouwrapport 2012* [221711]. A description of the ecosystem of the polder area is discussed in the theme **Nature and environment**. The effects on the ecosystem are *inter alia*:

- The use of chemical products for crop protection (more information: *Lenders et al. 2011* [225410]);
- The use of water (more information: salinisation of the coastal area, *Lenders et al. 2011* [225410]);
- The use of energy (more information: *Lenders et al. 2011* [225410]);
- The impact on the soil quality and erosion sensitivity;

- Fertilisation (more information: eutrophication of the coastal waters *Voortgangsrapport Mestbank 2012* [226552], *Overloop et al. 2009* [214728]);
- The emission of greenhouse gases;
- The emission of particulates;
- Waste production;
- The impact on the spatial use.

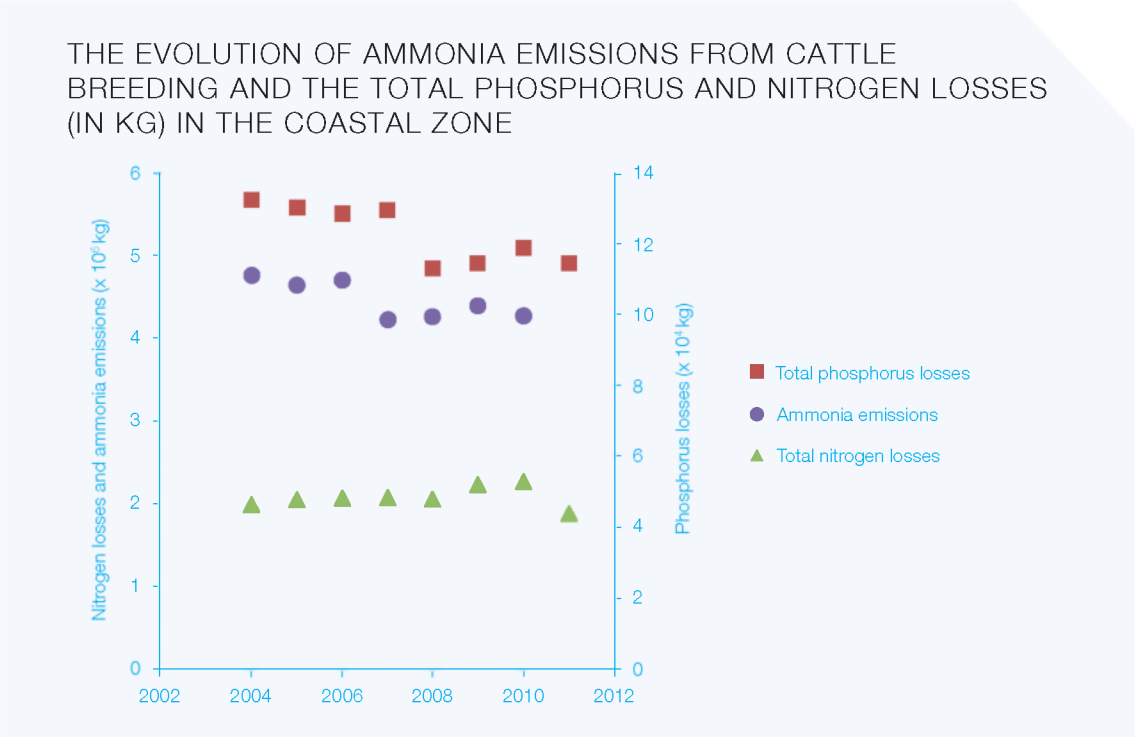


Figure 4. The evolution of ammonia emissions from cattle breeding and the total phosphorus and nitrogen losses (in kg) in the coastal zone (Source: *www.lokalestatistieken.be*).

In 2010, the total ammonia emission in the coastal zone amounted to 11.1% of the total Flemish emission. The SENTWA model (System for the Evaluation of Nutrient Transport to Water) is used to estimate the losses of nitrogen and phosphorus from agriculture. This model indicates that the total phosphorus and nitrogen losses in the coastal zone in 2011 accounted for 9.9% and 11.6%, respectively, of the total Flemish losses.

8.4.2 Eutrophication of the coastal waters

Along with some other actors, the use of fertilisers in agriculture has played an important role in the increase of the nutrient concentrations (nitrogen N, phosphorus P) in the aquatic ecosystems. An excessive supply of nutrients or 'eutrophication' amplifies the production of phytoplankton. A phytoplankton bloom can lead to changes in the structure of the ecosystems, destruction of habitat and a decrease in biodiversity (*André et al. 2010* [200613]). Over the last 20 years, the phosphorus concentrations have decreased in the sea water of the Belgian part of the North Sea (BNS), whereas the nitrate concentrations have varied strongly and without any clear trend (*Goffin et al. 2007* [114225]). Besides the transport of nutrients by rivers, there is an increased awareness of the atmospheric supply (*OSPAR QSR 2010* [198817]). The eutrophication of the coastal waters has been comprehensively studied in the *AMORE* (*AMORE project BELSPO*), *AMORE II* (*AMORE II project BELSPO*) and *AMORE III* projects (AMORE III project *phase 1* en *phase 2* BELSPO project) (more information: *Lancelot & Rousseau 2004* [109039], *Rousseau et al. 2006* [127722], *Lancelot et al. 2007* [109769], *Lancelot et al. 2009* [211949]). The *ISECA project* aggregates the knowledge and information about the eutrophication in the southern part of the North Sea.

8.4.3 The salinisation of the coastal area

An important impact on the agriculture in the coastal area is salinisation. During this process brackish or salt ground water can penetrate in the root layer of the soil. This causes an accumulation of salts (*Peeters et al. 2010* [214732], *Peeters et al. 2011* [2147710]). Naturally, there is a distribution of fresh and salt/brackish water in the coastal area. This distribution between fresh and salt water is the result of a complex history, influenced by human activities such as water extraction, infrastructure works (such as harbour expansion, tunnels, drainage, etc.) and interventions in the water management. These hydraulic interventions in coastal areas may result in the short or long term in changes of the fresh-salt water distribution, possibly leading to salinisation (*Vanleberghe & Vanhoutte 2001* [24538], *Van Houtte 2002* [24654], *Vandenbohede et al. 2008* [214769]). Furthermore, sea level rise increases the salt pressure towards shallow groundwater and surface water. The fresh water lens in the dunes acts as a buffer against the intrusion of salt sea water in the hinterland (*Van den Eynde et al. 2011* [212421] (CLIMAR project *phase 1* en *phase 2* BELSPO) and *CLIWAT project*).

8.5 Sustainable use

The international (WTO, climate conference of Copenhagen 2009, conference about sustainability in New York 2009, etc.) and European policy (the Treaty of Lisbon, the EU-2020 Strategy, the CAP, etc.) to maintain a sustainable agriculture is discussed in *Landbouwrapport 2012* [221711]. In *Landbouwrapport 2012* [221711] several sustainability themes in agriculture are linked with each other, based on indicators. Furthermore, recommendations and measures to reduce the environmental impact of agriculture in Flanders are listed in *Wustenberghs et al. (2009)* [214735], *Van Steertegem (2009)* [142609] and *Van Steertegem (2012)* [138542]. *Gobin et al. (2008)* [127585] discusses the adaptation possibilities of Flemish agriculture whereas *Mathijs et al. (2012)* [226553] focuses on the sustainability of food production and consumption from a transition perspective.

The sustainable compatibility of several user functions in the coastal area (housing, tourism, recreation, agriculture, industry, nature, etc.) is discussed within the *European recommendation for integrated coastal zone management* (ICZM) (*COM (2002) 413*). In Belgium, the Coordination Centre for ICZM is the contact point for coastal zone management (see theme **Integrated coastal zone management**). The compatibility of different sectors in the polders is discussed in a case study of the Uitkerkse polder (Blankenberge) (*Bogaert et al. 2002* [30300]).

Measures and regulations for certain effects linked to agricultural activities that have a specific importance for the coastal zone are discussed below.

8.5.1 Measures (in agriculture) against eutrophication

In the Northeast Atlantic Ocean, OSPAR created a '*common procedure (2005)* [226582]' for the identification of the eutrophication status (*Eutrophication Status of the OSPAR Maritime Area, 2008* [214727]). This procedure serves as a framework to identify the actions described in the *OSPAR Eutrophication Strategy (2003)* [214845]. A part of this strategy concerns a eutrophication monitoring programme (see also *OSPAR website*).

At the European level, the issue of eutrophication is covered by several directives. The *Nitrates Directive* (*91/676/EC*) aims to reduce the leaching of nitrates from agriculture (*Goffin et al. 2007* [114225]). In the *Marine Strategy Framework Directive* (MSFD) (*2008/56/EC*) , eutrophication is defined as one of the descriptors for determining the environmental status. The criteria and methodological standards to determine the environmental status are described in *Ferreira et al. (2010)* [199550]. In the *Water Framework Directive* (WFD) (*2000/60/EC*) an obligation was imposed to reach a good status of the surface and ground waters by 2015 (see theme **Nature and environment**). In this context, chemicals that contribute to eutrophication such as nitrogen and phosphorus are listed among the pollutants. Furthermore, eutrophication is discussed in the *Directive 91/271/EC concerning urban waste-water treatment*, *Directive 2008/1/EC concerning integrated pollution prevention and control* and *Directive 2001/81/EC on national emission ceilings for certain atmospheric pollutants*.

On the Flemish level, the nitrates directive is implemented in the *Decree of 22 December 2006*. This decree was originally approved on 23 January 1991 and was afterwards repeatedly adapted. The *Decree of 22 December 2006* came into force on 1 January 2007. On 1 January 2011, the fourth fertiliser action plan was launched (MAP-4, 2011-2014) (for implementing decisions and changes: *website VLM*). The *WFD* was implemented on the Flemish level in

the *Decree of 18 July 2003* on integrated water management (for implementing decisions and changes: *website Coordination Committee on Integrated Water Policy*) and on the federal level in the *Royal Decree of 23 June 2010* concerning the good status of surface waters. In addition, the *MSFD* is incorporated in Belgian legislation by the *Royal Decree of 23 June 2010* concerning the marine strategy for the BNS. The *VMM* has a monitoring network for the water quality at its disposal that was expanded in 1999 with specific measuring points for agriculture (the so-called *MAP-network*). In *Lancelot et al. (2011)* [204120] the costs and ecological efficiency of measures to prevent eutrophication in the southern Bight of the North Sea were modelled (see also AMORE III project *phase 1* and *phase 2* of the BELSPO project, and *TIMOTHY BELSPO project*).

8.5.2 Measures against salinisation

In *COM (2002) 179* and *COM (2006) 231*, the EC pleas for a Thematic Strategy for Soil Protection. In spite of several attempts, no agreement has been reached between the Member States. This directive would be *inter alia* focused on the prevention of soil damage due to salinisation (*Landbouwrapport 2010* [205845]). Furthermore, intrusions of salt water were also included in the *WFD* (*2000/60/EC*) (see theme **Nature and environment**) as parameters for the quantitative status of the ground water.

The *WFD* was translated into Flemish legislation by the *Decree of 18 July 2003* concerning integrated water management (*website Coordination Committee on Integrated Water Policy*). The *WFD* is also partially implemented in Belgian legislation by the *Royal Decree of 23 June 2010* concerning the good status of surface waters. The quality of the surface and ground water is monitored by the *VMM* (more information: *Vandenbohede et al. 2010* [143943], the legislation is listed in the coastal codex theme *ground water extraction*).

Legislation reference list

Table with European legislation. The consolidated version of this legislation is available on *Eurlex*.

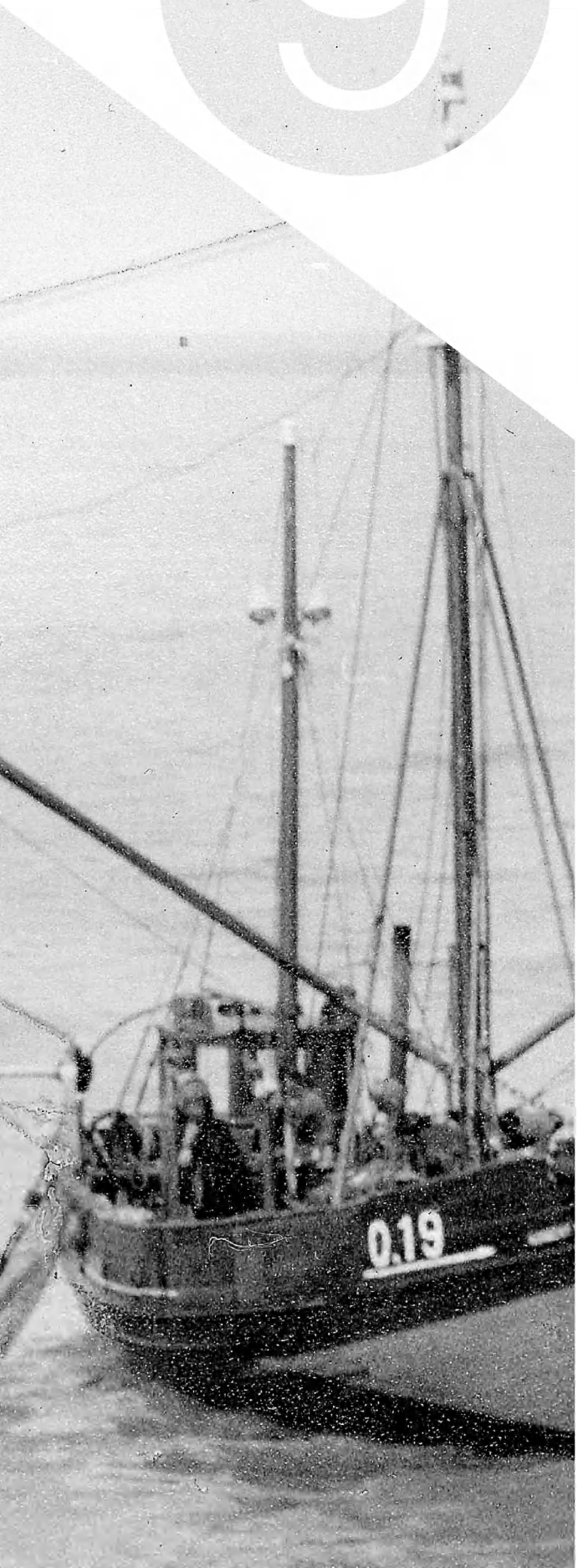
EUROPEAN LEGISLATION			
Abbreviations (if available)	Title	Year	Number
Directives			
	Council Directive concerning urban waste-water treatment	1991	271
Nitrates Directive	Council Directive concerning the protection of waters against pollution caused by nitrates from agricultural sources	1991	676
Water Framework Directive	Directive 2000/60/EC establishing a framework for Community action in the field of water policy	2000	60
	Directive on national emission ceilings for certain atmospheric pollutants	2001	81
	Directive concerning integrated pollution prevention and control	2008	1
Marine Strategy Framework Directive	Directive 2008/56/EC establishing a framework for community action in the field of marine environmental policy	2008	56
Other (Decisions, Communications, White Papers, etc.)			
	Communication from the Commission to the Council, the European Parliament, the Economic and Social Committee and the Committee of the Regions - Towards a Thematic Strategy for Soil Protection	2002	179
	Recommendation of the European Parliament and of the Council of 30 May 2002 concerning the implementation of Integrated Coastal Zone Management in Europe	2002	413
	Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions - Thematic Strategy for Soil Protection	2006	231

Table with Belgian and Flemish legislation. The consolidated version of this legislation is available on *Belgisch staatsblad* and the *Justel-databases*.

BELGIAN AND FLEMISH LEGISLATION	
Date	Title
Royal Decrees	
KB van 23 juni 2010	Koninklijk besluit betreffende de vaststelling van een kader voor het bereiken van een goede oppervlaktewatertoestand
KB van 23 juni 2010	Koninklijk besluit betreffende de mariene strategie voor de Belgische zeegebieden
Decrees	
Decreet van 18 juli 2003	Decreet betreffende het integraal waterbeleid
Decreet van 22 december 2006	Decreet houdende de bescherming van water tegen de verontreiniging door nitraten uit agrarische bronnen

9

Maritime and coastal heritage



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Citation:

Pieters, M., Strubbe, B., Van Dijck, M., Pirlet, H., 2013. Maritime and coastal heritage. In: Lescrauwaet, A.K., Pirlet, H., Verleye, T., Mees, J., Herman, R. (Eds.), Compendium for Coast and Sea 2013: integrating knowledge on the socio-economic, environmental and institutional aspects of the Coast and Sea in Flanders and Belgium. Oostende, Belgium, p. 187-196.

Maritime and coastal heritage covers a very wide range of aspects. It includes maritime archaeological heritage in the sea as well as on land, maritime heritage, architectural heritage which is typical for the coastal zone, coastal landscapes with heritage value, maritime movable heritage and intangible maritime heritage. Comprehensive works that cover these maritime heritage themes in the Belgian part of the North Sea (BNS) and the adjacent coastal area do not exist. Moreover, overview works that deal with a particular aspect of maritime heritage in an integrated way, beyond artificial and variable limits (legal, physical or disciplinary), are not available either.

Addressing maritime and coastal heritage in an integrated way offers benefits with regard to the understanding of the relationships and elucidating the wider context. Furthermore, the various types of borders have also changed significantly over time. In the Roman period, for example, the coastline was further seaward compared to the present situation. This is the reason why archaeological heritage that was originally formed on land may nowadays be situated below sea level. It goes without saying that this heritage, if still available, should be seen in conjunction with the archaeological heritage situated in the current coastal plain.

9.1 Current situation

9.1.1 Maritime archaeology

The concept of maritime archaeological heritage covers a wide range of aspects. The three main elements are:
- Shipwrecks and other wrecks as well as parts thereof, regardless of where they are found;
- Settlements or other traces or remains of human activity in seas, rivers or other bodies of water;
- Archaeological sites and traces situated on land, which were for their operations entirely focused on the sea such as lighthouses, fishing villages, shipyards, dikes, peat extraction, salt extraction, etc.

There is no restriction with regard to the age of the investigated archaeological heritage. A shipwreck from WWII deserves an appropriate archaeological treatment, which will obviously differ from the treatment of a shipwreck from the Bronze Age.

Since 2003, systematic research has been performed on maritime archaeological heritage by the *Flanders Heritage Agency* and its predecessors (Institute for the Archaeological Heritage (IAP), Flemish Institute for Immovable Heritage (VIOE)).

For certain aspects of the maritime archaeological heritage, there are (partial) overviews which cover Flanders and the BNS:
- The database of the Flanders Heritage Agency: *www.maritieme-archeologie.be* aims at structurally documenting and disclosing relevant information concerning maritime archaeological heritage in Flanders and in the BNS. On this website, more information can be found about shipwrecks (and their contents) which are present in the North Sea and in Flanders, artefacts from the sea, and maritime sites such as fishing villages and lighthouses. In February 2013, there were 305 shipwrecks, 2 aircraft wrecks, 7 other underwater sites, 101 structures and 101 isolated individual archaeological objects registered in this database which were also made available for the public.

In addition, there are two more databases that provide valuable information about a structured part of the heritage treated here, namely shipwrecks, without having an archaeological perspective:
- The wreck database of the Flemish Hydrography, *www.vlaamsehydrografie.be/wrakkendatabank.htm* has been developed from a perspective of safe shipping. The information in this database formed the basis for a book about shipwrecks in the North Sea which inventoried 277 wreck sites (*Termote & Termote 2009* [141636]);
- The online searchable database *www.wrecksite.eu* (private initiative), which has become an internationally respected and consulted database on shipwrecks.

Besides the three databases mentioned above, a number of reviews are available that cover a part of the maritime archaeological spectrum. For example, in the so-called *onderzoeksbalans* of Flanders Heritage Agency (*https://onderzoeksbalans.onroerenderfgoed.be*), two summary documents are available on maritime archaeology:
- An overview of the archaeological research in the BNS below the high water line (including the beach) (published in adapted format in *Pieters et al. 2010* [197284]);
- An overview of shipwrecks and components found in rivers and on land in Flanders. The medieval shipwrecks from Flanders have also been included in a recent overview article on medieval ships (*Van de Moortel 2011* [227403]).

For the study of shipwrecks found on land, the research on the medieval shipwrecks discovered in Doel is important in an international context (see also *http://www.kogge.be/en*). Extensive research has been conducted on the archaeological heritage of late medieval and early modern fishermen in the recent decade in Flanders, focusing on the medieval fishing community of Walraversijde. A large part of the study of the archaeological research in Raversijde was published in *Pieters et al. (2013)* [227995].

Until now, little attention has been paid in the archaeological research field in Flanders to the other categories of maritime archaeological heritage on land such as dikes, harbour structures, lighthouses, salt extraction, etc.

In 2013, the project 'Archaeological research in the North Sea: development of an efficient evaluation methodology and proposals for sustainable management in Belgium' (*SEARCH*) (2013-2016) was launched. This project aims to provide guidelines for a methodology with regard to buried shipwrecks and prehistoric relics in the North Sea. An efficient and low-cost methodology will be developed that will allow to detect the paleolandscapes, linked with prehistoric presence and buried archaeological remains, and manage them according to internationally accepted standards and protect them from uncontrolled destruction.

9.1.2 Naval heritage (including historical shipbuilding)

The naval heritage policy is relatively recent. In the early 1990s, increased attention was paid to naval heritage by the industrial heritage cell within the former Department of Monuments and Sites (the current Flanders Heritage Agency). The link between the naval and the industrial heritage is obvious. Ships were built with materials used in other economic sectors. Initially, wood was the material of choice for ships. Depending on the type of vessel, the switchover to steel, the key product of the industrial revolution, was made sooner or later. Synthetic materials were increasingly used for recreational boating. The propulsion of the ships evolved from sails to steamers, and subsequently to diesel engines. The naval heritage is inventoried in a database by the Flanders Heritage Agency, which will contain approximately 250 vessels and which will be made accessible for the public in the future (*https://inventaris.onroerenderfgoed.be/*).

Two types of vessels are of great importance for the coast: fishing boats and sail yachts. In table 1, some of the most important ships and their characteristics are presented. An overview of the fishing vessels from 1929 onwards is given in the *database of the Belgian fishing fleet* of the Flanders Marine Institute (VLIZ) (see also theme **Fisheries**).

Table 1. A selection of important historical fishing boats and sail yachts with their characteristics.

NAME OF THE SHIP	CHARACTERISTICS
Outka	Year of construction: 1963, a wooden sail yacht of 9.04 m, shipyard: Maria Hots in Ostend, protected as naval heritage
Tomidi	Year of construction: 1984-1985, Race Yacht of 17.54 m, shipyard: Standfast Yachts in Breskens. Participated as the Rucanor Tristar in the Whitbread Round the World Race. Protected as naval heritage
Lorette de Gravelines	Year of construction: 1907, 17 m, oldest existing fishing sailboat of the Belgian coast, under restoration
De Nele	Replicated fishing sailboat, Ostend
Jacqueline-Denise	Shrimp fishing boat, 17 m, based on the hull of a ship that was built in 1942 by Borrey in Ostend
O.32 Jessica	Year of construction: 1935, motor trawler, shipyard: Crabeels in Ostend, collection of the Sincfalamuseum
OD.1 Martha	Year of construction: 1942, motor trawler, showpiece of the NAVIGO fishing museum
Z.53 Gilbert-Norbert	Year of construction: 1942, motor trawler
N.788 Moed en Vertrouwen	Year of construction: 1942, wooden motor trawler, 15 m, in very poor condition, along an access road to Oostduinkerke
O.305 François Musin	Year of construction: 1948, deep-sea trawler for Iceland fishing, shipyard: Belliard - Crighton in Ostend NV Motorvisscherij. Restored in Antwerp by Werkvormm vzw. Protected as naval heritage

NAME OF THE SHIP	CHARACTERISTICS (continuation)
O.129 Amandine	Motor trawler, museum ship in Ostend about the history of the Iceland Fisheries (*Van Dijck 2012* [222595])
O.192 Lydie-Madeleine (now the Hallingdal)	Year of construction: 1957, motor trawler, built at Denye, partly dismantled and in poor condition
O.148 Snipe	Year of construction: 1958, motor trawler, built by Loy
O.116 Caroline	Year of construction: 1961, motor trawler, shipyard: De Graeve in Zeebrugge, still fishing
Z-580 Poseidon	Year of construction: 1963, motor trawler, shipyard: De Graeve in Zeebrugge, stalled restoration project
Crangon	Year of construction: 1965, motor trawler, shipyard: De Graeve in Zeebrugge, the first ship protected as naval heritage in 2007, tourist trips from Ostend

The Panesi project took a closer look at the construction of fishing vessels on the coast based on the archives of the shipyard 'Panesi' (Van Dijck & Daems, to appear in Relicta). The study outlines the history of shipbuilding on the coast and describes the development of the fishing boats between 1870 and 1970.

The Mercator is a special case. The ship was protected as a monument in 1996. This steel barquentine of 78 m was built in 1932 according to the plans of Adrien de Gerlache. The Mercator was used to train merchant marine officers. Since 1961, the ship has been open to the public as a museum (*Vanden Bosch 2001* [41936]). Finally, the Westhinder Light Ships (1950, Belliard yard, Ostend) must be mentioned. These floating lighthouses warned ships for shallow sandbanks and were replaced in 1993 by unmanned light platforms.

9.1.3 Architectural heritage along the coast

The interest in the preservation of architectural heritage in Belgium goes back to the 19th century. The architectural heritage along the coast includes many components which are specifically maritime-related: hotels and other residential accommodation, tourist and recreational facilities and infrastructure (see also **Tourism and recreation**), coastal defense (civil and military) (see also the theme **Safety against flooding** and **Military use**), lighthouses, sluices, all kinds of maritime business infrastructure, etc. The first two groups of architectural heritage mentioned above are closely linked to the rise of tourism in Flanders during the last 200 years. This coastal tourism especially took off in the last quarter of the 19th century (*Constandt 1986* [206001]).

The architectural heritage of the coastal zone has been gradually inventoried since 1977 (*Maelfait et al. 2012* [221016]). It was not until then that the vulnerable coastal heritage received more attention (*Cornilly 2005* [206049]). The results of the inventory are available online for the public: *https://inventaris.onroerenderfgoed.be*. Specifically for the province of West Flanders, there is '*Monumentaal West-Vlaanderen*', an illustrated overview in 3 parts of all protected monuments and sites in the province on 1 January 2001. The coastal area is mainly covered in Volume III, published in 2005 (*Cornilly 2005* [206049]). The update for the province of West Flanders after 1 January 2001 is discussed in the heritage magazine '*In de Steigers*'. An overview of the spatial distribution of the protected architectural heritage along the coast and additional information can be consulted on the geo-portal of the Flanders Heritage Agency (*https://geo.onroerenderfgoed.be/*).

For certain groups of architectural heritage, such as lighthouses (*Warzée 1999* [34353]), military heritage on the coast from WWI (*Deseyne 2007* [155933]), the Atlantic Wall (*Philippart et al. 2004* [222460]), tourism-related heritage (*Cornilly 2006* [122563]) and modern architecture (*Cornilly 2007* [119502]), thematic overview publications exist as well, although they are not exhaustive.

The industrial archaeological heritage is increasingly addressed in the context of heritage conservation. This industrial heritage contains, among other things, some typical maritime components such as shipyards, port infrastructure and fish processing companies (*Onderzoeksbalans – Bouwkundig erfgoed*). Because of its maritime location, Flanders hosted a fairly large number of shipyards that built both wooden and metal vessels for inland, coastal and maritime navigation until the 20th century. The study of the industrial heritage of shipbuilding in Flanders remains limited to a few case studies, such as the shipyards by Van Praet and Van Damme in Baasrode (*Segers 1994* [148027]) and a first major overview of fisheries-related shipyards by *Desnerck & Desnerck (1974)* [9601] and *Desnerck & Desnerck (1976)*

9606. Pioneering work on the port of Antwerp was conducted by Albert Himler (see for instance *Himler 1993* 99566, *Asaert et al. 1993* 99546 and *Himler & Moorthamers 1982* 123566). The other Flemish ports have been far less studied. Also the industrial heritage linked to sea fisheries (fish smoking and processing plants) has been little explored up till now. An overview of the history of the Belgian oyster farming is given by *Polk (2000)* 24883, *Halewyck & Hostyn (1978)* 64754 and *Pirlet (2012)* 222245, as well as on the following website: *http://www.vliz.be/wiki/Historiek_van_de_Belgische_oesterkweek* (see also theme **Aquaculture**).

9.1.4 Landscapes with heritage value

The coastal landscape, bordered by the Pleistocene sand region, has been largely shaped by human hands. Without dikes and drainage, this area would look completely different. There has been a significant human impact, although some areas, such as the Grote Keignaard in Zandvoorde, have a quite natural appearance (*Cornilly 2005* 206049). The protected landscapes in the coastal zone include very diverse areas ranging from creek areas (Lapscheure, Grote Keignaard in Zandvoorde), backlands (Lampernisse), dune regions (Westhoekduinen, Houtsaegerduinen in De Panne, Cabour in Adinkerke), tidal areas (Zwin and Yser estuary), heathlands (Westend), transitional areas (Zwinbosjes, Duinenweg/Duinenstraat in Raversijde) to specific and completely human-made areas such as the '*Moeren*' region.

An overview of the spatial distribution of the known landscape heritage can be found on the geo-portal of the Flanders Heritage Agency (*https://geo.onroerenderfgoed.be/*). An overview of the protected landscapes in West Flanders, on 1 January 2001, can be found in '*Monumentaal West-Vlaanderen*' (*Cornilly 2005* 206049). The situation after 1 January 2001 is recorded in the heritage magazine '*In de Steigers*' and in the geo-portal of the Flanders Heritage Agency.

9.1.5 Movable and intangible heritage

The term 'movable heritage' covers historically valuable material objects which are usually to be found in museum collections, archives or heritage libraries. Museums focus their collection policy on a particular theme. Certain museums focus on the historical story of a city, region or country, whereas others focus on collecting art, technology or everyday objects. An overview of the museums on the coast can be found on the provincial *museum map*. There are about twenty museums located in the coastal zone, some of them specifically focused on the coast. Furthermore, there are several libraries located along the coast. Some of them have publications with historical value in their collection. An overview of these collections is given on the following website (*collectiewijzer*) of the Flemish heritage library. The *Marine Library* of the Flanders Marine Institute collects exclusively publications about the sea and coast. *The library and documentation center of the National Fisheries Museum Oostduinkerke (NAVIGO)* focuses on the history of fisheries. Furthermore, the archives of the various governments are often important sources for movable heritage and in the *Archiefbank* database private archives are inventoried, some of which are important for maritime heritage (e.g. the archives of fishing schools). The State Archives of Belgium preserve many documents relating to the coastal municipalities. An overview of the latter archives can be found in the online *database*. The provincial archive has its own database, *Probat*, where in addition to the archives of the Province of West Flanders, various municipal archives can be searched as well (De Haan, Koksijde, Middelkerke, Blankenberge). The archive of Ostend has its own *website*. In addition, the various image databases should also be mentioned for their role in the disclosure of historical imagery. The provincial image bank contains photographs of many coastal communities. The municipalities of De Panne, Koksijde and Nieuwpoort are included in the image bank '*Westhoek verbeeldt*' of the *Erfgoedcel CO7* and Ostend has its own *image bank.* The initiative '*a century of sea fisheries in Belgium*' of the Flanders Marine Institute collects historical data about the landing, gross revenues and legislation of the Belgian fisheries (see also theme **Fisheries**). Finally, the local historical societies also preserve a lot of interesting material. An overview of all societies is available on the following website: *Heemkunde Vlaanderen*.

Comparable to the protection of buildings, valuable (sub-)collections or documents can also be protected by Decree (*Topstukkendecreet*). The list of valuable objects and collections (*topstukkenlijst*) provides an overview of the protected movable heritage. Some objects from the collections of the NAVIGO museum and '*Museum aan de Stroom*' (*MAS*) are also included in the Dutch initiative '*Maritiem Digitaal*', a collection-search system of the maritime world.

Intangible heritage represents traditions, customs, knowledge and practices inherited or historically developed by a group of people. Dialects, processions or crafts are just some examples of intangible heritage. Recently, the Flemish government launched the *Platform for intangible heritage in Flanders.* An overview of the intangible heritage is included in *the inventory of immaterial heritage*. Individuals or organisations must submit an application

themselves to be included in the inventory. This inclusion is a prerequisite to apply for UNESCO recognition. Some examples of intangible heritage on the coast are the horseback shrimp fishermen in Oostduinkerke and the *carnival of Blankenberge*.

The typical coastal intangible heritage is currently threatened by several factors. The fisheries heritage as well as the fisheries sector are under pressure. Rising fuel prices, increasing regulation and decreasing catches cause the professional reorientation of many fishermen. Because of this, the movable and intangible heritage related to fisheries has an increasingly smaller source of supply. A museum such as NAVIGO collects everything related to fisheries and its history, but there are also other initiatives such as oral history projects (*Rappé 2008* [135896], *Strubbe 2011* [213162]), which are committed to the preservation of this heritage.

9.2 Policy context

At an international level, the policies related to cultural heritage are primarily defined by the United Nations Educational, Scientific and Cultural Organization (*UNESCO*). Important legal instruments are the *Convention concerning the Protection of the World Cultural and Natural Heritage* (1972), the *Convention for the Safeguarding of the Intangible Cultural Heritage* (2003) and specifically for maritime and coastal heritage, the *Convention on the Protection of the Underwater Cultural Heritage* (2001) (see website for *full list* of UNESCO legal instruments). A *database* updated by UNESCO also contains many national laws of the Member States relating to cultural and natural heritage. The International Council on Monuments and Sites (*ICOMOS*) is an international non-governmental organisation dedicated to the preservation of monuments and sites of the world, working closely with UNESCO and also acting as an advisory body for it. ICOMOS consists of an international committee, national committees and scientific committees. For underwater heritage, there is an active international scientific committee, namely the International Committee on the Underwater Cultural Heritage (*ICUCH*) that *inter alia* promotes the Convention of 2001.

The main legislative framework for activities at sea is the *UN Convention on the Law of the Sea* (UNCLOS, 1982). In this almost globally ratified treaty, two clauses concerning heritage were added. The *UNESCO Convention* on the protection of underwater heritage has the intention to further complement and specify *UNCLOS* regarding the underwater cultural heritage.

At the European level, the policy on cultural heritage is developed by the *Directorate-General for Education and Culture (DG EAC)* of the European Commission, which only recently regarded immovable heritage (landscapes, architectural heritage and archaeological heritage) as part of the cultural heritage. In addition, the *Council of Europe (culture, heritage and diversity)* plays a very important role via heritage conventions, such as the *Convention for the Protection of the Architectural Heritage of Europe (Granada, 1985)*, *Convention for the Protection of the Archaeological Heritage of Europe (revised) (Valletta, 1992)*, *Convention on the Value of Cultural Heritage for Society (Faro, 2005)* and the *European Landscape Convention (Firenze, 2000)* (see *website* for an overview of the European cultural heritage legislation). The *European Heritage Network* (HEREIN) is a permanent information system that assembles public authorities of the Member States responsible for cultural heritage (focusing on the architectural and archaeological heritage) under the umbrella of the Council of Europe. The HEREIN network also provides an overview of the heritage policies in the Member States (*e.g. Flanders*).

In Belgium, immovable cultural heritage is a competence of the regions whereas the intangible heritage is covered by the communities. For the management of the archaeological heritage in the North Sea under Belgian supervision (federal jurisdiction), a cooperation agreement was concluded between the federal Minister for the North Sea and the Flemish Minister for Heritage on 5 October 2004. In this context, the *law of 9 April 2007* on the discovery and protection of wrecks is also important. This law was revised and adjusted in the course of 2013, particularly in view of the Belgian ratification of the *UNESCO Convention* for the protection of the underwater cultural heritage (2013).

In Flanders, the responsibilities of immovable, movable and intangible heritage are covered by different bodies:

Under the Policy domain Spatial Planning, Housing Policy and Immovable Heritage (*RWO*), the Flanders Heritage Agency is responsible for the policy preparation and evaluation and for the policy implementation (policy-oriented scientific research, realisation of inventories, protection, management support and communication) with regard to immovable heritage. The agency has carried out these tasks in an integrated way since January 1, 2013. The *RWO Inspection Agency* is responsible for the supervision and enforcement.

The Department of Culture, Youth, Sports and Media (*CJSM*) is responsible for the policy concerning tangible and intangible heritage. The *Agency for Arts and Heritage (Heritage Department),* takes on the policy preparation and implementation regarding tangible and intangible heritage. The Flemish interface center for cultural heritage (*FARO*) plays an intermediary role between the cultural heritage field (immovable and intangible heritage) and the government, supports cultural heritage organisations, local and provincial governments and managers of cultural heritage, and promotes the development of the cultural heritage field.

The policy document on immovable heritage (*beleidsnota onroerend erfgoed (2009 – 2014)* [214788]), the policy document on culture (*beleidsnota cultuur (2009 – 2014)* [214791]) and the vision document for intangible cultural heritage (*visienota voor immaterieel cultureel erfgoed* [214591]) contain the guidelines for the heritage and cultural policy in Flanders. The following decrees are important legislative documents at the Flemish level: the three decrees on immovable heritage (*Monuments Decree* (*Decree of 3 March 1976*), *Archaeology Decree* (*Decree of 30 June 1993*) and *Landscape Decree* (*Decree of 16 April 1996*)), the *Heritage Decree* (*Decree of 6 July 2012*, on the Flemish cultural heritage policy), the *Decree of 24 January 2003* (to protect cultural heritage because of its particular value in Flanders) and the *Decree of 29 March 2002* (on the protection of naval heritage) (*Provincie West-Vlaanderen (2008)* [126150], more information: *Wet-, decreet- en regelgeving: Monumenten, Stads- en Dorpsgezichten Landschappen, Archeologie en Varend Erfgoed 2012* [225481]).

The Flemish government committed itself in the Coalition Agreement 2009-2014 to establish a new umbrella decree for immovable heritage that replaces the three decrees mentioned above (*Monument Decree of 1976*, *Archaeology Decree of 1993* and *Landscape Decree of 1996*). This new legislative initiative reached the status of draft in January 2013. The new draft decree on immovable heritage includes a new, integrated approach to immovable heritage. It replaces the three existing decrees and a law of 1931 on the conservation of monuments and landscapes (*law of 7 August 1931*).

The *Province of West Flanders* is responsible for the 'depot policy' and invests in maritime heritage by developing projects in which coastal actors can participate.

9.3 Spatial use

9.3.1 Maritime archaeology

The geographical position of the maritime heritage in marine areas is included in a number of databases. These also play an important role in decision-making in the area of policy and management. Flemish partners have been involved in two European projects: the *Archaeological Atlas of the 2 Seas project* (in which the maritime archaeological heritage in France, England and Belgium has been mapped) and the *MACHU project* (Managing Cultural Heritage Underwater) in which a Geographical System with the position of underwater cultural heritage in European seas has been set up. Concerning the BNS, there are three databases that provide structured information: *www.maritieme-archeologie.be*, *the wreck database of the Flemish Hydrography* and *www.wrecksite.eu*. As far as maritime heritage is concerned, it is not evident to claim specific marine space for this purpose. It seems more appropriate to take advantage of the existing protective measures to conserve and protect a representative sample of the underwater heritage in situ. The aim of this policy is that, when underwater heritage has to disappear for compelling reasons, it gets the appropriate care and does not disappear without control.

9.3.2 Architectural heritage along the coast

The new geo-portal of the Flanders Heritage Agency (*https://geo.onroerenderfgoed.be*) provides an overview of the geographical location of the architectural heritage in the coastal area. Additional information can be obtained about the localised heritage elements.

9.3.3 Landscapes with heritage value

The valuable landscapes of Flanders were inventoried at the end of the 20th century in the *landscape atlas*. This atlas covers the entire Flemish region with the exception of the urban centers and densely populated agglomerations. The new geo-portal of the Flanders Heritage Agency (*https://geo.onroerenderfgoed.be*) provides an overview of the geographical location of the landscapes with heritage value.

9.4 Societal interest

Despite the fact that the importance of heritage is generally recognised, the economic significance of heritage, benefits and societal return on investment remain often unknown. The study by *De Baerdemaeker et al. (2011)* [214595] deals with the socio-economic impact of the immovable heritage (policy) in Flanders.

According to *De Baerdemaeker et al. (2011)* [214595], 189,229 (or 10% of) overnight stays in hotels on the coast were related to the presence of immovable heritage in 2009. Along with day trippers and recreationists, heritage tourism on the coast accounts to more than 2 million visitors per year, whereas the total heritage-related tourism expenditure amounts to almost 60 million euro (see also theme **Tourism and recreation**). According to *Maes et al. (2005)* [78279] (*GAUFRE project BELSPO*), many shipwrecks in the BNS create a tourism revenue. However, this kind of revenue is rather diffuse and difficult to estimate.

The other aspects of the societal importance of cultural heritage in the coastal zone are less known and only some fragmented figures and information are available:

- According to *Maelfait et al. (2012)* [221016], more than 4 million euro of grants were allocated between 2008 and 2010 by the Flemish government for the restoration and maintenance of cultural heritage in the coastal zone;
- The proximity of immovable heritage creates a better living environment which affects the value of housing (see also theme **Social and economic environment**). In De Panne, where 44% of the municipal area is protected (especially the landscape heritage is important in this regard), a property gets an added value of approximately 21,000 euro. In Knokke-Heist, the protected area amounts to 17% leading to an added value of property of approximately 8,300 euro (*De Baerdemaeker et al. 2011* [214595]);
- In a number of historic shipyards, social employment projects are developed;
- Museums are also involved in education. However, there are no data available regarding their impact.

9.5 Sustainable use

9.5.1 Maritime archaeology

Until now, the heritage at sea and underwater has barely been taken into account, mainly because of the ignorance about it. Therefore, there are no protected heritage sites in the BNS at present. Recently, however, there have been a number of new legislative initiatives that will bring change in the short term: a new Belgian law on cultural heritage in the sea is pending (the *law of 9 April 2007*), the Belgian ratification (2013) of the *UNESCO Convention* (Paris, 2001) on the protection of the underwater cultural heritage, and the amendment of the law on the marine environment in view of marine Spatial Planning at sea (*law of 20 January 1999*).

There is no intention to claim specific areas for heritage purposes in the North Sea. Instead it is examined how existing protective measures can be used to achieve the multiple use of certain marine areas.

9.5.2 Naval heritage (including historical shipbuilding)

Initially, some ships that became immovable were protected as a monument. Floating or sailing ships, which basically belong to the movable cultural heritage, could however not be protected by the *Decree of 3 March 1976* (monuments, townscapes, etc.). Hence, a separate decree for the protection of the naval heritage was established on 29 March 2002. The Decree on the naval heritage (*Decree of 29 March 2002*) and associated decision of 4 June 2004 provided encouragement for owners of naval heritage to protect their vessel as well as a management agreement that made the allocation of grants possible. The naval heritage policy is implemented by the Flanders Heritage Agency. A separate section of the Royal Commission for Monuments and Sites has been created to advise the Minister on the naval heritage. In order to achieve a responsible conservation policy, an inventory of the naval heritage has been realised (will be disclosed within the immovable heritage inventory: *https://inventaris.onroerenderfgoed.be/*).

In the spring of 2013, five ships were protected as monuments and fourteen vessels were permanently protected as naval heritage. Nine additional vessels were provisionally protected. The final protection will follow in principle within a year. Of course, not all protected and inventoried vessels are related to the coast. Other sectors such as inland navigation are included in these figures as well.

9.5.3 Architectural heritage along the coast

Due to the increasing scarcity of open space on the coast, the remaining heritage comes increasingly under pressure both in the coastal and hinterland municipalities (*Maelfait et al. 2012* [221016]). Important legislative instruments to protect the architectural heritage are: the *Monument Decree of 1976* (*Decree of 3 March 1976*), the *Archaeology Decree of 1993* (*Decree of 30 June 1993*), the *Landscape Decree of 1996* (*Decree of 16 April 1996*) and the *law of 7 August 1931* on the conservation of monuments and landscapes. Since 2009, the architectural heritage has been 'established' in the inventory (*https://inventaris.onroerenderfgoed.be*), which has certain legal consequences: demolition becomes less evident (with a few exceptions), whereas a change of function is made easier, as long as it benefits the preservation of the cultural heritage value (*Maelfait et al. 2012* [221016]).

9.5.4 Landscapes with heritage value

The scarcity of open space on the coast also applies to landscapes with heritage value. In addition to the protected landscapes with heritage value, which usually have an important natural value as well, the immovable heritage sector is currently mainly working on the instrument of the so-called anchorage areas. These areas are designated by the Flemish Minister for Heritage, and constitute the contribution from the sector for the AGNAS consultation (Defining the natural and agricultural structure in the Flemish Spatial Plan - '*Ruimtelijk Structuurplan Vlaanderen*'). An anchorage area is a valuable landscape with a series of heritage elements (landscape, architectural, archaeological, maritime). An anchorage area is described in the *landscape atlas*, but only gets a legal status after the 'designation'. From then on, the local government is obliged to take it into account when drawing up a Spatial Implementation Plan. As soon as an anchorage area is included in a SIP, it is called a heritage landscape (Article 27 to 30). This means that the landscape values and characteristics of the anchorage area are converted into planning regulations. This way it is possible to ensure that the landscape heritage is dealt with in a sustainable way. More information about protected landscapes can be found in the following publication: *brochure Beschermde landschappen* [143094] .

9.5.5 Movable and intangible heritage

The *list of objects and collections with an exceptional value* contains several hundred pieces or (sub-)collections. Some of these are linked to the coast. These are mainly paintings of Ensor, Permeke and Spilliaert from the collection of Mu.Zee. To be incorporated in the latter list, an object has to meet strict selection criteria. It should be both rare and essential. Grants can be requested for the restoration of these valuable pieces (*Decree of 24 January 2003*).

A great deal of movable heritage has not been included in the list of pieces with an exceptional value. Therefore, the Province of West Flanders developed a so-called 'depot policy' with the support of the Flemish government (more information: *Steen & Van den Nieuwenhof 2008* [225480]). This policy focuses on two lines, the registration of movable heritage held by museums, local heritage societies and other heritage managers as well as the conservation and management of these pieces. To assist museums and heritage organisations in the registration of their collection, the heritage database *www.erfgoedinzicht.be* has been developed. Regional depots should gradually host documents or (sub-)collections of museums and local heritage associations. In the former chapel '*Ster der Zee*' (Koksijde), a regional archaeological depot is built that should be ready by 2014.

The inventory of intangible heritage currently contains 33 elements, 2 of them are specific to the coast: the Carnival of Blankenberge and horseback shrimp fishing in Koksijde. The inventory is established according to the bottom-up principle. Organisations or individuals must submit an application to have an element of intangible cultural heritage included in the inventory. Included elements must submit an annual progress report with information about the activities concerning the protection of the element. For now, the inclusion in the inventory only increases the visibility of the element. Being in the inventory is a prerequisite to be included in the *UNESCO list of intangible heritage*.

Legislation reference list

Table with international agreements, conventions, etc.

INTERNATIONAL AGREEMENTS, CONVENTIONS, ...			
Abbreviations (if available)	Title	Year of conclusion	Year of entering into force
	Convention Concerning the Protection of the World Cultural and Natural Heritage	1972	1996 (ratification by Belgium)
UNCLOS	United Nations Convention on the law of the sea	1982	1994
	Convention on the Protection of the Underwater Cultural Heritage	2001	2013 (ratification by Belgium)
	Convention for the Safeguarding of Intangible Cultural Heritage	2003	2006 (acceptance by Belgium)

Table with legislation of the European Council.

EUROPEAN LEGISLATION			
Abbreviations (if available)	Title	Year of conclusion	Year of entering into force
Granada Convention	Convention for the Protection of the Architectural Heritage of Europe	1985	1987
La Valetta Convention	Convention for the Protection of the Archaeological Heritage of Europe	1992	1995
Florence Convention	European landscape convention	2000	2004
Faro Convention	Convention on the Value of Cultural Heritage for Society	2005	2011

Table with Belgian and Flemish legislation. The consolidated version of this legislation is available on *Belgisch staatsblad* and the *Justel-databases*.

BELGIAN AND FLEMISH LEGISLATION	
Date	Title
Laws	
Wet van 7 augustus 1931	Wet op het behoud van monumenten en landschappen
Wet van 20 januari 1999	Wet ter bescherming van het mariene milieu [en ter organisatie van de mariene ruimtelijke planning] in de zeegebieden onder de rechtsbevoegdheid van België.
Wet van 9 april 2007	Wet betreffende de vondst en de bescherming van wrakken
Decrees	
Decreet van 3 maart 1976	Decreet tot bescherming van monumenten en stads- en dorpsgezichten
Decreet van 30 juni 1993	Decreet houdende bescherming van het archeologisch patrimonium
Decreet van 16 april 1996	Decreet betreffende de landschapszorg
Decreet van 29 maart 2002	Decreet tot bescherming van varend erfgoed
Decreet van 24 januari 2003	Decreet houdende bescherming van het roerend cultureel erfgoed van uitzonderlijk belang (topstukkendecreet)
Decreet van 16 juli 2010	Decreet houdende instemming met het verdrag ter bescherming van het cultureel erfgoed onder water, aangenomen in Parijs op 2 november 2001
Decreet van 6 juli 2012	Decreet houdende het Vlaams cultureel-erfgoedbeleid (erfgoeddecreet)

10 Social and economic environment

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[4] Wonen Vlaanderen

Citation:

Coudenys, H., Barbery, S., Depestel, N., Traen, S., Vandermeulen, A., Pirlet, H., 2013. Social and economic environment. In: Lescrauwaet, A.K., Pirlet, H., Verleye, T., Mees, J., Herman, R. (Eds.), Compendium for Coast and Sea 2013: integrating knowledge on the socio-economic, environmental and institutional aspects of the Coast and Sea in Flanders and Belgium. Oostende, Belgium, p. 197-208.

The European coastal areas are characterised by their increasing number of inhabitants and a population density that is on average 10% higher compared to the hinterland. Moreover, these regions are also subject to an expansion of infrastructure and economic activities (*The changing faces of Europe's coastal areas, EEA 2006* 100281). Hence, the coastal zones are regions with a unique identity and specific challenges. The Belgian coastal area is characterised by its typical social environment, with a higher population density, a large ageing population, a high amount of second homes and high house prices. Furthermore, the coast constitutes a specific region from an economic perspective. On the one hand large economic gateways (sea ports and airports) are present, but the region is also characterised by a higher unemployment rate, seasonal employment and a limited number of high-quality jobs for the highly educated (*Breyne et al. 2007* 114957, *Maelfait et al. 2012* 221016). In the current text, the Belgian coastal area is mainly compared to the province of West Flanders. In the publications mentioned below, the figures are also benchmarked within larger geographical areas, such as the Flemish Region.

10.1 Policy context

Both federal and Flemish actors are involved in the Belgian policy concerning the economic environment. On the federal level, the following Federal Public Services (FPS) exist: *FPS Employment, Labour and Social Dialogue* and *FPS Economy, SMEs, Self-Employed and Energy*. Furthermore, there are the following Flemish policy domains: *Work and Social Economy* and *Economy, Science and Innovation*.

The housing policy and spatial planning belong to the Flemish policy domain of Spatial Planning, Housing Policy and Immovable Heritage (*RWO*) (see the *Flemish Policy Note Spatial Planning 2009-2014* 225363 and the *Flemish Policy Note Housing 2009-2014* 227507). Furthermore, the Flemish policy domains of *Wellbeing, Public Health and Family*, *Education* and *Culture, Youth, Sports and Media* are important as well with regard to the social environment.

The Province of West Flanders and the municipalities are involved in the translation of the economic policy, the housing policy and spatial planning (see below). The legal framework concerning spatial planning can be found in the coastal codex, theme *Spatial Planning*. The local legislation for inhabitants of the coast is listed as well (coastal codex, theme *Local Legislation*).

10.2 Spatial use

The actual spatial use has been determined by the regional spatial plans, drafted by the federal government. A regional spatial plan covers one or several districts, in which the space has been divided into areas dedicated to housing and services, to industry, to recreation areas, to nature reserves, as well as agriculture. A destination in a regional spatial plan has been further refined by the municipality in urban plans (BPA). These plans have been particularly created in buildable areas. Therefore, differences exist today between several coastal municipalities, concerning the specific interpretation, such as the heights and density of the apartment blocks.

The new Flemish *Decree on Spatial Planning* (*Decree of 18 May 1999*) has changed the planning system. The destinations on the regional spatial plan remain valid until they are replaced by a new destination, through a spatial implementation plan (RUP). These RUPs can be elaborated by the municipalities, the provinces as well as by the Flemish Region. The drafting of an RUP is the implementation of a spatial vision described in a spatial structure plan. Three spatial structure plans exist: the Flemish spatial structure plan (*RSV*) (Flemish Region), the spatial structure plan of the province of West Flanders (*PRS-WV*) (Province of West Flanders) and the municipal spatial structure plans. These spatial visions determine the future spatial use. The regional spatial plans, RUPs and BPAs can be consulted on the following website: *http://www.giswest.be/gewestplan-rups-internet*.

In the *RSV*, the coast is regarded as an urban network and a touristic, recreational network. This means that a coherent urban policy for the coast should be in place, with opportunities for further touristic and recreational activities. In this context the regional urban area of Ostend (consisting of parts of Middelkerke, Ostend and Bredene) serves to meet new needs with regard to housing and industry. Besides, Ostend and Zeebrugge are designated as economic gateways, which means that the ports of Ostend and Zeebrugge, as well as the Ostend Airport, can benefit from opportunities for further development. This development is elaborated in regional spatial implementation plans (GRUPs). The large connected nature areas such as het Zwin, the beaches between coast towns on the West Coast, etc. are also demarcated by the Flemish Region in GRUPs. The *RSV* and the GRUPs can be consulted on the following website: *www.ruimtelijkeordening.be*.

The *PRS-WV* refines the spatial planning in the coastal zone. Every coastal municipality benefits from opportunities for further development. This needs to be concretised by the municipalities in municipal spatial structure plans. The province determines the possibilities for constructions on the beach and seawall in provincial spatial implementation plans. The PRS and RUPs can be found on the following website: *www.west-vlaanderen.be/ruimtelijkeordening*.

10.3 Current state

10.3.1 The social environment

THE COAST AND ITS INHABITANTS (more information: *demografische fiche Kust 2012* [221384])

On 1 January 2012, the coastal area[1] numbered 417,570 inhabitants. This constitutes 35.7% of the total population of the province of West Flanders. In the period 2002-2012, the population in the coastal area increased by 4% (figure 1), a growth comparable to the surrounding coastal areas around the North Sea. (*The changing faces of Europe's coastal areas, EEA 2006* [100281]). A detailed comparison of the population growth of the Belgian coast and the Côte d'Opale in Northern France is discussed in the following publication: *Grensoverschrijdende atlas: Van Berck tot Brugge, één grens, twee gebieden, één gezamenlijke horizon (2006)* [107715].

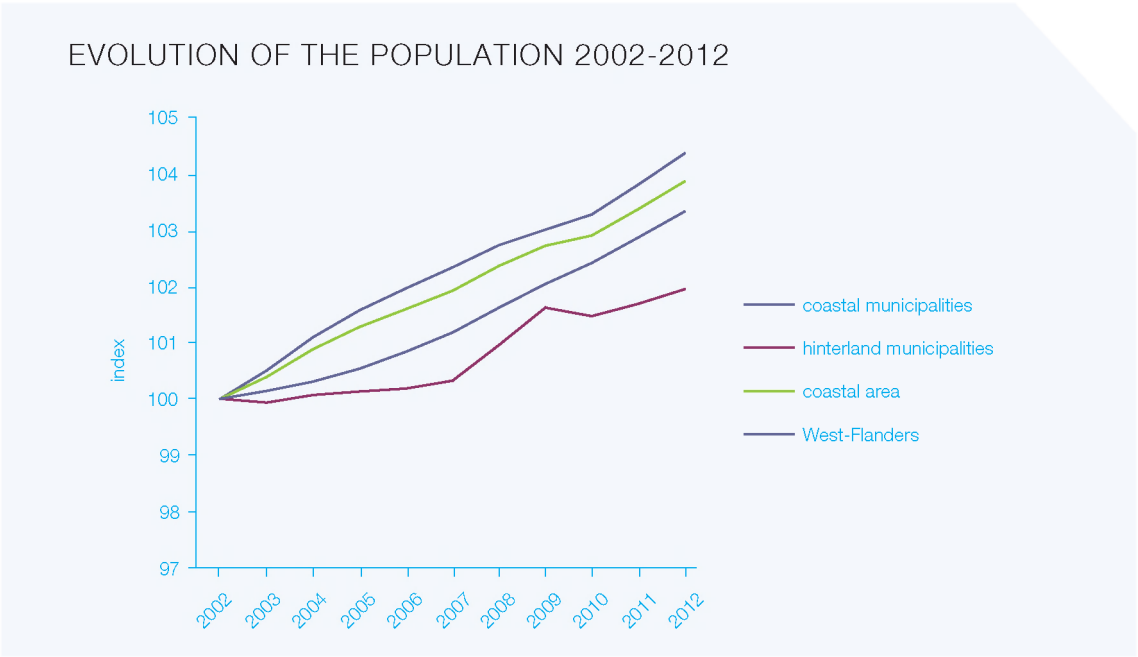

Figure 1. Evolution of the population in the coastal area (coastal municipalities + hinterland municipalities) and the province of West Flanders between 2002-2012 (Source: '*rijksregister*', population on 01.01 of each year, processed by the Province of West Flanders).

The coastal municipalities as well as the hinterland municipalities are characterised by a population growth, although the increase is more evident on the coast than in the hinterland. The population growth in the coastal zone is stronger than the average in the province of West Flanders (Source: '*rijksregister*' on 01.01.2012, processed by the Province of West Flanders).

The increase in population will continue in the future. In the context of the European DC Noise project (*http://www.dcnoise.eu/*), researchers (VUB) have worked out population forecasts. The Province of West Flanders uses these forecasts for the development of its policy. The forecasts that are made on a regional level predict a further population increase in the coastal municipalities (*Denorme & Verhaeghe 2011* [225362]).

1 The coastal area includes the 10 coastal municipalities (Blankenberge, Bruges, Knokke-Heist, Bredene, De Haan, Middelkerke, Ostend, De Panne, Koksijde and Nieuwpoort) and the 9 hinterland municipalities (Damme, Jabbeke, Zuienkerke, Diksmuide, Lo-Reninge, Gistel, Oudenburg, Alveringem and Veurne).

The Belgian coast, as well as the Dutch coast and parts of the Northern-French coast constitute the coastal area around the North Sea with the highest population density (*The changing faces of Europe's coastal areas, EEA 2006* [100281]). The average population density in our coastal area amounts to 367 inhabitants per km². This average masks certain differences: the population density of the coastal municipalities amounts to 694 inhabitants per km², while the population density of the hinterland municipalities is 128 inhabitants per km². 80% of the inhabitants of the coastal area live in a coastal town (Source: '*rijksregister*' on 01.01.2012, processed by the Province of West Flanders).

The coastal population has a few typical characteristics. According to the publication *Grensoverschrijdende atlas: Van Berck tot Brugge, één grens, twee gebieden, één gezamenlijke horizon (2006)* [107715], the profile of the inhabitants of the Belgian coast strongly resembles the profile of the French Côte d'Azur. The dejuvenation and ageing processes are more pronounced in the Belgian coastal area than in the other parts of Flanders and West Flanders (Coudenys 2012 in *Maelfait et al. 2012* [221016]). The age groups under 55 years decrease proportionally, the age groups above 55 years increase proportionally (figure 2). Furthermore, the structural coefficients tell us something about the demographics (table 1).

Table 1. The structural coefficients in the coastal area (coastal municipalities and hinterland municipalities) and the province of West Flanders on 1 January 2012 (Source: '*rijksregister*').

	STRUCTURAL COEFFICIENTS			
	coastal municipalities	hinterland	coastal zone	West Flanders
Ageing degree (60+/0-19 year)	187.49	114.63	169.85	131.65
Grey pressure (60+/ 20-59 year)	66.78	48.51	62.91	53.02
Internal ageing (80+/60+)	21.83	22.90	22.00	22.60
Family care index (80+/50-59 year)	48.33	40.83	46.86	44.29
Juvenile pressure (0-19 year/20-59 year)	35.62	42.32	37.04	40.27

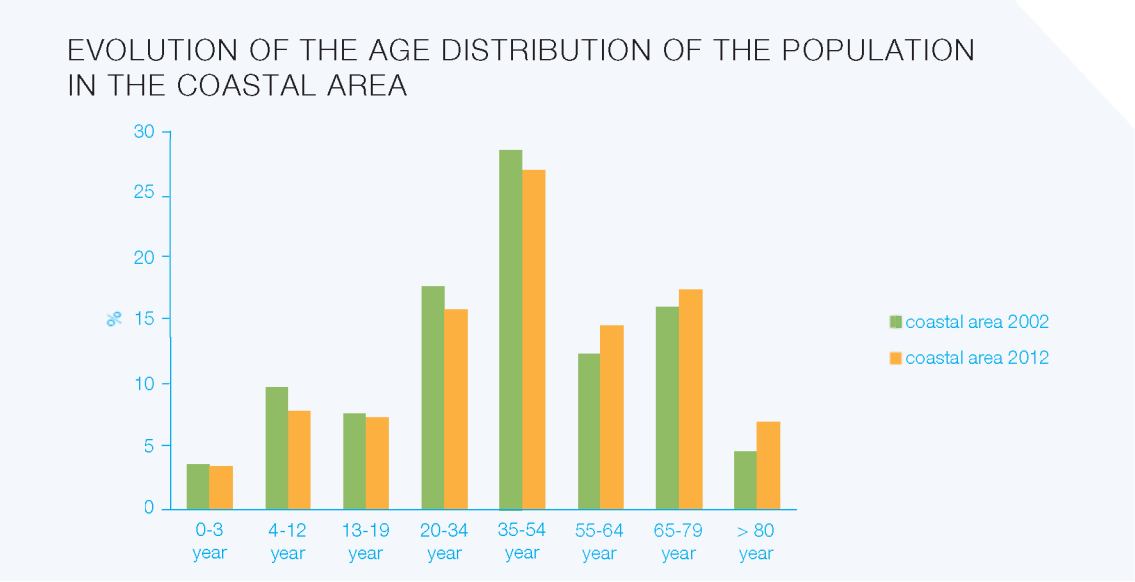

Figure 2. The evolution of the age distribution of the population in the coastal area, between 2002 and 2012.

In West Flanders, for every 100 persons between 0 and 19 years old, there are 132 people aged 60+. In the coastal municipalities, this proportion increases to 187: for every 100 persons aged under 20, there are 187 people aged 60+. The so-called 'grey pressure' is 67 in the coastal municipalities: for every 100 persons in the professionally active age range (20-59 years) there are 67 people aged 60+. The internal ageing (the share of 80+ people within the group of 60+) amounts to 22 in the coastal municipalities. This figure is slightly lower than in the hinterland municipalities and West Flanders.

On 1 January 2012, 121,749 persons aged 60+ lived in the coastal area (Source: *rijksregister* on 01.01.2012, processed by the Province of West Flanders). The increase between 2002 and 2012 amounts to 25%, which means that there are now 25% more persons aged 60+ in the coastal area compared to 10 years ago. In the same period, the number of persons under 20 years in the coastal area decreased by 8% (from 84,219 in 2002 to 77,275 in 2012).

On 1 January 2012, 193,287 households were living in the coastal area. In the time range 2002-2012, the amount of households increased by 10%. The increase in the amount of households is stronger than the increase in the number of inhabitants. Hence, the coast was characterised by a continuing reduction in family size within the past 10 years.

When the features of the households are observed in detail, a distinction can be made with regard to the composition of the household: a household consisting of a single adult or of several adults living together, a household without children aged under 20 (family without children) or a household with one or more adults living together with one or more children aged under 20 (family with children). This last category also includes single-parent families.

The households in the coastal area comprise 36% singles, 40% families without children and 22% families with children (figure 3). The coastal municipalities are characterised by more singles and fewer families with children compared to the hinterland municipalities and less than the average of West Flanders. (Source: '*rijksregister*' on 01.01.2012, processed by the Province of West Flanders).

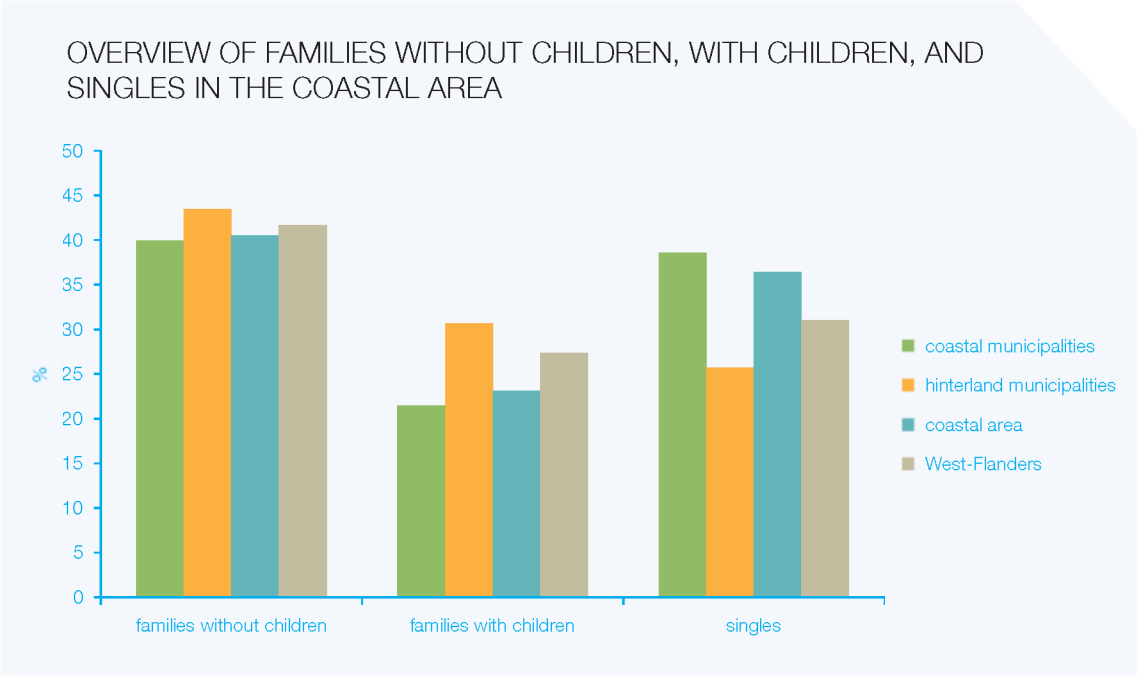

Figure 3. Overview of families without children, with children, and singles in the coastal area (coastal municipalities and hinterland municipalities) and the Province of West Flanders on 1 January 2012 (Source: '*rijksregister*').

A distinctive feature of the coastal municipalities is the large number of singles. This group has grown a lot over the past 10 years (+20% in the coastal area, +23% in West Flanders) (see above: reducing family size) (figure 4). The highest increase is observed in the hinterland municipalities.

When we observe the features of the population, a few indicators reveal the urban character of the coastal municipalities: an older population, a lot of singles and a higher population density. This urban profile first appeared in the 'deprivation atlases' (*Kesteloot et al. 1996* [221393], *Kesteloot & Meys S. (2008)* [225361]) that contain an analysis on neighbourhood level. The neighbourhoods along the coast show a completely different profile than the neighbourhoods behind the coastal zone. The line of demarcation between more deprived quarters and less deprived neighbourhoods does not correspond with the borders of the municipalities. To determine the urban profile of the coastal zone and the related problems, an analysis on neighbourhood level is required.

The deprivation atlas of the Province of West Flanders (*provinciebestuur West-Vlaanderen, Steunpunt Sociale Planning, Kansarmoede-atlas West-Vlaanderen 2011* [214561]) confirms the urban nature of the coastal municipalities

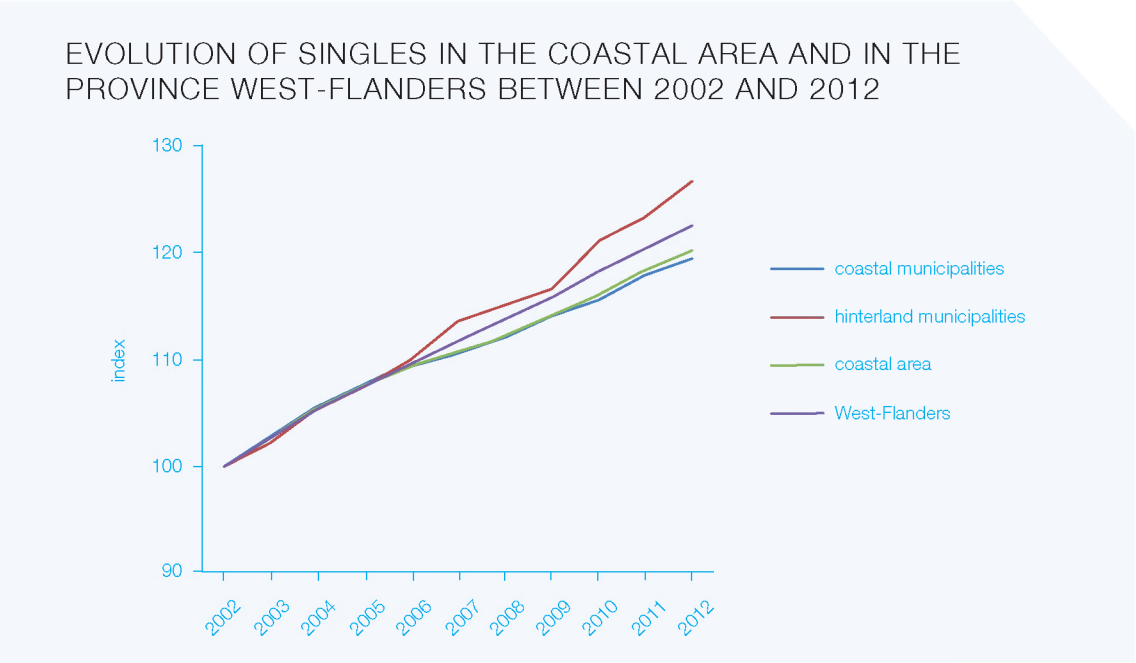

Figure 4. The evolution of singles in the coastal area (coastal municipalities and hinterland municipalities) and in the province of West Flanders between 2002 and 2012 (Source: *'rijksregister'*, population on 1 January of each year, processed by the Province of West Flanders).

and determines that coastal towns are more often confronted with deprivation than the average (Rammelaere 2012 in *Maelfait et al. 2012* [221016]). In the coastal area, 22.2% of all families live in a deprived neighbourhood. The share of families living in a deprived neighbourhood is nearly twice as high as the average in West Flanders (11.7%). In the coastal municipalities, an average of 22.6% of families live in a deprived neighbourhood. For the hinterland municipalities, this share amounts to 14.5% of families (Rammelaere 2012 in *Maelfait et al. 2012* [221016]).

THE COAST AND ITS INHABITANTS (more information: *woonfiche kustzone 2012* [221385])

The total surface of the coastal area is 1,183 km². The coastal municipalities account for 42% of this area, the hinterland municipalities for the other 58% (Source: *FPS Economy Algemene Directie Statistiek en Economische Informatie*, based on the land register).

The Belgian coastal zone has the highest share of built-up area compared to the other European coastal zones (The changing faces of Europe's coastal areas, EEA 2006 [100281]). In the publication: *Grensoverschrijdende atlas: Van Berck tot Brugge, één grens, twee gebieden, één gezamenlijke horizon (2006)* [107715] a detailed comparison between the habitation of the Belgian Coast and the Côte d'Opale (Northern France) is made. The built-up area in the Belgian coastal area amounts to 239 km². 7% of this built-up area in the coastal area serves housing. For the coastal municipalities, the area for housing constitutes 35% of the built-up area, in the hinterland municipalities this is only 4% (Source: *FPS Economy Algemene Directie Statistiek en Economische Informatie*, based on the land register).

In 2010, 289,558 housing facilities were present in the coastal area (table 2). However, there is a significant difference in the types of housing. In the coastal municipalities, 54% of the housing facilities are situated in an apartment (block) compared to 7% in the hinterland municipalities. In the hinterland municipalities, 88% of the housing facilities are ordinary houses (Source: *Land register 'kadastrale statistiek van de West-Vlaamse gemeenten'*, 2010).

The total amount of housing facilities in the coastal municipalities is slightly higher than the amount of homes needed for housing its inhabitants. An average of 39% of the housing facilities in the coastal area is not used as a permanent home (figure 5). In other words, housing facilities often serve other functions: second homes, some sort of industry, or sometimes they remain tenantless houses (Coudenys 2012 in *Maelfait et al. 2012* [221016]).

Table 2. An overview of the housing facilities in the coastal area, as well as in the hinterland and coastal municipalities (Source: *Land register 'kadastrale statistiek van de West-Vlaamse gemeenten'*, 2010).

Housing facilities	COASTAL ZONE		HINTERLAND MUNICIPALITIES		COASTAL MUNICIPALITIES	
	Total		Total		Total	
Total number housing facilities	289,558	100%	35,937	100%	253,621	100%
• Residential houses	139,696	48%	31,787	88%	107,909	43%
• Commercial premises	9,732	3%	1,608	4%	8,124	3%
• Apartments and buildings	140,130	48%	2,542	7%	137,588	54%

The use of the housing facilities for other functions than permanent housing might have negative consequences for the community, such as an increased feeling of insecurity and a lack of social cohesion. On the other hand, a large amount of second homes is one of the preconditions for the tourism industry (see theme **Tourism and recreation**).

Figure 5 clearly shows a large housing surplus. This phenomenon is typical of the coast given that the hinterland municipalities only have 10% housing facilities which are used for other purposes than permanent housing.

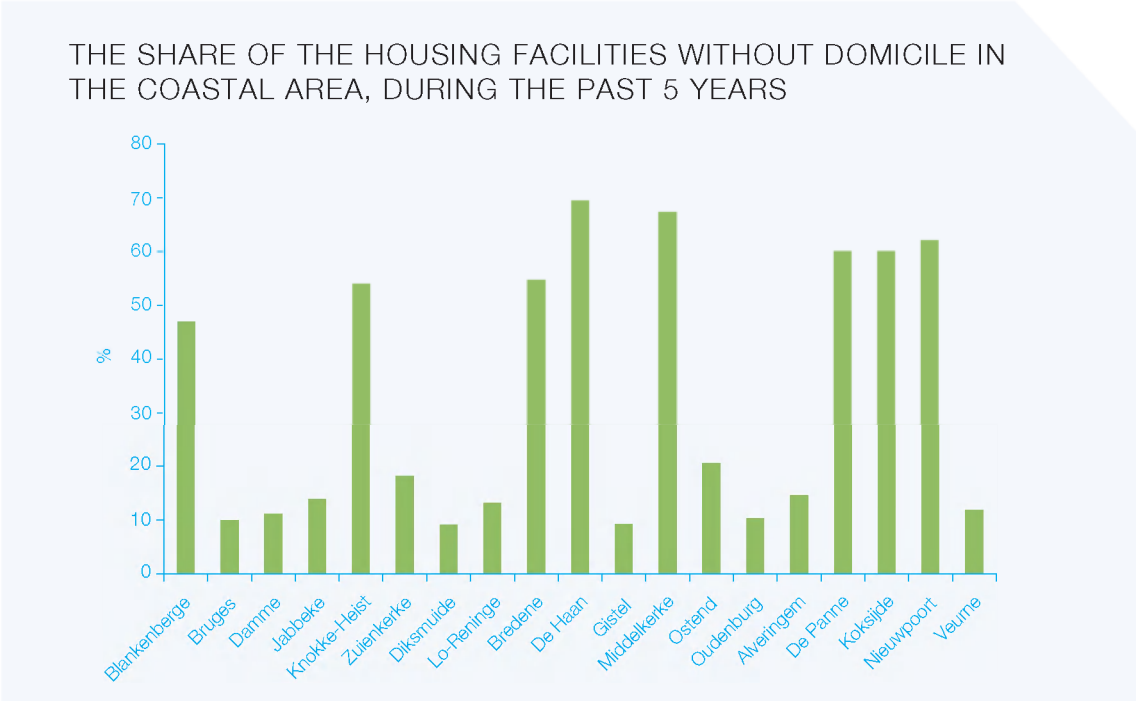

Figure 5. The share of the housing facilities without domicile in the coastal area, during the past 5 years (Source: Coudenys 2012 in *Maelfait et al. 2012* [221016]).

10.3.2 The economic environment

THE COAST AND ITS LABOUR MARKET

In 2010, there were 168,809 professionally active persons in the coastal area (employees, self-employed and helpers) aged between 18 and 64 years. Hence, the coastal area constitutes 33.6% of the total number of working persons in West Flanders. (Source: *Steunpunt Werk en Sociale Economie*, *www.lokalestatistieken.be*). There were 141,312 employees in the coastal area at the end of 2010 (Depestel 2012 in *Maelfait et al. 2012* [221016]) which represents 34.8% of the total amount of West Flanders. Moreover, 36,586 self-employed and helpers (excluding the self-employed as a secondary activity) were active in the coastal area, which equals 35.0% of the total number in West Flanders (source: RSVZ, *www.lokalestatistieken.be*).

The coastal area is characterised by a very weak industrial basis. The share of the industry within salaried employment was only 9.8% in 2010, compared to 21.4% in West Flanders (Depestel 2012 in *Maelfait et al. 2012* [221016]). In the coastal area, 85.3% of salaried employment is situated in trade and services, of which tourism and the hotel and catering industry constitute a major part. In the latter sector, a large number of the jobs are seasonal employment. In West Flanders, 71.2% of all employees are active in trade and services (Depestel 2012 in *Maelfait et al. 2012* [221016]).

In 2010, 181,587 inhabitants of the coastal area belonged to the professionally active population (working people and not-working jobseekers) aged between 18 and 64 years. This is 34.0% of the total number in West Flanders (source: *Steunpunt Werk en Sociale Economie*, *www.lokalestatistieken.be*). The degree of activity – the proportion of the professionally active population compared to the total population aged between 18 and 64 – in the coastal area equalled 73.2% (2010), which is less than in West Flanders (75.8%). The employment rate – the proportion of the number of working people compared to the total population aged between 18 and 64 – is lower as well in the coastal area (68.1%) than in West Flanders (71.3%) (figure 6). The unemployment rate – the number of not-working jobseekers compared to the professionally active population aged between 18 and 64 – in the coastal area amounts to 7.0%, which is higher than the average of West Flanders (5.8%) (Source: *Steunpunt Werk en Sociale Economie*, *www.lokalestatistieken.be*).

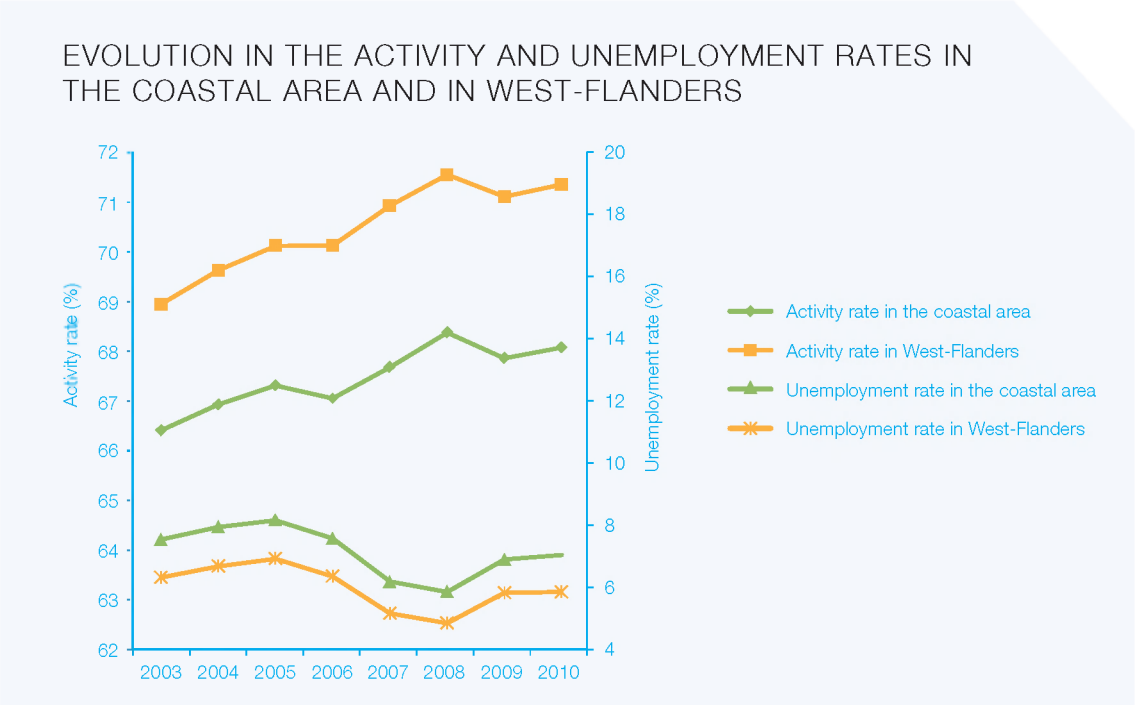

Figure 6. Evolution in the activity and unemployment rates in the coastal area and in West Flanders, 2003-2010 (Source: *Steunpunt Werk en Sociale Economie*, *www.lokalestatistieken.be*).

In 2011, 12,090 not-working jobseekers were present in the coastal area, which represents 42.1% of the total in West Flanders (source: *VDAB*). Furthermore, the older jobseekers amount to 3,547 or 43.9% of the total in West Flanders. The unemployment pressure – the proportion of the number of not-working jobseekers and the older jobseekers compared to the potential professionally active population (18-64 years) – is higher in the coastal area (6.3%) than in West Flanders (5.2%). In the coastal municipalities, the unemployment pressure is considerably higher than in the hinterland municipalities (figure 7) (Source: VDAB and RVA in *West-Vlaanderen Ontcijferd editie 2012* [226504]).

In 2010, only four of all coastal municipalities (Bruges, Ostend, Veurne and Nieuwpoort) had a positive commuting balance for employees. In these municipalities, the number of employees that work in the cities, but live elsewhere is bigger than the amount of inhabitants working outside of the municipality. (Source: *Steunpunt Werk en Sociale Economie*).

In the following information sources: *West-Vlaanderen Ontcijferd editie 2012* [226504] and the *Gemeentelijke Steekkaarten* statistics about the labour market are provided on the level of municipalities, districts and the province of West Flanders.

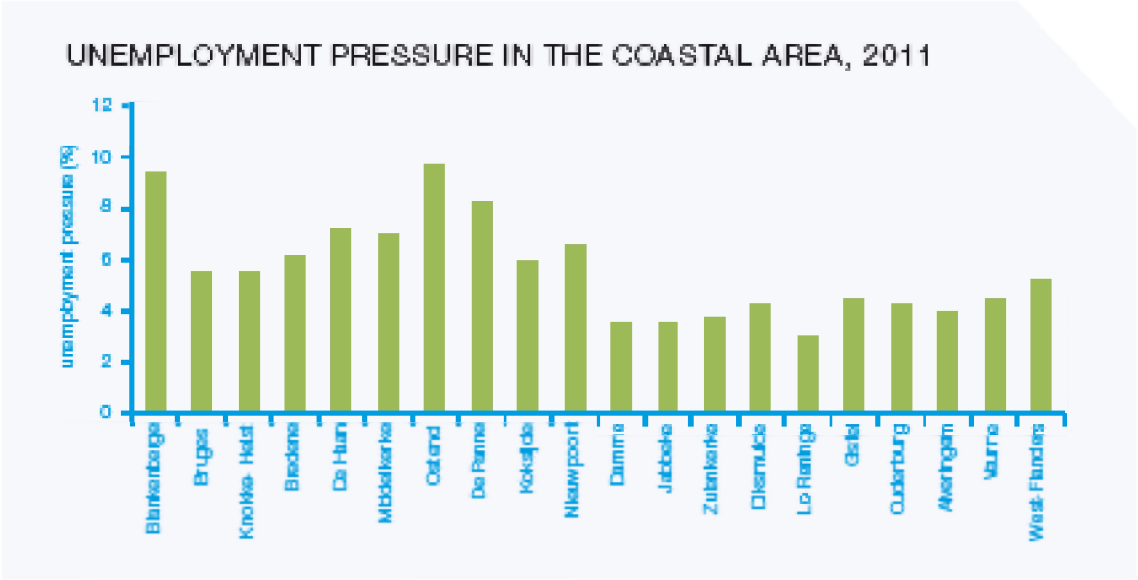

Figure 7. Unemployment pressure in the coastal area, 2011 (Source: based on VDAB and RVA in *West-Vlaanderen Ontcijferd editie 2012* [226504]).

ENTREPRENEURSHIP ON THE COAST

In 2010, the produced wealth measured on the basis of the Gross Domestic Product (GDP[2]) per capita was lower in West Flanders than in the Flemish Region or in Belgium. The district of Bruges (also including municipalities that are not part of the coastal area) is the only coastal district where the GDP per capita is higher than the average of West Flanders. During the period 2003-2010 the GDP per capita in the district of Bruges grew with an average of 3.6% per year; in West Flanders, the average increase of the GDP per capita was limited to 3.0% per year. Hence, the district of Bruges widened the gap with the province of West Flanders. In the other coastal districts of Ostend and Veurne (also including municipalities that do not belong to the coastal zone), the GDP per capita grew with an average of 2.9% and 3.0% respectively. The latter increase did not allow to close the gap with West Flanders (Source: NBB in *West-Vlaanderen Ontcijferd editie 2012* [226504]).

With regard to the realised gross value added[3], the district of Bruges ranks second after Kortrijk, with a share of 25.4% of the gross value added that was realised in West Flanders in 2010. In the other coastal districts of Ostend and Veurne the gross value added amounted to 10.5% and 5.1% respectively. In 2010, the gross value added per employee in West Flanders was 78,650 euros. This means that the province remains far below the Flemish average (83,921 euros). The coastal districts of Veurne and Ostend, as well as the district of Tielt, have a gross value added per employee that is higher than the Flemish average (source: INR in *RESOC-dataset 2012*).

On 1 January 2011, 35,284 active enterprises were present in the coastal area, which equals 34.0% of the total in West Flanders (Depestel 2012 in *Maelfait et al. 2012* [221016]). 26,545 of the active enterprises are situated in the coastal municipalities, 8,739 in the hinterland municipalities. In the coastal areas 69.9% of the active enterprises can be situated in the tertiary sector of the economy[4], and 6.2% in the quaternary sector[5]. In West Flanders the share of the active enterprises in these sectors is lower (63.0% in the tertiary sector and 4.9% in the quaternary sector). Also, the number of founded and disappeared enterprises is notably higher in the coastal area compared to West Flanders. The economic dynamics in the coastal zone are relatively high. In 2011, both the foundation ratio (proportion of the number of foundations in comparison to the number of active enterprises) (coastal zone: 8.0%, coastal municipalities: 8.3%, hinterland municipalities: 7.1%) and the retirement ratio (proportion of the number of shutdowns and bankruptcies compared to the number of active enterprises) (coastal area: 6.5%, coastal municipalities: 6.9%, hinterland municipalities: 5.4%) were higher in the coastal area than in the entire province of West Flanders. The

2 The GDP is the market value of all officially recognised final goods and services produced within a country in a given period of time. The GDP per capita is often considered an indicator of a country's standard of living.
3 The difference between the marketable value of production and the purchased primary resources.
4 Service sector: the economic sector in which enterprises want to make profit by selling their goods or services.
5 The non-commercial services: e.g. governmental services and services with government funding.

turbulence ratio (sum of the foundation and retirement ratios) is therefore considerably higher (coastal area: 14.5%, coastal municipalities: 15.2%, hinterland municipalities: 12.5%) than the figure for West Flanders (13.3%). These observations can be entirely attributed to the coastal municipalities, as the ratios of the hinterland municipalities are always below the number for West Flanders (Depestel 2012 in *Maelfait et al. 2012* [221016]). Urban centres usually mark more foundations and shutdowns. This is inherent to the opportunities these centres offer. The higher turbulence at the coast can also be partly explained by the nature of the activities. The hotel and catering sector, which is abundantly present in the coastal area, is characterised by a large number of foundations and shutdowns. In 2011, 4,150 active enterprises were present in the hotel and catering sector in the coastal area (coastal municipalities: 3,547 active enterprises, hinterland municipalities: 603 active enterprises), equalling 43.6% of the Province of West Flanders (Source: *FPS Economy (ADSEI)*, processing: *Afdeling DSA*, the West Flanders Development Agency).

The coastal area covers 36.2% of the total surface of West Flanders. With regard to the surface used for economic activity, the coastal area only constituted 22.5% of the total in West Flanders on 1 January 2011. In West Flanders 18.0% of the built-up area is used for economic activity whereas this number equals 14.5% in the coastal area. In the coastal municipalities, the share of the built-up area that is used for economic activity is larger than in the hinterland municipalities (16.2% and 11.8% respectively) (Source: *FPS Economy* (ADSEI), *www.lokalestatistieken.be*).

In 2010, the spatial productivity in the coastal area equalled 45.7. This means that in the coastal area, there were 45.7 persons working per hectare of economically occupied surface. In the coastal municipalities this number amounted to 56.1 compared to 24.1 the hinterland and 32.9 in the entire province. These differences are caused by the different morphology and the economic structure of these regions. In urbanised regions, the economic use of space is totally different as a result of a different sectoral structure: on the one hand relatively less industry and fewer users of large spaces and on the other hand more trade and services with offices and high-rises and more employees per surface unit. Until 2008, the spatial productivity of West Flanders remained on the same level. After 2008 the indicator revealed a decreasing course. In the other regions, the spatial productivity already started to decrease from 2006 onwards. These decreases are the result of a growing spatial dispersion of living and working. In this regard, the commercial suburbanisation or the migration from municipalities towards the surrounding country-side has strongly increased over the past five years. Up till now, the Flemish spatial structure plan (*RSV*) could not reverse this trend (Depestel 2012 in *Maelfait et al. 2012* [221016]).

In the following information sources: *West-Vlaanderen Ontcijferd editie 2012* [226504] and the *Gemeentelijke Steekkaarten* statistics about entrepreneurship are provided on the level of municipalities, districts and the province of West Flanders.

10.4 Sustainable use

10.4.1 Sustainable living at the coast

In the coastal zone, few ingredients for a balanced, sociologically healthy social environment are present. The continued ageing, the many singles, the numerous relocations and the strong pressure caused by tourists and second homes cause an unbalanced social and demographic situation. This disrupted social climate appears mostly in the neighbourhoods close to the coast (*Meire & Bracke, 2005* [70929], Coudenys 2012 in *Maelfait et al. 2012* [221016]).

Population ageing results in an unbalanced demographic mix, which causes a different model of society. On the coast, there are proportionally much more elderly people compared to the rest of West Flanders. This feature is amplified by the second home owners, who are nearly always older than 45 years and do not have children under 18 living at home. 75% of second home owners are at least 55 years old and live together with their partner. More than half of them are retired. Hence, the ageing process is amplified by the nearly 124,500 second home owners aged 50+, who reside on average 82 nights a year in their second home (WES 2008, second homes at the coast, *part 1* [214669] and *part 2* [214672]).

The latter situation can be seen as a threat, but also as an opportunity. The population forecast for Flanders reveals that the coastal situation is offering a predictive image of the situation in Flanders within the next 30 years. This situation might therefore serve as a test case for policy initiatives, to see what the societal model in Flanders will look like in a couple of years, and which measures can or should be taken.

A personal social network is important and gains importance with age. Hence, social isolation is a realistic problem for the many singles and retired migrants who left their social environment. It is therefore essential to repair and strengthen their social network as much as possible. A study about the liveability on the coast (*Meire & Bracke, 2005* [70929]) revealed that the mutual involvement of inhabitants is indeed weak along the coast, especially in neighbourhoods close to the sea.

A good physical environment and good living conditions are also essential to a sustainable living environment and the wellbeing of the inhabitants. The urban profile and the high deprivation rate indicate the many challenges of the coastal area (*Maelfait et al. 2012* [221016]).

Legislation reference list

Table with Belgian and Flemish legislation. The consolidated version of this legislation is available on *Belgisch staatsblad* and the *Justel-databases*.

BELGIAN AND FLEMISH LEGISLATION	
Date	Title
Decrees	
Decreet van 18 mei 1999	Decreet houdende de organisatie van ruimtelijke ordening

11

Tourism and recreation

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Citation:

Monballyu, M., Van Den Driessche, E., Pirlet, H., 2013. Tourism and recreation. In: Lescrauwaet, A.K., Pirlet, H., Verleye, T., Mees, J., Herman, R. (Eds.), Compendium for Coast and Sea 2013: integrating knowledge on the socio-economic, environmental and institutional aspects of the Coast and Sea in Flanders and Belgium. Oostende, Belgium, p. 209-218.

Many coastal regions in the Northeast Atlantic region are popular holiday destinations. Since the 1990s, the number of tourists in this region has gradually increased to 100 million in 1998 and 146 million in 2007 (*OSPAR QSR 2010* [198817]). In 2011, the Belgian coast accounted for 5,715,223 arrivals and 32,554,895 overnight stays (*trendrapport Kust 2006-2011* [225376]). 60.7% of the arrivals (excl. second home tourism) and 80.8% (excl. second home tourism) of the overnight stays in the province of West Flanders (2010) can be attributed to the coastal zone (*toerisme kerncijfers Provincie West-Vlaanderen 2011* [225382]). At peak moments the number of people on the coast increases strongly with 210,000 day trippers and 300,000 staying tourists on top of the 215,000 inhabitants. At these moments, population densities of 2,830 persons per km² are reached in the 4 km wide coastal strip, which is comparable to the densities of important Flemish urban areas such as Antwerp (*strategisch beleidsplan voor toerisme aan de kust 2009-2014* [216835]). In the hinterland, the tourist and recreational regions of the Bruges woodland and the Westhoek area accounted for about 470,000 arrivals and more than 1.1 million overnight stays (*trendrapport Brugse Ommeland 2006-2011* [225375], *trendrapport Westhoek 2006-2011* [225377]). It should be mentioned that the borders of these regions extend further than the hinterland communities (the strategic policy plans for tourism and recreation: *Bruges woodland (2004-2008)* [225371] and *Westhoek (2008-2013)* [225373]).

11.1 Policy context

Considering that the coast constitutes a 'macro product' within Flemish tourism but is completely located in the province of West Flanders, it has been decided to draft a policy plan jointly by 'Tourism Flanders-Brussels' (*Toerisme Vlaanderen*), under the supervision of the Flemish minister of Tourism (Flemish level, *beleidsnota toerisme 2009-2014*) [214675], and '*Westtoer*' (provincial level). The policy of the Westhoek and the Bruges Woodland regions were defined on a provincial level by *Westtoer* in the strategic policy plans for tourism and recreation of the Bruges Woodland (*het Brugse Ommeland (2004-2008)* [225371]) and the Westhoek area (*de Westhoek (2008-2013)* [225373]).

To support this policy, the Flemish government and the minister of tourism provided funding in the context of the 'Coastal Impulse Programme' (*Impulsprogramma Kust (since 2010)*, before Coastal Action Plan I (*Kustactieplan*) (1997-2002), II (2000-2004) and III (20005-2009)) (more information: *nota aan Vlaamse regering* [225496]), to invest in certain coastal-related projects. A permanent measurement and monitoring system has furthermore been developed (KiTS, Coastal-Indicators-Tourist-Statistical) that publishes numbers with respect to the tourist activities along the coast three times a year. These statistics are annually bundled in a trend report (*trendrapport Kust 2006-2011* [225376]). More information on the sectoral legislation with regard to tourism can be found on the website of Tourism Flanders-Brussels (*Toerisme Vlaanderen*) and in the coastal codex, theme *tourism and recreation*.

The policy concerning outdoor recreation is described in the strategic policy plan for outdoor recreation for the province of West Flanders 2009-2018 (*het Strategisch beleidsplan openluchtrecreatie voor de Provincie West-Vlaanderen 2009-2018* [225372]). The legislative framework of the recreation and sport activities along the coast has been extensively elaborated in the coastal codex, themes *tourism and recreation*, *coastal zone management* and *local legislation* and is also discussed by *Derous (2005)* [78300] and *De Wachter & Volckaert (2005)* [78302] (*GAUFRE project BELSPO*). With respect to water recreation along the coast, the *Royal Decree of 4 August 1981* is of interest concerning the Police and Shipping regulation in the Belgian territorial sea, harbours and beaches (more information: *website FPS Mobility listing shipping rules*). Furthermore, the *law of 20 January 1999* and the associated Royal Decrees stipulate a number of restrictions for recreation in marine protected areas. The regulation on boating and water recreation on the fairways is discussed by the DG Maritime Transport (*DG Maritiem Vervoer*, FPS Mobility and Transport) and in the following documents: *Vademecum van de pleziervaart in België (2011)* [225380], *De pleziervaart op de bevaarbare waterwegen in Vlaanderen (2011)* [225380] and *Wijzer op het water (2010)* [198458].

The *European Directive concerning the management of bathing water quality* (*2006/7/EC*) stipulates the standards the bathing water quality has to meet (more information: *De nieuwe zwemwaterrichtlijn, VMM 2006* [127108]).

11.2 Spatial use

The areas for tourism and recreation are primarily steered by spatial planning (see also theme **Social and economic environment**). Instruments such as the spatial structure plans, spatial implementation plans (RUP) and regulations, on a Flemish, provincial and municipal level, indicate the possibilities for the future tourist-recreational developments of a specific area.

In the Flemish spatial structure plan (*RSV*), the coast is identified as an urban network which is a structure on a Flemish level. Because of its tourist-recreational facilities, the coast is also recognised as a tourist-recreational network which requires a policy on a Flemish level (this policy has not been developed yet). Furthermore, the designation of Ostend and Bruges as regional urban areas (regionaal stedelijke gebieden) and Blankenberge and Knokke-Heist as local urban areas (*kleinstedelijke gebieden*) in the RSV is important for the tourism sector as this designation has consequences for the potential 'highly dynamic functions' that may be developed in the coastal region. Tourism Flanders-Brussels drafted a study on the Spatial use of Tourism and Recreation in Flanders (*Ruimte voor Toerisme en Recreatie in Vlaanderen (WES, 2007)* [119295]) in order to provide input for a large reconsideration of the *RSV* of 2011. In addition to the RSV, the regional spatial implementation plans (GRUPs) can be consulted at: *www.ruimtelijkeordening.be*.

The Flemish government is the owner of almost all beaches along the coast. The Coastal Division grants concessions for the development, maintenance and exploitation of the marinas for water recreation and sports along the Flemish Coast (*website afdeling Kust*). The Coastal Division also distributes the concessions for the beach and seawall in consultation with the municipalities, other public councils, contractors, etc. (*website afdeling Kust*).

Important regional policies for the coast have been formulated in the spatial structure plan of the province of West Flanders (*PRS-WV*) (currently under reconsideration). In the PRS-WV, several coastal municipalities have been selected as 'main coastal villages' (*kusthoofddorpen*) with opportunities for development under specific conditions. Furthermore, an action plan for the 'Koninklijke Baan (N34)' road has been discussed in the provincial spatial structure plan (more information: *Waarheen met de Koninklijke Baan? 2008* [214818]). The *PRS-WV* also demarcates outdoor recreational green domains, amusement parks and tourist-recreational linear elements (watercourses, railway track, seawall and road infrastructure). Furthermore, three strategic project areas have been selected with important touristic and recreational aspects (*PRS-WV*, *strategisch beleidsplan voor toerisme aan de kust 2009-2014* [216835]): the mouth of the river Yser at Nieuwpoort (*geïntegreerde gebiedsgerichte projecten, meer dan een experiment 2007* [225366]), the area east of Blankenberge (*Plan-MER voor publieke consultatie 2011* [225497]) and the area south of the station of Knokke (*Toelichtingsnota afbakening van het structuurondersteunend kleinstedelijk gebied Knokke-Heist 2010* [225500]). In addition, the *provincial spatial implementation plans* (in particular the provincial RUPs for beach and seawall) are of significant importance for the planning of the tourist-recreational functioning of the coastal zone.

At the municipal level, processes are under development, that create new possibilities for tourism and recreation within the municipal structure plans. These possibilities are elaborated in detail in spatial implementation plans.

11.3 Societal interest

11.3.1 Coastal tourism

The tourist-recreational sector is of crucial importance for the coastal economy. In 2011, the coast accounted for 5,715,223 arrivals and a total of 32,554,895 overnight stays (incl. marinas) (table 1 and figure 1). Commercial accommodation constitutes 45.8% of these stays, second home tourism 53.8% and mooring in the marinas 0.5%. In addition, 19,131,095 day trippers arrived on the coast in 2011 (*trendrapport Kust 2006-2011* [225376], more information, *Vakantieganger in commercieel logies aan de Kust in 2011* [225378], *Callens 2010* [214676]).

Table 1. Arrivals and overnight stays (excl. marinas) on the coast in 2011(*trendrapport Kust 2006-2011* [225376]).

	ARRIVALS (2011)		OVERNIGHT STAYS (2011)	
Commercial accommodation (holiday houses, hotels, camping grounds, holiday centers and holiday parks)	2,768,244	48.4%	14,906,445	46.0%
Second home tourism (holiday houses)	2,334,913	40.9%	13,929,317	43.0%
Second home tourism (on camping grounds)	612,066	10.7%	3,568,943	11.0%
Total	5,715,223		32,404,705	

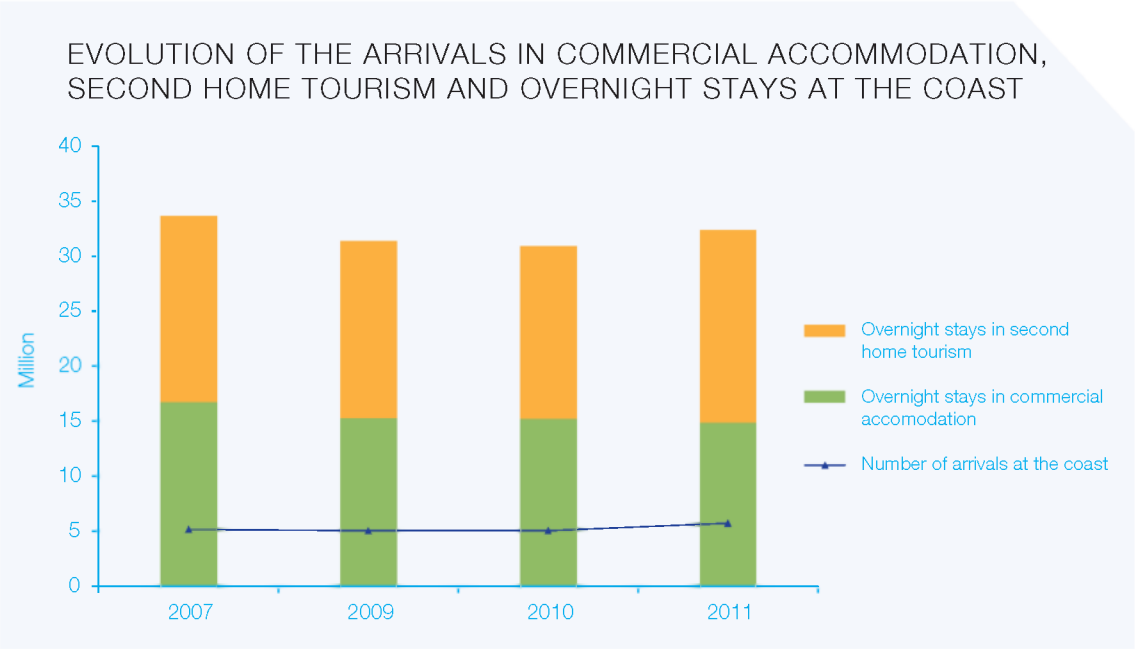

Figure 1. Evolution of the arrivals in commercial accommodation, second home tourism and overnight stays at the coast (*trendrapport Kust 2006-2011* [225376]).

The registered direct turnover of the hotel and catering industry and retail outlets on the coast amounted to 651 million euros and 1.3 billion euros respectively (2010) (Source: FPS Finance (VAT-database) in *trendrapport Kust 2006-2011* [225376]). The direct spending generated by residential tourism on the one hand (commercial accommodation, second home tourism and mooring in marinas) and day trippers on the other hand amounted to more than 2.8 billion euros (table 2 and figure 2). In this context, residential tourism represents 2.2 billion euros in direct spending whereas the day trippers account for 659.9 million euros (*trendrapport Kust 2006-2011* [225376], more information: *Vakantieganger in commercieel logies aan de Kust in 2011* [225378], *Callens 2010* [214676]). The direct turnover of the construction sector as a result of the construction of second homes amounted to 367 million euros in 2007 (*IDEA consult 2009* [135446]).

Table 2. The direct spending of coastal tourism per type of tourism in 2011 (*trendrapport Kust 2006-2011* [225376]).

TYPE OF TOURISM	DIRECT SPENDING OF TOURISTS IN MILLION EUROS	PERCENTAGE OF DIRECT SPENDING
Commercial accommodation	914.6	32.2
Second home tourism	1,248.5	43.9
Mooring in marinas	12.5	0.4
Day trippers	668.8	23.5
Total	**2,844.4**	**100**

The activities of the Belgians during day trips (*inter alia* to the coast) were examined in detail in the following study: *pilootonderzoek naar daguitstappen van de Belg (2010-2011)* [225493]. This report shows that the majority of day trips to the coastal region are focused on visiting the sea, beach and dunes (76.6%), followed by amusement parks (7.8%), sightseeing (2%) and other activities such as hiking, gastronomy, shopping, events, museums, etc. According to the trend report (*trendrapport Kust 2006-2011* [225376]) 25 water sport clubs and 12 yacht clubs (3,356 moorages) were active in 2011 along the coast. The spending at the yacht clubs increased to 12.5 million euros and the renting of sports equipment amounted to 12.8 million euros. The economic benefits of these recreation and sport activities on the coast (without indirect effects) are also discussed in *De Wachter & Volckaert (2005)* [78302] (*GAUFRE project BELSPO*). In the *SEACo project* the economic importance of yacht clubs will be further investigated.

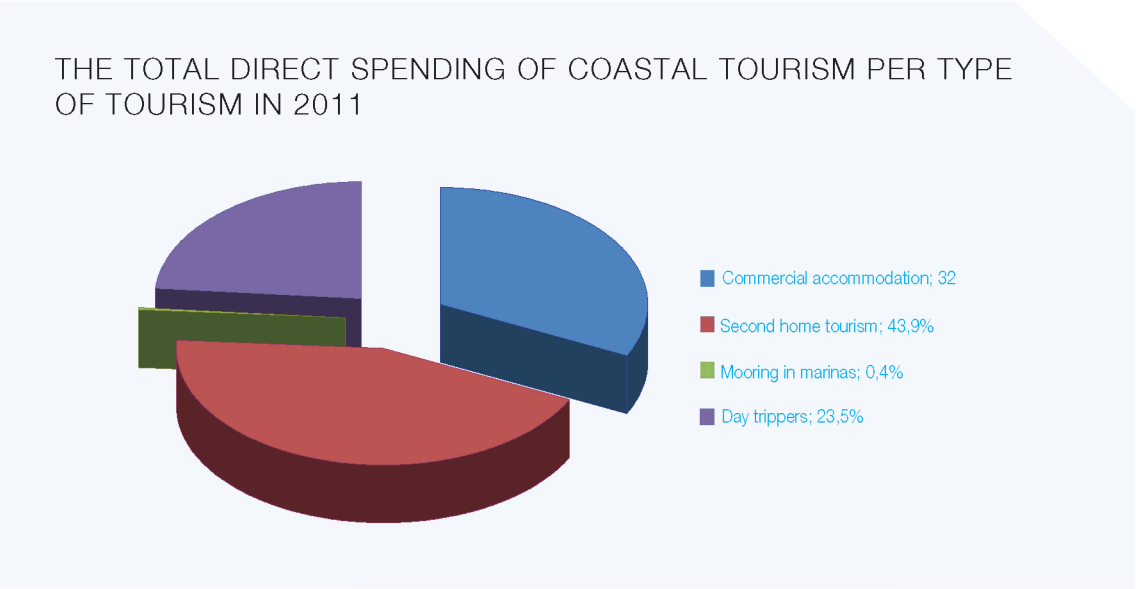

Figure 2. The total direct spending of coastal tourism per type of tourism in 2011 (*trendrapport Kust 2006-2011* [225376]).

According to statistics of the research department of the Flemish government (based on data from the National Social Security Office (NSSO) and the National Institute for the Social Security of the Self-employed (NISSE)), the total employment of employees in the tourism industry on the coast in 2010 amounted to 11,253 jobs. The employment of the self-employed and helpers on the coast was 2,286 jobs (*Weekers 2013* [225498]). According to another study, the direct and indirect employment in 2011 related to tourism on the coast was estimated at more than 42,000 fulltime equivalents (assuming a turnover of 1 million = 10 direct fulltime equivalents and 5 indirect fulltime equivalents) (*toerisme kerncijfers Provincie West-Vlaanderen 2011* [225382]). Employment in the construction sector related to second home tourism was estimated at 1,814 jobs in 2007 (*IDEA consult 2009* [135446]).

11.3.2 Hinterland tourism

In addition to coastal tourism, tourism in the Westhoek area, the Bruges Woodland and Bruges is of significant importance. The Bruges Woodland accounted for 137,330 visitors and 333,149 overnight stays in 2011 (*trendrapport Brugse Ommeland 2006-2011* [225371]). The arrivals and overnight stays in the Westhoek area amounted to 331,998 and 808,303 respectively (*trendrapport Westhoek 2006-2011* [225373]). Bruges (excl. Zeebrugge) accounted for 1,142,546 arrivals and 2,038,960 overnight stays in 2011. These are arrivals and overnight stays in commercial accommodation (hotels, youth hostels, social tourism establishment, camp sites, guest rooms and rented holiday homes) (Source: *Trendrapport KiTS Brugge (excl. Zeebrugge) 2006-2011*). In these trend reports, spending and employment are discussed as well.

11.4 Impact

As mentioned above, coastal tourism has a significant economic and social value. However, tourism in the coastal area has a number of effects on the social and ecological environment. On the social level, the amount of second homes has an impact on the quality of life along the coast: higher real estate prices, weakened social environment, mobility problems, etc. (Coudenys 2012 and Keunen & Hoornaert 2012 in *Maelfait et al. 2012* [221016], *Meire & Bracke 2005* [114397], *Goffin et al. 2007*, [114225] (see also theme **Social and economic environment**)).On the other hand, the high concentration of tourists provides several utilities such as the coastal tram.

The large amount of second homes also affects the cultural heritage of the coast (*IDEA consult 2009* [135446]) (see theme **Maritime and coastal heritage**), though clear synergies between tourism and the coastal heritage are present, such as the tourism function of cultural-historical buildings along the coast (*De Baerdemaeker et al. 2011* [214595]).

On an ecological level, the development of coastal tourism with the massive construction of tourist-recreational accommodation (holiday houses, camping grounds, holiday parks, second homes, etc.) has played an important role in the fragmentation of valuable open space and in the disappearance of habitats (*PRS-WV*, *Goffin et al. 2007* [114225], Boone 2012 in *Maelfait et al. 2012* [221016]). Especially the dune area underwent a strong fragmentation, *inter alia* caused by spatial planning (*Welkom in de duinen 2008* [226560]) (see theme **Nature and environment**). Furthermore, the high concentration of tourists and residents in the coastal zone during the high season has some direct and indirect ecological effects (table 3). Also, recreation and sport activities on the beach and in the dunes have direct and indirect ecological effects (table 4).

Table 3. An overview of the ecological effects caused by the high concentration of tourists and residents in the coastal area.

IMPACT	LITERATURE
Increased consumption of energy and water	*Vanlerberghe & Vanhoutte 2001* [24538], *Goffin et al. 2007* [114225] (see also theme **Agriculture**, salinisation)
Problems with waste processing	*Goffin et al. 2007* [114225], De Groof in *Maelfait et al. 2012* [221016], *kustactieplan OVAM* [214846]
Contribution of coastal tourism to the eutrophication of the coastal waters	*Maes et al. 2004* [70936] (*MARE-DASM project BELSPO*) (see theme **Agriculture**)
Pollution caused by traffic	*Goffin et al. 2007* [114225]

Table 4. An overview of the ecological effects caused by recreation and sport activities on the beach and in the dunes.

IMPACT	LITERATURE
Trampling and disruption of the beach and dune ecosystem	*Vincx et al. 2001* [20166], *Maes et al. 2004* [70936] (*MARE-DASM project BELSPO*), *Goffin et al. 2007* [114225], *Derous 2005* [78300] (*GAUFRE project BELSPO*), *Welkom in de duinen 2008* [226560] (see theme **Nature and environment**)
Litter on the beach	*Lescrauwaet et al. 2006* [105200], *Goffin et al. 2007* [114225], *Maelfait 2008* [143294], *Doomen et al. 2009* [214555], *André et al. 2010* [200613] (see theme **Nature and environment**)
Mechanical cleaning of the beaches and its associated ecological effects	*Belpaeme 2003* [38412], *Goffin et al. 2007* [114225], *Doomen et al. 2009* [214555] (see theme **Nature and environment**)
Pollution by recreational boating	*Maes et al. 2004* [70936] (*MARE-DASM project BELSPO*), *De Wachter & Volckaert 2005* [78302] (*GAUFRE project BELSPO*), *Lescrauwaet et al. 2006* [105200], *Goffin et al. 2007* [114225]
Sport fisheries	see theme **Fisheries**

11.5 Sustainable use

11.5.1 A sustainable development of coastal tourism

The sustainable co-existence of the various users and sectors of the coastal areas (*inter alia* tourism and recreation) is discussed in the *European recommendation on integrated coastal zone management (ICZM) in Europe* (*2002/413/EC*; see theme **Integrated coastal zone management**). In Belgium, the *Coordination Centre for Integrated Coastal Zone Management* is the contact point for ICZM. One of their main objectives is the support of sustainable tourism and recreation. In *Maelfait et al. (2012)* [221016], published by the Coordination Centre for ICZM, measures are proposed that promote the sustainable development of tourism and recreation on the coast. In the theme about **Integrated coastal zone management**, some studies and initiatives which develop visions for the coastal zone are discussed.

In the strategic policy plan for tourism at the coast (*het strategisch beleidsplan voor toerisme aan de kust (2009-2014)* [216835]), *Tourism Flanders-Brussels* and *Westtoer* formulated 6 strategic objectives in order to fulfill the needs of tourists in a sustainable manner but also to ensure the socio-economic position of coastal tourism:

- The improvement of the quality of the coastal product and service;
- Expansion of the experience value of the coastal product with respect for sustainability;
- The maintenance of the balance between the different types of coastal tourism: residential tourism in commercial accommodation, second home tourism and daytrip tourism;
- The adjustment of the market approach by a more efficient use of the resources;
- The development of a stronger image for the coast as a holiday destination during the whole year and aiming for cooperation with the private sector with regard to specific offers;
- Structural investment in the future of coastal tourism.

The Coastal Impulse Programme (*Impulsprogramma Kust*) (before *het Kustactieplan*) responds to the mentioned strategic objectives by means of 3 types of measures: investments, sector support (education, quality and innovation) and image-enhancing events and marketing (*nota aan Vlaamse regering* [225496]). In this context, the further development of coastal tourism is largely affected by spatial planning (see **Spatial use**).

Several labels (such as *Blauwe vlag of Bond Beter Leefmilieu*, the *Q-label* for touristic entrepreneurs, *Groene Sleutel*, *het toegankelijkheidslabel*, etc. more information: *website Toerisme Vlaanderen*) and studies (e.g. *Kindvriendelijkheid aan de Vlaamse kust 2008* [214848], the project '120 km coastal quality' with studies such as *van Meenen 2009* [214831] and *Pijpers 2009* [214832], etc.) contribute to sustainable (coastal) tourism. In the theme about **Integrated coastal zone management**, several visions with regard to the development of the coastal region (incl. coastal tourism) are discussed.

11.5.2 Accessibility of and mobility along the coast

In *Maelfait et al. (2012)* [221016] measures are discussed that improve the accessibility of the coast (more information: *Goffin et al. 2007* [114225]). Integral accessibility of the tourist infrastructure for people with disabilities and elderly people is argued for (more information: *kansen aan de kust 2009* [214834] in the context of the project '120 km coastal quality'). The problem of accessibility and equal opportunities in West Flanders is the main task of the non-profit organisation *Westkans* (*Vervaeke et al. 2011* [225364]). Commissioned by Tourism Flanders-Brussels, *Westkans* screens the tourist infrastructures with regard to their accessibility and awards an *accessibility label* (Mampaey 2012 in *Maelfait et al. 2012* [221016]).

The mobility problems along the coast are managed on the Flemish level in the Mobility plan of Flanders (final report of public inquiry: *Glorieux et al. 2011* [214822]), as well as in the Flemish spatial structure plan *(RSV)* in the development perspectives of the road infrastructure (e.g. the circulation of touristic traffic to and from the east coast), of the infrastructure of suburban traffic and of public transport in the periphery (e.g. coastal trams, more information: *Mobiliteitsvisie 2020* [214560] of De Lijn) and of the waterways infrastructure (e.g. coastal shipping). On the provincial and municipal level, mobility problems are discussed as well in the provincial spatial structure plan of West Flanders (*PRS-WV*) (more information: *Waarheen met de Koninklijke Baan? 2008* [214818]) and in the municipal mobility plans. In Monballyu (2012) (*Maelfait et al. 2012*) [221016] the use of public transport by day trippers is elaborated in detail.

11.5.3 Tourism and nature

In *Goffin et al. (2007)* [114225], *Maelfait et al. (2012)* [221016] and *het strategisch beleidsplan voor toerisme aan de kust (2009-2014)* [216835] measures are formulated from an ecological perspective in order to achieve a balance between the maintenance of the natural system and the needs of recreationists and tourists. In this regard, policy instruments such as the *Dune Decree* and spatial planning play an important role and are discussed in more detail in the theme **Nature and environment**. The compatibility of recreation and nature is also discussed in publications such as *Belpaeme (2003)* [38412], *Zwaenepoel et al. (2005)* [108609], *Uitkerkse polder, een recreatieve meerwaarde voor de Vlaamse kust (2007)* [214849], *Welkom in de duinen (2008)* [226560] and *Doomen et al. (2009)* [214555].

The (bathing) water quality of the coastal zone is managed on the European level by the *Directive 91/271/EC* concerning urban waste-water treatment, the *Water Framework Directive* (WFD) (*2000/60/EC*) and the *Directive 2006/7/EC* concerning the bathing water quality.

On the federal level, these European measures are implemented in the *Royal Decree of 23 June 2010 concerning the status of surface waters*. On the Flemish level, the following decrees are important: the *Decree of 18 July 2003*

(integrated water policy) (more information: *website Coordination Committee on Integrated Water Policy (CIW)*) and the *Decree of 8 December 1998 concerning the bathing water quality*.

The quality of the bathing water off the coast is frequently sampled by the Flemish Environment Agency (*VMM* and the *website kwaliteit zwemwater*) (*Goffin et al. 2007* [114225], Pelicaen 2012 in *Maelfait et al. 2012* [221016]). The *Flemish Agency for Care and Health* ensures the health aspect of the bathing water quality. The eutrophication of the coastal waters and the problem of salinisation are discussed in more detail in the theme **Agriculture**.

Legislation reference list

Table with European legislation. The consolidated version of this legislation is available on *Eurlex*.

EUROPEAN LEGISLATION			
Abbreviations (if available)	Title	Year	Number
Directives			
	Council Directive concerning urban waste-water treatment	1991	271
Water Framework Directive	Directive establishing a framework for Community action in the field of water policy	2000	60
Bathing water Directive	Directive concerning the management of bathing water quality and repealing Directive 76/160/EEC	2006	7
Other (Decisions, Communications, White Papers, etc.)			
	Recommendation concerning the implementation of Integrated Coastal Zone Management in Europe	2002	413

Table with Belgian and Flemish legislation. The consolidated version of this legislation is available on *Belgisch staatsblad* and the *Justel-databases*.

BELGIAN AND FLEMISH LEGISLATION	
Date	Title
Laws	
Wet van 20 januari 1999	Wet ter bescherming van het mariene milieu en ter organisatie van de mariene ruimtelijke planning in de zeegebieden onder de rechtsbevoegdheid van België
Royal Decrees	
KB van 4 augustus 1981	Koninklijk besluit houdende politie- en scheepvaartreglement voor de Belgische territoriale zee, de havens en de stranden van de Belgische kust
KB van 23 juni 2010	Koninklijk besluit betreffende de vaststelling van een kader voor het bereiken van een goede oppervlaktewatertoestand
Decrees	
Decreet van 18 juli 2003	Decreet betreffende het integraal waterbeleid
Other	
Besluit van de Vlaamse Regering van 8 december 1998	Besluit van de Vlaamse Regering tot aanduiding van de oppervlaktewateren bestemd voor de productie van drinkwater categorieën A1, A2 en A3, zwemwater, viswater en schelpdierwater, ter omzetting van Richtlijn 2006/7/EG van het Europees Parlement en de Raad van 15 februari 2006 betreffende het beheer van de zwemwaterkwaliteit en tot intrekking van Richtlijn 76/160/EEG

12 Safety against flooding

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Citation:

Verwaest, T., DeWolf, P., Mertens, T., Mostaert, F., Pirlet, H., 2013. Safety against flooding. In: Lescrauwaet, A.K., Pirlet, H., Verleye, T., Mees, J., Herman, R. (Eds.), Compendium for Coast and Sea 2013: integrating knowledge on the socio-economic, environmental and institutional aspects of the Coast and Sea in Flanders and Belgium. Oostende, Belgium, p. 219-230.

Climate change has led to a warmer climate and to an associated sea level rise caused by the melting of the ice caps and the thermal expansion of the ocean water. Between 1961 and 2003, the global sea level rose by an average of 1.8 mm per year. In the period between 1993 and 2003, this increase reached a value of 3.1 mm per year (*Climate change 2007: synthesis report 2008* [226555]), whereas the global average amounts to 3.4 mm per year (*http://www.milieurapport.be/en/home/*). In the case of Belgium, the average sea level in Ostend rose by 1.69 mm per year (1927-2006), while the average sea level rise after 1992 amounted to 4.41 mm per year (figure 1) (*Van den Eynde et al. 2009* [206438], *Van den Eynde et al. 2011* [212421], *CLIMAR project BELSPO*, *Van den Eynde 2011* [206376], more recent figures in *Van Steertegem 2012* [138542]). Moreover, the increase is more pronounced during flood tides compared to ebb tides, which enhances the tidal amplitude. Climate change and the associated sea level rise also result in the erosion of coastal areas and a higher frequency of storm surges (*EEA Technical Report 2010a* [205600], *The European environment: state and outlook 2010. Adapting to climate change 2010* [226556]), although no increase in the storm frequency in the Belgian Part of the North Sea (BNS) has been observed so far (*Van den Eynde et al. 2011* [212421], *CLIMAR project BELSPO*). These factors imply an enhanced flood risk in low-lying coastal areas. The Netherlands and Belgium belong to the most vulnerable countries of the European Union, given that the elevation of more than 85% of the Belgian and Dutch coastal area is lower than the level of a yearly storm (+5 m TAW) (*EEA Report 2006* [100281], *Eurosion*): in Flanders, 15% of the area is situated below 5 meters above the average sea level. Moreover, the Belgian coast has the most built-up area of all European coasts: in 2000, more than 30% of the coastal strip of 10 km wide was built-up area. This figure amounted to 50% of the coastal area when considering the first kilometre inland of the coastline (*http://www.milieurapport.be/en/home/*). Besides housing, intense economic activities take place in the coastal areas of the Netherlands and Belgium, *inter alia* due to the presence of harbours. Hence, the loss of life and material damage in case of a flood may be quite high (*The European environment: state and outlook 2010. Adapting to climate change 2010* [226556], *Kellens, 2011* [207941]). Moreover, more than a third of the Flemish coastline is subject to erosion and needs to be protected against the impact of super storms. Besides the natural coastal protection (beaches and dunes), additional protection is needed. In Flanders, the *Masterplan Coastal Safety* [206919] defines the measures required for a sufficient protection of the coastline and the adjacent low-lying polders against super storms. The *Masterplan Coastal Safety* [206919] also takes into account the expected sea level rise by 2050. Both 'soft' measures (beach nourishment, dune nourishment, etc.) and 'hard' coastal protection measures (seawall, flood barriers, etc.) are included in the masterplan. These measures extend as far as the locks and weirs of the rivers and canals in the hinterland. Flooding of low-lying polders due to heavy rainfall also occurs in the coastal area, but is not restricted to this zone. Nevertheless, it is important to take these kind of floods into account, especially given that by 2100, the chance of rainfall may be 10% higher in the coastal area compared to the hinterland (*Van Steertegem 2009* [142609]). However, this type of floods will not be discussed in the current text.

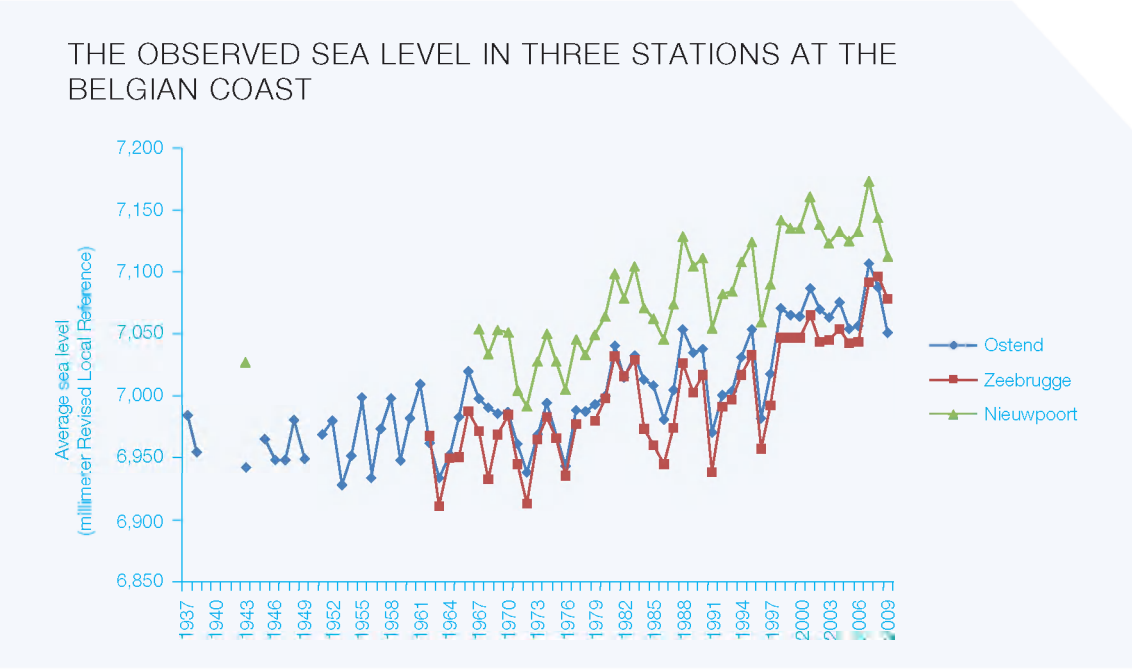

Figure 1. The observed sea level rise in three stations on the Belgian coast (1937 – 2009) (*kustbarometer*; *MD&K-Flemish Hydrography*, more information: *website milieurapport*).

12.1 Policy context

In 2007, the *Directorate-General Environment* of the European Commission issued the *Floods Directive* (*2007/60/EC*) to counter the harmful consequences of floods on humans, nature, heritage, economy, etc. and the potential increase in the number of floods in the context of climate change. The directive is valid in all European coastal and inland waters. Flanders implemented this directive in 2010, by modifying the *Decree of 18 July 2003 on Integrated Water Policy*. Comparable to other European countries, the water safety policy in Flanders does not only take into account the protection against floods, but also the control of flood risks (*Coordination Committee on Integrated Water Policy*) (see also **Sustainable use**). The Coordination Committee on Integrated Water Policy (*CIW*) effectuates an integrated approach by means of a platform to consult the different policy domains and administrative levels that are involved in the water policy, together with the water companies. *Waterwegen en Zeekanaal NV* (*W&Z*) is competent for the water management of the navigable waterways. The *Coastal Division* (part of the Agency for Maritime and Coastal Services – *MD&K* of the Flemish policy domain of Mobility and Public Works - *MOW*) is responsible for the protection of the Flemish coast against floods from the sea. Furthermore, the Flemish government approved a concept note on 1 February 2013 with the draft of the Flemish climate policy plan 2013-2020 (Mitigation plan and Adaptation plan) (*website deparement LNE*).

Every 6 years, the Flemish authorities submit the entire sea barrier to a safety test. In the context of this test, the basic safety in all coastal zones needs to be guaranteed, namely the protection against a super storm with a statistic return period of 1,000 year. On the other hand, the test examines from a cost/benefit perspective whether there is a significant residual risk in terms of damage and casualties. The current sea barrier offers protection against a 100 year flood. In order to sufficiently protect the coastal zone until 2050, the *Coastal Division* elaborated in collaboration with *Flanders Hydrologic Research*, a flood risk management plan for the coastal area, that was approved by the Flemish government on 10 June 2011: the *Masterplan Coastal Safety* [206919] (see also **Sustainable use**).

To realise all coastal protection measures, the environmental legislation needs to be respected by the elaboration of Environmental Impact Assessments (EIA's). Besides, building permits have to be requested for so-called 'hard measures'. This requires collaboration, in particular with the Agency for Nature and Forest (*ANB*) of the Flemish policy domain of Environment, Nature and Energy and with the policy domain Spatial Planning, Housing Policy and Immovable Heritage with regard to the building permits.

100% safety can never be guaranteed. Hence, emergency plans remain necessary. All coastal towns need to elaborate a municipal emergency plan against floods (so-called 'BNIP floods'). The provincial level is responsible for the coordination between the municipalities in case of super storms. Furthermore, the province of West Flanders is competent for the elaboration and coordination of a provincial BNIP floods. When cross-border problems occur in case of a super storm, the crisis centre of the FPS Home Affairs will take over the coordination, *inter alia* by the implementation of the National Emergency Plan 'Floods and High water'.

12.2 Spatial use

In the *Masterplan Coastal Safety* [206919] the demarcation of areas of particular interest along the Flemish coast is discussed, as well as the necessary protection measures for each of these areas. The status of the works in each of these zones can be found on the following website: *www.kustveiligheid.be*. A map with the hard and soft coastal protection measures is available in the *coastal atlas* (*Belpaeme et al. 2011* [207333]) and *Maes et al. (2005)* [78279] (*GAUFRE project BELSPO*) (figure 2).

The protection of the coast is also discussed in the draft of the Marine Spatial Plan (*Ontwerp van koninklijk besluit tot vaststelling van het marien ruimtelijk plan* [227527]), as proposed by the Minister competent for the North Sea. The draft plan formulates some spatial policy choices with regard to coastal safety. In the context of the implementation and support of the Masterplan Coastal Safety, sufficient sand and gravel extraction areas are demarcated with a view to the soft coastal protection (see also theme **Sand and gravel extraction**). In addition, new possibilities for coastal protection are being explored, with a location for experiments in the coastal waters in the proximity of the Broers Bank.

AN OVERVIEW OF THE CURRENT HARD AND SOFT COASTAL PROTECTION MEASURES ALONG THE COASTLINE

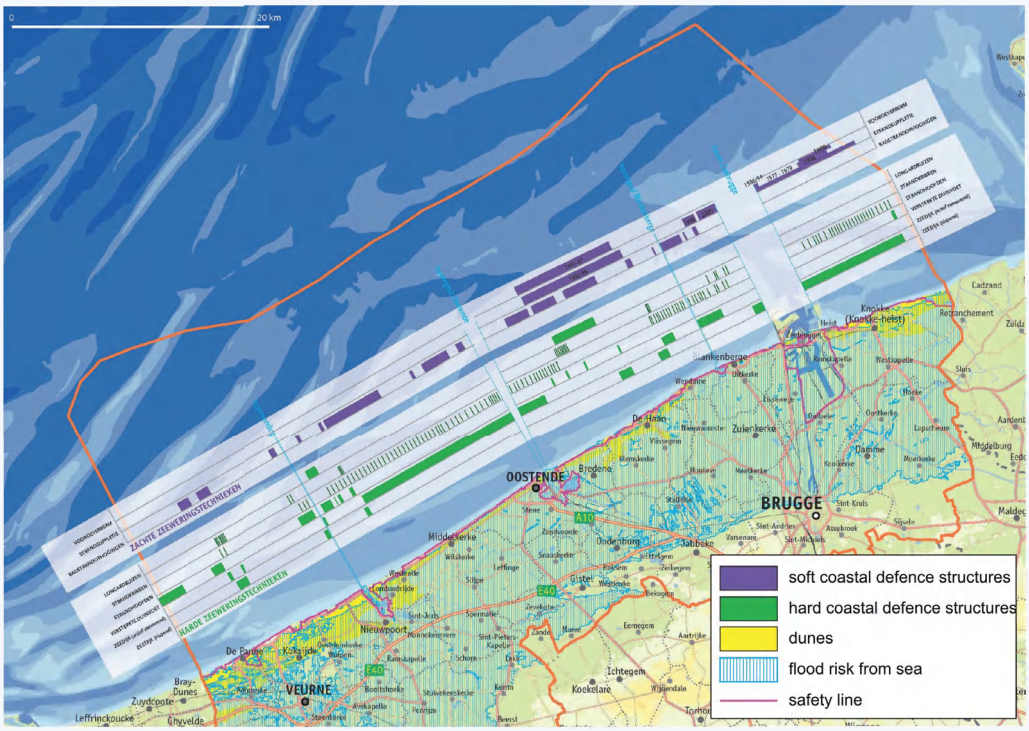

Figure 2. An overview of the current hard and soft coastal protection measures along the coastline (*Coastal Atlas*, *Belpaeme et al. 2011* [207333]).

12.3 Societal interest

12.3.1 Damage and casualties in case of floods

The study of the protective measures of the *Masterplan Coastal Safety* [206919] revealed that more than one third of the coastline was not sufficiently protected against a super storm with a return period between 100 years and 17,000 year. In addition to the safety tests of the sea barrier, flood risk calculations were executed. In these calculations, the number of casualties and economic damage was investigated for a range of super storms. Table 1 summarises the calculation results.

Table 1. An overview of the flood risks in the Belgian coastal area for different storm surge levels and return periods, with the associated deaths and the direct economic damage.

FLOOD RISKS IN THE BELGIAN COASTAL ZONE			
Storm surge level	Return period	Deaths	Direct economic damage
+ 6.5 m TAW	~100 year	41	0.67 billion euro
+ 7.0 m TAW	~1,000 year	251	2.1 billion euro
+ 7.5 m TAW	~4,000 year	885	3.9 billion euro
+ 8.0 m TAW	~17,000 year	3.297	6.5 billion euro

Moreover, the ongoing spatial developments in the coastal areas further increase the potential economic and human losses. Hence, this increases the damage a storm may cause with a certain probability of occurrence (*Plan-MER voor het Geïntegreerd Kustveiligheidsplan: kennisgeving 2009* [139531], *Kellens 2011* [207941]).

In the context of the *CLIMAR project (BELSPO)*, *Van der Biest et al. (2009)* [134413] selected three indicators quantifying the risks of climate change with regard to floods in the coastal zone: (1) the loss of beach and dune areas by erosion, (2) modelling of the economic damage and (3) the number of casualties in case of a storm surge level of + 8.00 m TAW in two long-term climate scenarios (2100). In the CLIMAR study (*CLIMAR project BELSPO*), the research focused on the coastal municipalities whereas the ports were not taken into account, despite their relative low-lying location. Hence the ports may constitute weak spots in the sea barrier. In the *Masterplan Coastal Safety* [206919], 2050 is set as the time horizon: the proposed measures thus offer protection for all coast towns and coastal ports, until at least 2050. For the storm surge barrier in Nieuwpoort, this is until 2100. Beach nourishment constitutes the most important measure of the *Masterplan Coastal Safety* [206919]. This measure allows a flexible reaction to the sea level rise, even after 2050. In the project *Flanders Bays* of the Flemish government, climate change and sea level rise are considered in the long term until 2100 (see also **Sustainable use**). The *Masterplan Coastal Safety* [206919] was approved by the Flemish government in June 2011 and subsequently the execution of the measures of the Masterplan started. Global long-term climate scenarios have been published by the Intergovernmental Panel on Climate Change (*IPCC*). These kinds of estimates allow a detailed understanding of the societal interest of coastal protection and safety against floods in general.

A map with the distribution of the flood in case of a 1,000-year storm under the conditions present in 2006 is shown in figure 3. The largest risk of damage is situated in the four ports. With regard to the coastal municipalities, special attention needs to be paid to the zones Ostend-centre, Ostend-Raversijde, Ostend-Mariakerke, Ostend-Wellington and De Haan-Wenduine. Also, the damage risk in Middelkerke is relatively high. Moreover, the expected number of casualties in these zones is not socially acceptable (*Masterplan Coastal safety* [206919]).

CALCULATION OF THE DISTRIBUTION OF THE FLOOD OF A 1,000-YEAR STORM, UNDER THE CONDITIONS PRESENT IN 2006

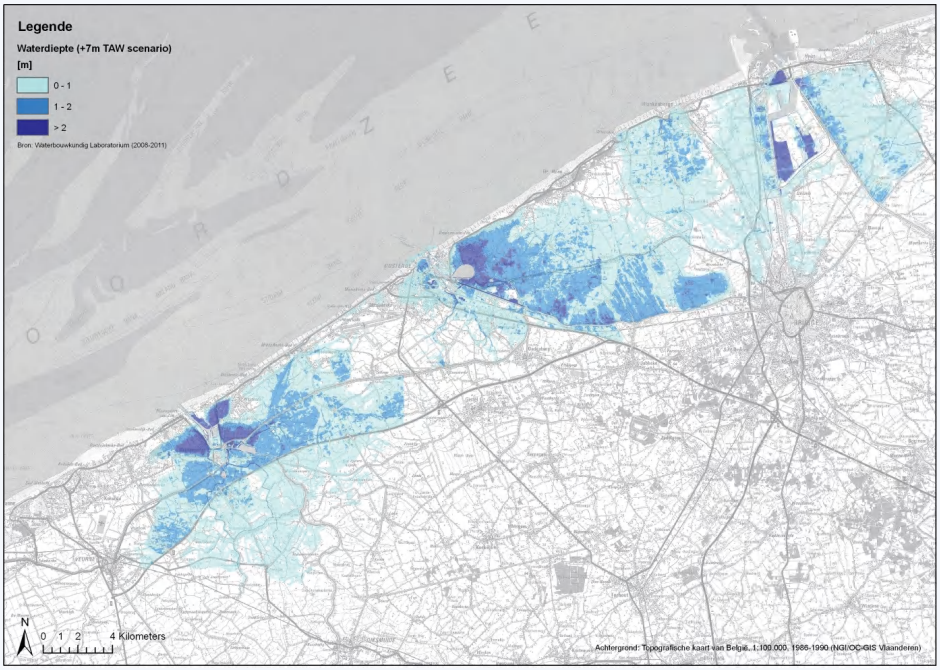

Figure 3. Calculation of the distribution of the flood of a 1,000-year storm, under the conditions present in 2006 (*Masterplan Coastal Safety* [206919]).

12.3.2 Investments in coastal safety

The total cost of investment of the *Masterplan Coastal Safety* [206919] is estimated to be more than 300 million euros. An important share of this estimate is included in the renovation and reinforcement of sea locks, weirs and other constructions in the ports. The estimated maintenance cost for the new beaches amounts to a yearly average of 8 million euros (*Masterplan Coastal Safety* [206919]). Prior to the *Masterplan Coastal Safety* [206919], the Belgian beaches were replenished with a yearly average of 550,000 m^3 of sand (both by means of pressure pipes and by trucks) (*Maelfait & Belpaeme 2007* [119667], *Vandewalle et al. 2008* [127263], *Masterplan Coastal safety* [206919]).

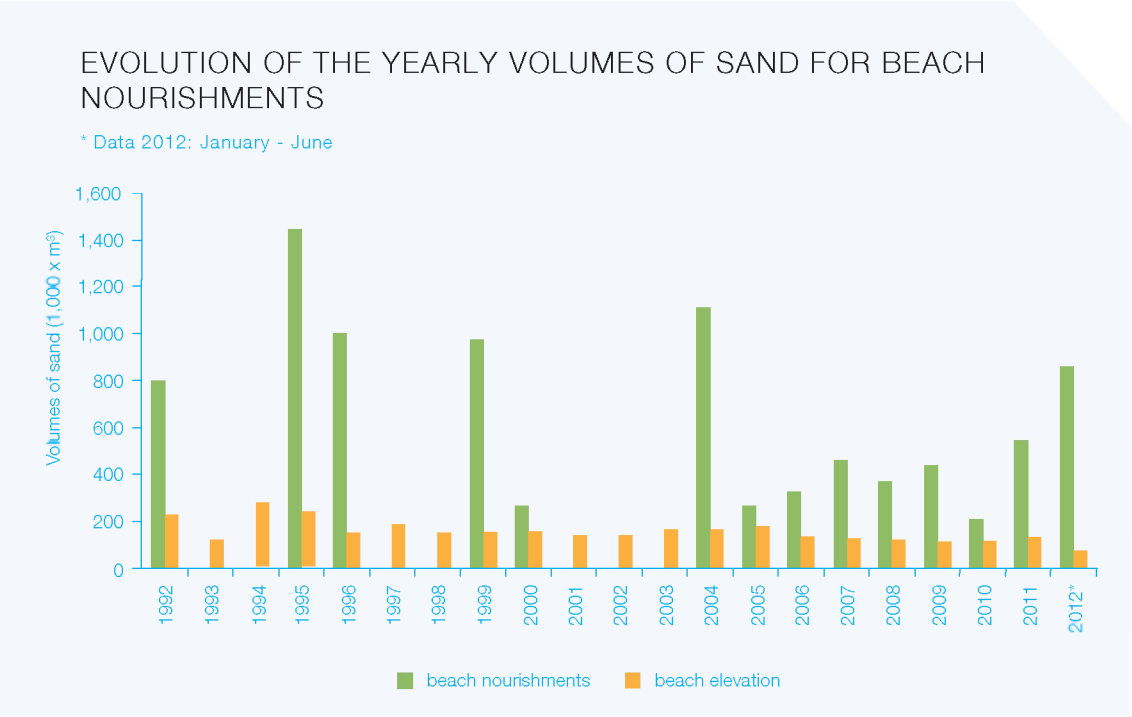

Figure 4. Evolution of the yearly volumes of sand for beach nourishments (*Van Quickelborne 2012* [221538]; MD&K, Coastal Division).

12.4 Impact

12.4.1 The impact of the sea barrier

The coastal protection works and infrastructure have an impact on some environmental aspects, depending on the technique used. The hard as well as the soft protection works are therefore governed by the European *EIA Directive* (*85/337/EEC*), implying that an EIA needs to be drafted prior to the granting of any environmental permit.

The different measures that were investigated in the context of the *Masterplan Coastal Safety* [206919], are:

For the coastal municipalities:
- Beach nourishment;
- Beach nourishment with a wave absorbing seawall;
- Beach nourishment with a water barrier on the seawall;
- Beach nourishment in combination with groynes;
- Beach nourishment in combination with breakwaters.

For the dunes:
- Beach nourishment;
- Dune nourishment.

For the ports:

- Water barriers around the port and/or seawall strengthening (depending on the location) in combination with the strengthening and/or regulation of the existing sea locks and weirs;
- Storm surge barriers at the entrance of the port.

In general, the EIA studies estimate the environmental impact that may appear during the construction, subsequent to the execution and during the maintenance works. Therefore, the effects need to be considered as potential effects. The impact of the extraction of the necessary raw materials (e.g. sand extraction at sea) has been included in separate EIAs.

Table 2 gives an overview of the potential effects which need to be considered during the assessment of coastal protection measures, as well as the associated literature which deals with these effects in detail. A more detailed description is given in the following publications: *Geïntegreerd Kustveiligheidsplan. Niet-technische samenvatting 2009* [226558], *Plan-MER – Plan voor kustverdediging en maritieme toegankelijkheid van Oostende (2007)* [214633].

Table 2. An overview of the potential effects that have to be taken into account when evaluating coastal protection measures, as well as the related literature.

DISCIPLINE	POTENTIAL EFFECTS	LITERATURE
Water	• Turbidity of the water column • Modification of the flow pattern and the currents of the sea water • Hydrological effects - changing groundwater levels in the dunes and adjacent areas • Changes in the groundwater quality (depending on the quality of the replenished sand)	*Plan-MER – Plan voor kustverdediging en maritieme toegankelijkheid van Oostende 2007* [214633], *Geïntegreerd Kustveiligheidsplan. Niet-technische samenvatting 2009* [226558], *Lebbe 2011* [206161]
Soil	• Impact on the present seabed, beach, dune and polder soils (degree of soil disturbance) and the effect on the morphology	*Plan-MER – Plan voor kustverdediging en maritieme toegankelijkheid van Oostende 2007* [214633], *Geïntegreerd Kustveiligheidsplan. Niet-technische samenvatting 2009* [226558]
Air	• Emissions into the air and their impact on human health	*Plan-MER – Plan voor kustverdediging en maritieme toegankelijkheid van Oostende 2007* [214633], *Geïntegreerd Kustveiligheidsplan. Niet-technische samenvatting 2009* [226558]
Noise and vibrations	• Noise impact on humans and animals and the effects on human health	*Plan-MER – Plan voor kustverdediging en maritieme toegankelijkheid van Oostende 2007* [214633], *Geïntegreerd Kustveiligheidsplan. Niet-technische samenvatting 2009* [226558]
Landscape, archaeology and architectural heritage	• Functional fragmentation of the spatial use • Visual-spatial effects of adding or changing landscape elements • Disappearance and disturbance of the historical geographical elements and structures • Effects on the architectural heritage and archaeology	*Plan-MER – Plan voor kustverdediging en maritieme toegankelijkheid van Oostende 2007* [214633], *Geïntegreerd Kustveiligheidsplan. Niet-technische samenvatting 2009* [226558]
Fauna and flora	• Effects on the habitat, vegetation, benthos and avifauna • Creation of habitats due to the expansion of dry beaches and dunes • Barrier function for benthos	*Engledow et al. 2001* [25266], *Speybroeck et al. 2004* [69028], *Volckaert et al. 2004* [69036], *Speybroeck et al. 2006a* [100573], *Speybroeck et al. 2006b*, *Speybroeck et al. 2007* [116938], *Plan-MER – Plan voor kustverdediging en maritieme toegankelijkheid van Oostende 2007* [214633], *Van Ginderdeuren et al. 2007* [120913], *Geïntegreerd Kustveiligheidsplan. Niet-technische samenvatting 2009* [226558], *Janssen & Rozemeijer 2009* [142372], *Braarup Cuykens et al. 2010* [197472], *Van den Eede & Vinckx 2011* [202895]

DISCIPLINE (continuation)	POTENTIAL EFFECTS	LITERATURE
Mobility	• Modifications in the accessibility	*Plan-MER – Plan voor kustverdediging en maritieme toegankelijkheid van Oostende 2007* [214633], *Geïntegreerd Kustveiligheidsplan. Niet-technische samenvatting 2009* [226558]
Spatial use (Human - Space)	• Modifications in the access possibilities • Modifications of the recreational area • Modification of functions • Nuisance	*Plan-MER – Plan voor kustverdediging en maritieme toegankelijkheid van Oostende 2007* [214633], *Geïntegreerd Kustveiligheidsplan. Niet-technische samenvatting 2009* [226558]
Human – health and safety aspects	• Possible health effects, due to the exposure to polluted air, noise emissions and vibrations • Changes in the safety of recreationists or inhabitants, due to changing sea currents, or due to the placement or removal of obstacles, or general modification of coastal safety	*Plan-MER – Plan voor kustverdediging en maritieme toegankelijkheid van Oostende 2007* [214633], *Geïntegreerd Kustveiligheidsplan. Niet-technische samenvatting 2009* [226558]

Besides a general EIA plan that maps the total environmental effects of the measures of the *Masterplan Coastal Safety* [206919], a project EIA may be elaborated when needed, in order to evaluate the local effects of the different projects. However, in most cases an exemption from the project EIA can be requested.

12.5 Sustainable use

12.5.1 Safety measures against floods

In the context of the *EU Floods Directive* (*2007/60/EC*), the Member States monitor the river basins and associated coastal areas that are vulnerable to floods. Flood risk maps for these regions have to be elaborated by 2013. Subsequently, the reporting follows a 6-year cycle. Before the end of 2015, the Member States also need to elaborate flood risk management plans at river basin level, focusing on the prevention of and protection against floods. These flood risk management plans are integrated into the river basin management plans that have to be drafted in the context of the *European Water Framework Directive* (*2000/60/EC*) (WFD; see theme **Nature and environment**) in one integrated plan (2015). The first generation of river basin management plans has already included a few measures (*CIW 2010* [132013]) concerning floods (*Vanneuville et al. 2011*). An additional challenge in the coastal area concerns the integration of flood risks from the inland waters (such as the Yser) on the one hand, and from the sea on the other hand. In Flanders, the *CIW* coordinates the procedures for the drafting of all required documents for the *WFD* and the *Floods Directive*. Furthermore, an instrument such as the *water test* also contributes to the preventive reduction of the damage caused by floods.

By means of the *Masterplan Coastal Safety* [206919], the Coastal Division wants to protect the coast from at least a 1,000-year storm surge, and wants to reduce the residual risk of serious economic damage and casualties, based on a cost/benefit approach. The Masterplan is aimed at an approach according to the principles of integrated coastal zone management (see theme **Integrated coastal zone management**). The plan has been gradually executed since 2011.

In order to protect the Flemish coast against at least a 1,000-year storm surge, and to reduce the risk of serious economic damage and casualties as much as possible, measures are necessary along certain parts of the coastline (*Plan-MER voor het Geïntegreerd Kustveiligheidsplan: kennisgeving 2009* [139531]). A separate safety test of the sea barrier along the first safety line (a solid line from the French to the Dutch border, that mostly coincides with the most seaward border of the habitation, or in unpopulated areas with the height of the surge of a 1,000-year storm) has revealed that one third of our coast, as well as the coastal ports, have a protection level which is not sufficient against a 1,000-year storm. The dikes, quays, locks and other protective constructions in the ports of Nieuwpoort, Blankenberge, Zeebrugge and Ostend cannot always resist the high water levels that are related to super storm floods (*website Masterplan Coastal Safety*, *Plan-MER voor het Geïntegreerd Kustveiligheidsplan: kennisgeving 2009* [139531]). Figure 5 provides an overview of all zones of particular attention.

ZONES OF PARTICULAR ATTENTION WITH REGARD TO COASTAL SAFETY ALONG THE EAST AND WEST COAST

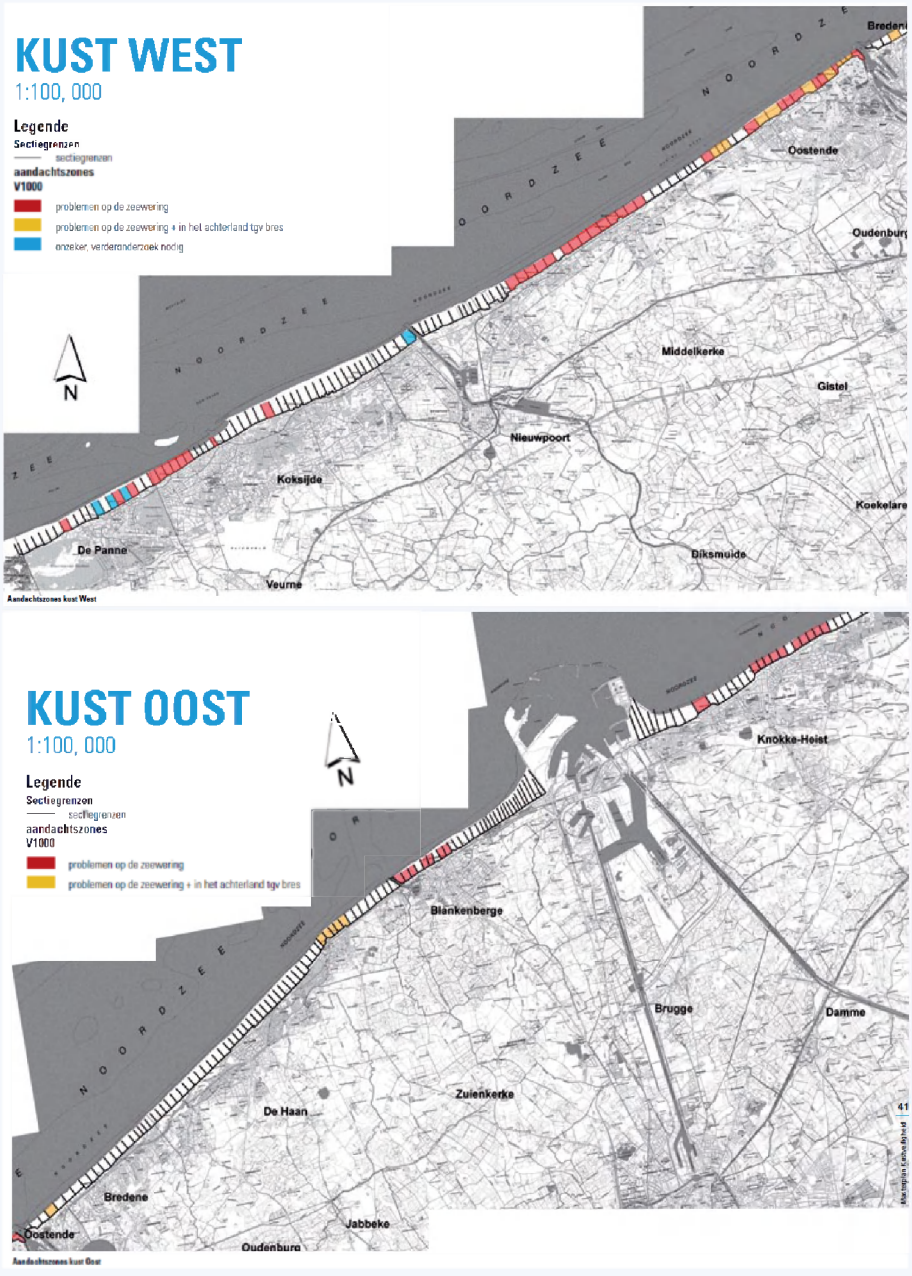

Figure 5. Zones of particular attention with regard to coastal safety along the east and west coast (*Masterplan Coastal Safety* [206919]).

For each type of environment (coastal municipalities, dunes and ports) of the zones that require special attention, different measures were selected on the basis of the cost and the technical effectiveness (table 3). In the bathing areas, beach nourishment was preferred, whether or not in combination with measures to strengthen the seawall (water barriers or wave absorbing expansions of the seawall) or measures limiting the maintenance works (windscreens, brushwood, marram grass, etc.). For the dunes, beach or dune nourishments were considered. For the ports, storm walls, raising of the seawall/quay, or the construction of a storm surge barrier were investigated (*Geïntegreerd*

Table 3. Overview of the selected protection measures for each zone of particular attention (*Masterplan Coastal Safety*).

ZONE OF PARTICULAR ATTENTION	SELECTED MEASURES
De Panne - section 8	Dune nourishment
De Panne – centre (section 13 to 18)	Beach nourishment with an elevated beach
St. Idesbald - Koksijde-centre (section 21 to 31)	Beach nourishment with an elevated beach
Koksijde - section 39	Raising the road by the replenishment of the dune passage in combination with the reconstruction of the road
Port of Nieuwpoort	Construction of a storm surge barrier
Middelkerke - Westende (section 74 to 88)	Beach nourishment with a low-lying beach in combination with wave absorbing expansions and a storm wall seawards of the casino
Raversijde – Ostend Wellington (section 97 to 108)	Beach nourishment with a low-lying beach in combination with a high stormwall or adapted seawall ramp and wave absorbing expansion or widening of the seawall at Raversijde
Ostend centre (section 109 to 117) + Port of Ostend + Ostend-East (section 118 tot 120)	OW-Plan Ostend
Ostend-East (section 121)	Beach nourishment in connection with the OW-plan, subplan for integrated coastal zone management at Oosteroever (section 119 and 120)
De Haan - Wenduine (section 172 to 176)	Beach nourishment with a low-lying beach in combination with stormwalls at De rotonde and the seawall/widening of the seawall
Port of Blankenberge	Construction of a storm wall at +8m TAW in combination with anti-erosion protection around the port
Blankenberge (section 185 to 195)	Beach nourishment with a low-lying beach
Port of Zeebrugge	Construction of a storm wall at +8m TAW around the Prins Albert I dock and connected to the locks in combination with anti-erosion protection around the port
Knokke-Heist (section 225 to 243)	Beach nourishment (profile between steep and low-lying beach)
Zwin (section 250 to 255)	Zwinproject
Renovation of weirs and locks	Ports of Blankenberge, Ostend and Zeebrugge

Kustveiligheidsplan. Niet-technische samenvatting 2009 [226558]). The proposed measures were evaluated afterwards based on social, economic and environmental criteria. The required measures in order to realise the proposed level of flood protection along the entire coastline and in the coastal ports are summarised below. These measures are the most desirable alternatives. They are based on technical studies, impact assessments (EIAs, Social Cost-Benefits Analysis and residual risk calculations) and consultation with the stakeholders, in particular the municipalities.

12.5.2 Sustainable use of the coast

The ecological impact of beach nourishments has already been investigated in several studies (*Speybroeck et al. 2004* [69028], *Speybroeck et al. 2006a* [100573], *Speybroeck et al. 2006b* [225426], *Speybroeck et al. 2007* [116938], *Braarup Cuykens et al. 2010* [197472], *Van den Eede & Vinckx 2011* [202895]) executed on behalf of the *Coastal Division*.

In order to develop the sea barrier in an integrated way, the Flemish region, with the *Coastal Division* as competent authority, has signed the protocol of the Coordination Centre for Integrated Coastal Zone Management. With this protocol, the partners of the Coordination Centre (Coastal Division, Agency for Nature and Forest, Flanders Marine Institute, Province of West Flanders and FPS Health, Food Chain Safety and Environment) express their intention to collaborate in an integrated way and use the Coordination Centre as an instrument in this regard (see theme **Integrated coastal zone management**).

In the context of the future plan 'Flanders in Action', the Flemish government is developing an integrated approach with regard to the challenges of sustainable coastal management in the long term, within the concept '*Flanders Bays* [222799]'. In this project, *11 subprojects* have been further investigated to show which of these concepts and subprojects have sufficient potential to be implemented in future plans. On the basis of the research work, the Flemish authority wants to develop a series of measures in the medium term in the 'Masterplan Flanders Bays' (until 2050). The deadline for this Masterplan is 2014. The final goal of the Flanders Bays project is to develop an integrated long-term vision for the area (until 2100), that will serve as a framework for the future policy.

Finally, other initiatives and studies also look at a sustainable protection of the coastal zone. *Natuurpunt* pleads for one integrated plan that elaborates the adaptation of coastal nature to climate change: the so-called *Kappa-plan*, which develops a sustainable vision for the protection of our coast with natural climate buffers. Coastal protection is also discussed in several research projects, such as the CcASPAR (Climate change and changes in spatial structures in Flanders) project (*Allaert et al. 2012* [221516]), the BELSPO project *CLIMAR* (*Van den Eynde et al. 2009* [206438], *Van den Eynde et al. 2011* [212421]), the *SAFECOAST project*, and the European projects '*Coastal Communities 2050*' and *Theseus*. Moreover, the protection of the coast constitutes an important part in the (integrated) visions that are being generated for the development of the coastal region and the instruments for a sustainable and integrated coastal zone management (see theme **Integrated coastal zone management**).

Legislation reference list

Table with European legislation. The consolidated version of this legislation is available on *Eurlex*.

EUROPEAN LEGISLATION			
Abbreviations (if available)	Title	Year	Number
Directives			
EIA-Directive	Council Directive on the assessment of the effects of certain public and private projects on the environment	1985	337
Water Framework Directive	Directive 2000/60/EC establishing a framework for Community action in the field of water policy	2000	60
Floods Directive	Directive on the assessment and management of flood risks	2007	60
Other (Decisions, Communications, White Papers, etc.)			
	Recommendation of the European Parliament and of the Council of 30 May 2002 concerning the implementation of Integrated Coastal Zone Management in Europe	2002	413

Table with Belgian and Flemish legislation. The consolidated version of this legislation is available on *Belgisch staatsblad* and the *Justel-databases*.

BELGIAN AND FLEMISH LEGISLATION	
Date	Title
Decrees	
18 juli 2003	Decreet (betreffende het) Integraal Waterbeleid

13

Military use

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Citation:

Van den Steen, L., Depoorter, P., Wouters, B., Pirlet, H., 2013. Military use. In: Lescrauwaet, A.K., Pirlet, H., Verleye, T., Mees, J., Herman, R. (Eds.), Compendium for Coast and Sea 2013: integrating knowledge on the socio-economic, environmental and institutional aspects of the Coast and Sea in Flanders and Belgium. Oostende, Belgium, p. 231-240.

Military activities and exercises regularly take place in the Belgian part of the North Sea (BNS) and in the coastal area. These include: target practice on land towards the sea, target practice on sea towards floating targets, detonation exercises with practice mines and found mines, exercises to lay, search and sweep mines, and extensive mine exercises of several NATO countries. In addition, amphibian, rescue and fly exercises take place as well (*Maes et al. 2005* [78467], *GAUFRE project BELSPO*). A dump site of war munitions from World War I (WWI) is located in the BNS. It is situated along the coast of Knokke-Heist on the shallow sandbank '*De Paardenmarkt*'. According to OSPAR, 148 dump sites of war munitions are located in the North Sea and the north-eastern part of the Atlantic Ocean (*OSPAR QSR 2010* [198817]).

13.1 Policy context

The policy relating to military activities is a federal matter belonging to the Ministry of Defence (*beleidsnota landsverdediging 2012* [226457]). An overview of the legislation with regard to the military activities (at sea) is given in the coastal codex, theme *military activities*.

13.2 Spatial use

In the BNS, a number of zones reserved for military activities are indicated on the nautical charts (*Vermeersch & Desnouck 2009* [135696]). The coordinates of these areas are communicated in the *Notices to Mariners* (BaZ) at the beginning of each year (*BaZ 2013 nr. 1* [225449], *Derous 2005* [78297] (*GAUFRE project BELSPO*)). Some military zones have already been adjusted according to the shipping traffic and wind farms. In the draft of the Marine Spatial Plan (*Ontwerp van koninklijk besluit tot vaststelling van het marien ruimtelijk plan* [227527]), as proposed by the Minister competent for the North Sea, sufficient space for military activity is provided. Furthermore, it is examined whether there is a potential conflict between these military activities and the concession area for the energy atoll, as well as between the target practices in Nieuwpoort-Lombardsijde and the natural functions.

13.2.1 Military exercises in the coastal zone and the Belgian part of the North Sea

In the BNS and the coastal zone, military activities and exercises regularly take place (*BaZ 2013 nr. 1* [225449], Ministry of Defence). These include:

- Target practices from land towards the sea. This happens only during the day from the military base (beach) in Lombardsijde. The practice area (D07) is divided into three sectors (K-small, M-medium and G-Large), depending on the weapons used. Every year the practice area is approximately 150 days available for military activities. The K-sector is used about 60 days, the M-sector 30 days, and the G-sector 2 days per year. Depending on the operational requirements of the Belgian army, these numbers may change.
- Target practices at sea towards floating targets. These take place in the 'BNOM zone' in the proximity of the 'Hinderbanken' sandbanks, both during day and night-time. During the exercises, the ships are located in the southern part of the pentagon, and aim at targets in the North. The target practices are performed very rarely (up to 5 times per year), as the Belgian frigates mainly practice in Dutch waters.
- Detonation exercises with practice mines. This happens in the circular area in the south-eastern part of the BNOM zone (zone Thorntonbank-Gutterbank). After the exercises, the practice mines are removed.
- The zone QZR 040 is a practice area used by the international naval mine warfare school of Eguermin in Ostend for Naval Mine Counter Measures (NMCM) training.
- Detonation of found mines. Very occasionally, a real war mine can be found by ships, fishermen or dredgers. Such mines are also detonated in the circular area, unless in case of an emergency.
- Exercises to lay, search and sweep mines. These exercises take place in two smaller areas, in particular NB-01 (between Gootebank and Westhinder, for exercises in deep water) and NBH-10 (between Wenduine and Oostendebank, for exercises in shallow water). For certain manoeuvres, or due to weather conditions, it may be necessary to navigate outside of these areas. The training zones can therefore be extended, if necessary, to the circular detonation zone and towards the port of Ostend. Both zones are rarely used.
- Amphibian, rescue and fly exercises.
- Extensive mine exercises by several NATO countries. There is no set area for this kind of exercises. NATO always announces the location of the exercises beforehand. The NBH-10 zone is one of the possible training zones. Such large-scale exercises are held every two years in the BNS.

Figure 1. The demarcation of military training zones in the BNS (*Continentaal Plat & Vlaamse Hydrografie 2013* [227521]).

Besides the different training activities, the Belgian army also takes part in the SAR (Search and Rescue) organisation, under the leadership of the Maritime Rescue and Coordination Centre (*MRCC*), by means of helicopters and boats. The frequency of the SAR activities depends on the incidents that happen in the BNS. Additionally, in cooperation with other national governments, military infrastructure is deployed for security reasons in the framework of existing agreements and cooperation agreements.

13.2.2 Army bases

The following army bases are located in the coastal area:

- Quarter Lombardsijde (Nieuwpoort);
- Quarter Adjutant Vlieger F. Allaeys (Koksijde);
- Marine base Bootsman Jonsen (Ostend), including the naval mine warfare school;
- Marine base Zeebrugge;
- Quarter LTZ V. Billet (Brugge).

(*website Belgian army*)

There are also a number of military domains in the coastal zone which have a management protocol with the Flemish Region (generally this is the Agency for Nature and Forest (ANB)):

- Camp Lombardsijde in Middelkerke (54 ha);
- Camp 't Pompje in Oudenburg (62 ha);
- Munition depot Zedelgem-Zuid in Jabbeke (73 ha).

13.3.3 Dump site for war munitions

After WWI, the Belgian army dumped German war munitions a few kilometres off the coast of Knokke-Heist on a shallow sandbank called '*De Paardenmarkt*'. There are at least 35,000 tons of munitions, an estimated third of which are toxic gas grenades (*Missiaen & Moerkerke 2002* [26622]). On the hydrographical maps of the Belgian coast, this place is prohibited for fishing and anchoring (*Maes et al. 2000* [18619]). The exclusion zone is a pentagon of about 3 km^2 (*Missiaen et al. 2002* [23307]). The official coordinates of the pentagon are:

- 51°21',60N – 03°14',37E
- 51°22',15N – 03°15',32E
- 51°21',85N – 03°16',37E
- 51°21',42N – 03°16',70E
- 51°21',12N – 03°14',95E

(*Schrijvers 2005* [78292], *GAUFRE project BELSPO*)

13.3 Societal interest

The Belgian army is not only responsible for the defence of the Belgian marine areas. In the case of an emergency in the North Sea, the army offers help and assistance and provides *inter alia* Sea King helicopters (*website airbase Koksijde*), "ready duty ships" and divers (*website coastguard, Ministerial Decree 19 april 2005 rampenplan Noordzee*). Through the commander of the province of West Flanders, deployment of additional staff, infrastructure and military resources can be asked for (Source: National Defence, Guidelines for Homeland Operations).

In addition, the navy is responsible for the detection of violations in the Belgian exclusive economic zone (EEZ) (*law of 22 April 1999, law of 20 January 1999*). The *Regent Decree of 30 March 1946* grants other specific powers to the Belgian navy regarding demining and the surveillance of fisheries. Hence, the Naval component performs checks on board of fishing vessels in cooperation with the Flemish Department of Agriculture and Fisheries.

Through *Maritiem Informatie Kruispunt* (*MIK*) in Zeebrugge and Ostend Radio, the Belgian army constitutes a part of the operational branch of the *structure Coast Guard*. The organisation and responsibilities of MIK are stipulated in the *Royal Decree of 6 February 2009*. In addition to the distress, emergency and safety traffic, Ostend Radio provides the notifications to shipping, both inland and at sea (Source: Admiralty List of Radio Signals – Maritime Radio Stations). The army also intervenes in the case of pollution in the North Sea and in case of the detonation of explosives at sea (*website Coast Guard*).

Table 1. The direct employment at the army bases in the coastal zone in 2012 (Source: Ministry of Defence).

BASE	EMPLOYMENT (2012)
Zeebrugge (marine base, including crew)	1,380
Ostend (naval mine warfare school)	123
Lombardsijde (practice area + med)	532
St-Kruis (training navy, including Dutch colleagues in the context of binational activities)	357
Koksijde (helicopter base)	371
Poelkapelle (dismantling of munitions)	116
Total	**2,879**

Furthermore, the naval component of the Belgian army is responsible for the operation of the marine research vessel Belgica, which is operated by the Direction Natural Environment of the Royal Belgian Institute of Natural Sciences (RBINS). The army is also responsible for the training of foreign naval officers in the NATO naval mine warfare school in Ostend (*website Eguermin*). For this purpose they have their own databases on the sea bed and resources to investigate this matter at their disposal. In this context, there is also collaboration with universities.

13.3.1 Employment

With several bases along the coast, the Belgian army is responsible for significant direct and indirect employment. In 2012, direct employment in the coastal region amounted to 2,879 employees (table 1). Indirect employment derives from various maintenance companies which employ their staff at the bases (e.g. vessels maintenance), as well as from companies which perform occasional assignments for the army either at the naval base, or at their own shipyards. Furthermore, the suppliers of the quarters and ships should also be taken into account (Source: Belgian army).

13.4 Impact

13.4.1 Impact on the marine environment

MILITARY ACTIVITIES IN THE BNS AND SEAWARD TARGET PRACTICE

The impact on the marine environment of military activities in the BNS and seaward target practice is discussed in detail in the following study: *Degraer et al. (2011)* [225352]. The detection of mines and submarine exercises where sonar is used (zones NB-01 and NBH-10) may have a negative effect on marine mammals and fish (*André et al. 2010* [200613], *Degraer et al. 2011* [225352]). Other exercises with explosions / target practices can disrupt marine animals and birds. The temporary nature of the exercises should, however, be taken into account.

Munitions that end up on the seabed during exercises are not cleared. This may locally have a negative impact on the ecosystem, due to the risk of leakage of copper and lead from munitions, although the effect of this leaching may be smaller than the leaching due to other activities (*Derous 2005* [78297] (*GAUFRE project BELSPO*), *Maes et al. 2005* [78467] (*GAUFRE project BELSPO*), *Degraer et al. 2011* [225352]).

The target practices on land towards the sea take place near the '*De IJzermonding*' nature reserve and near the Ramsar and Habitats Directive Area of the 'Flemish Banks'. The negative impact on fauna can be partially reduced by proper timing that takes into account the presence of large concentrations of marine mammals and seabirds which are highly sensitive to disturbance (*Degraer et al. 2011* [225352]).

DUMP SITE FOR WAR MUNITIONS

The release of chemicals that were used in the munitions of the *Paardenmarkt* site, such as mustard gas and Clark components (see among others *Missiaen & Moerkerke 2002* [26622], *Francken & Ruddick 2003* [138993], *Francken et al. 2006* [138994], *Francken & Ruddick 2007* [138995], *Francken & Hafez 2009* [142543], *Missiaen & Henriet 2010* [199351]), may lead to the pollution of the sediment and the water column, and to the disturbance of the food chain (*OSPAR QSR 2010* [198817], *Goffin et al. 2007* [114225], *André et al. 2010* [200613]). A synthesis of the scientific research conducted on the impact of the munitions storage on the *Paardenmarkt* sandbank is given in *Missiaen & Henriet (2010)* [199351].

13.4.2 Impact on other users

Unexploded war materials constitute a potential danger for users of the sea such as fishermen and dredgers. The procedure to follow in Belgium when encountering mines or explosives is available in *BaZ 2013 nr. 1* [225449] and in the *chart of explosives*.

13.5 Sustainable use

13.5.1 Measures for seaward target practice

The target practices from the coastal area of Nieuwpoort-Lombardsijde are subject to restrictions in order to reduce social nuisance. No target practices take place on Saturdays, Sundays, public and school holidays. The periods when the target practices are suspended, are shown in the NtM (*BaZ 2013 nr. 1*)[225449]. Infringements and complaints relating to the rules of the target practice may be submitted to the Federal Police (website *Belgian army*).

The target practices take place near the nature reserve '*De IJzermonding*' and in the marine areas of the western coastal zone protected by the EU *Birds* and *Habitats Directives* (see also theme **Nature and environment**). The effects of these target practices on the environment can be reduced by proper timing (for example, no target practices during the breeding season or by taking into account the presence of marine mammals) (*Maes et al. 2005* [78467], *GAUFRE project BELSPO*, *Degraer et al. 2011* [225352]).

13.5.2 Measures for military activities at sea

On an international level, military ships need to respect the rules that are stipulated in the '*United Nations Convention on the Law of the Sea*', *UNCLOS*, 1982. The impact of military activities on the marine environment is not covered by environmental policies and treaties, such as the international ASCOBANS agreement (even though a call for mitigating measures was included in the *resolution ASCOBANS 2006* [206792]) and the European *Marine Strategy Framework Directive* (MSFD). There has been a plea for the consideration of the environmental effects of new military activities in the context of the Natura 2000 sites that are protected by the European *Birds Directive* and *Habitats Directive*. Article 6 (3) and (4) of the *Habitats Directive* offers a balanced framework to solve potential conflicts between military activities and environmental protection at sea (*Guidelines for the establishment of the Natura 2000 network in the marine environment (2007)* [214813]).

On the Belgian level, the measures protecting the marine environment (see theme **Nature and environment**) do not consider military activities (*law of 20 January 1999*). The military activities can only be submitted to a permission or authorisation as a result of a common proposal by the minister whose authority includes the protection of the marine environment and by the minister of Defence. In that case, the permission or authorisation is granted by both ministers. The *law of 20 January 1999* does, however, state that the military authority, in consultation with the minister, needs to put everything in order to prevent damage and environmental disturbance, without affecting the preparedness of the military force. In *Degraer et al. (2011)* [225352] a few measures were proposed in order to mitigate the impact of military shipping, the detonation of ammunition at sea, the use of a sonar, chemical pollution, etc.

The current trend for navy ships is to set an example on the ecological level. Within NATO a special task force exists (SWG12). Its aim is to promote the exchange of information between and the development of solutions within the NATO navies, in order to meet the national and international regulations regarding the protection of the marine environment and in order to create common initiatives for building an environmentally friendly fleet. In order to realise these goals, NATO copied and adapted the principles of the *MARPOL Convention* to the specific demands of navy ships. This resulted in a series of publications, the 'Allied Maritime Environmental Protection Publication' (AMEPP). These publications each treat a specific aspect of maritime environmental protection. The purpose of the documents is to provide a clear, general guideline for shipping architects and designers of navy systems. On the basis of the AMEPP documents, the environmental legislation is incorporated in the design of new ships, with minimal impact on the operational capacities, readiness, safety, survival and comfort of the crew (Source: Belgian army).

Since 1966 the testing of nuclear weapons in the BNS has been forbidden by law. The abandonment of nuclear weapons or weapons of mass destruction outside territorial waters has been forbidden since 1973, and since 1999 this prohibition has applied to the entire BNS (*Maes et al. 2005* [78467], *GAUFRE project BELSPO*).

13.5.3 Measures as to dump sites for war munitions

On an international level, the *OSPAR Convention* (1992) prohibits the dumping of all waste or other matters, including chemical waste. The dumping of chemical weapons at sea was finally forbidden explicitly with the ratification of the Chemical Weapons Convention (*CWC*) in 1997 (*Missiaen & Moerkerke 2002* [26622]). Later on OSPAR published a

recommendation for reporting with regard to conventional and chemical ammunition in the OSPAR area (*OSPAR recommendation 2010/20* [225444]).

On the European level, the dumping of ammunition appears in *Decision 2850/2000/EC* where a common framework is established for collaboration in case of marine pollution, caused by accidents or caused deliberately. Moreover, the dumping site of the *Paardenmarkt* sandbank is located in the Birds Directive Area SBZ (special protection area) 3 (*Birds Directive*). Furthermore, the *Marine Strategy Framework Directive* (MSFD) offers an important framework to take measures against pollution from ammunition in offshore dump sites. One of the descriptors in the *MSFD* to determine a good environmental status (GES) concerns the concentration of polluting matters (*Law et al. 2010* [202492]). Given the fact that the dumping site at the *Paardenmarkt* sandbank is situated within the territorial waters and partly within the coastal waters, the *Water Framework Directive* (*WFD*) offers a relevant legislative framework in case of pollution. The *WFD* and the *MSFD* were incorporated in the Belgian legislation by the *Royal Decree of 23 June 2010 - oppervlaktewatertoestand* and the *Royal Decree of 23 June 2010 - mariene strategie*.

Due to the short distance from the coast and the shallow location, and given the fact that the dumping area is partly situated in the Birds Directive Area SBZ (special protection zone) 3, it is very important to monitor the ammunition dump site on a regular basis. (e.g. *Missiaen et al. 2002* [23307], *Missiaen & Moerkerke 2002* [26622], *Martens 2005* [80181], *Missiaen & Henriet 2010* [199351], *website BMM*). *Missiaen & Henriet (2010)* [199351] provides an overview of the conducted research and gives recommendations concerning further research and monitoring of the *Paardenmarkt* site. The geochemical analysis of water samples and sediment samples providing information on the condition of the potential leaking and decomposition of the chemical compounds is monitored in the following studies: *Francken & Ruddick (2003)* [138993], *Francken et al. (2006)* [138994], *Francken & Ruddick (2007)* [138995] and *Francken & Hafez (2009)* [142543]. In *Degraer et al. (2011)* [225352], it is recommended to not intervene in the *Paardenmarkt* site at this moment.

13.5.4 The management of military domains

The Belgian army applies the federal and regional environmental legislation to the military activity, as far as this application does not obstruct the operational character or the international obligations (Source: *Bijlagenota bij het Federaal Milieucharter (12 december 2001)* and *Beleidsnota van Landsverdediging inzake Leefmilieu (14 januari 2004)*). The internal environmental care within the Belgian army is mentioned in *André et al. (2010)* [200613]. Three military domains in the coastal area are controlled by the Agency for Nature and Forest (ANB) through a cooperation protocol: camp Lombardsijde, camp 't Pompje and the ammunition depot Zedelgem-Zuid. The military function prevails and sets preconditions, but the often unique ecological, as well as recreational/economic values are recognised and correspondingly managed (*Dumortier et al. 2009* [142607]). The environmental technical management plan concerning the dunes of the military domain '*Kwartier Lombardsijde*' is established in *Degezelle & Hoffmann (2002)* [106066].

Legislation reference list

Table with international agreements, conventions, etc.

INTERNATIONAL AGREEMENTS, CONVENTIONS, ...			
Abbreviations (if available)	Title	Year of conclusion	Year of entering into force
MARPOL Convention	International Convention for the prevention of pollution from ships, as modified by the Protocol of 1978 relating thereto	1973	1978
UNCLOS	United Nations Convention on the law of the sea	1982	1994
ASCOBANS	Agreement on the conservation of small Cetaceans of the Baltic, North East Atlantic, Irish and North Seas	1991	1994
OSPAR Convention	Convention for the protection of the Marine Environment of the North-East Atlantic	1992	1998
Chemical Weapons Convention (*CWC*)	Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on their Destruction	1993	1997

Table with European legislation. The consolidated version of this legislation is available on *Eurlex*.

EUROPEAN LEGISLATION			
Abbreviations (if available)	Title	Year	Number
Directives			
Habitats Directive	Council Directive on the conservation of natural habitats and of wild fauna and flora	1992	43
Water Framework Directive	Directive 2000/60/EC establishing a framework for Community action in the field of water policy	2000	60
Marine Strategy Framework Directive	Directive 2008/56/EC establishing a framework for Community action in the field of marine environmental policy (Marine Strategy Framework Directive)	2008	56
Birds Directive	Directive on the conservation of wild birds	2009	147
Other (Decisions, Communications, White Papers, etc.)			
	Decision of the European Parliament and of the Council of 20 December 2000 setting up a Community framework for cooperation in the field of accidental or deliberate marine pollution	2000	2850

Table with Belgian and Flemish legislation. The consolidated version of this legislation is available on *Belgisch staatsblad* and the *Justel-databases*.

BELGIAN AND FLEMISH LEGISLATION	
Date	Title
Laws	
Wet van 20 januari 1999	Wet ter bescherming van het mariene milieu in de zeegebieden onder de rechtsbevoegdheid van België
Wet van 22 april 1999	Wet betreffende de exclusieve zone van België in de Noordzee
Royal Decrees	
Besluit van de Regent van 30 maart 1946	Besluit betreffende oprichting en organisatie van de Marine

BELGIAN AND FLEMISH LEGISLATION (continuation)	
Date	Title
KB van 6 februari 2009	Koninklijk besluit tot oprichting en organisatie van het maritiem informatiekruispunt
KB van 23 juni 2010 - oppervlaktewatertoestand	Koninklijk besluit betreffende de vaststelling van een kader voor het bereiken van een goede oppervlaktewatertoestand
KB van 23 juni 2010 - mariene strategie	Koninklijk besluit betreffende de mariene strategie voor de Belgische zeegebieden
Ministerial Decrees	
MB van 19 april 2005	Ministerieel besluit tot vaststelling van het Rampenplan Noordzee

14 Scheldt Estuary

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Citation:

Van den Bergh, E., Meire, P., Mostaert, F., Pirlet, H., 2013. Scheldt Estuary. In: Lescrauwaet, A.K., Pirlet, H., Verleye, T., Mees, J., Herman, R. (Eds.), Compendium for Coast and Sea 2013: integrating knowledge on the socio-economic, environmental and institutional aspects of the Coast and Sea in Flanders and Belgium. Oostende, Belgium, p. 241-250.

The Sea Scheldt and its tidal tributaries (Durme, Rupel with the Zenne, Dijle and Netes), the Western Scheldt and the mouth of the Scheldt together constitute the Scheldt Estuary. These water bodies are subject to the tides from the North Sea, whereby a strong interaction and coupling exists between the ecosystems of the Scheldt Estuary and the North Sea (exchange of water masses, dissolved substances, sediments, fauna, flora etc.). Given the relationship between the user functions of both areas (fisheries, shipping, dredging and dumping, recreation, etc.), the Compendium for Coast and Sea also covers the Scheldt Estuary. The current text is largely based on the content of the *ScheldeMonitor*. This is a Flemish-Dutch knowledge and information system for research and monitoring in the Scheldt Estuary, which offers expertise, literature, datasets, measurements, projects, maps and a set of indicators.

A number of important estuaries are situated in the North Sea area and, just like the Scheldt Estuary, they are strongly affected by the tides. These include the estuary of the Seine (France), the Oder (Germany and Poland), the Elbe (Germany), the Weser (Germany), the Humber (United Kingdom), the Ems - Dollard (Germany and Holland) and the Thames - Essex (United Kingdom) (*Debergh et al. 2009* [138216]). On the one hand, these estuaries have a great ecological value and parts of them are Natura 2000 area (see also theme **Nature and environment**). On the other hand, these estuaries provide space for important economic activities such as harbour developments. Besides, they face an increasing risk of flooding due to storm surges. Because of the common challenges of these areas, European collaboration projects concerning estuarine research and management have been conducted. Depending on the project and the project partners these projects focus on one or several challenges (e.g. *FLOODSCAPE*, *FRaME*, *HARBASINS*, *TIDE*, etc.).

The Scheldt Estuary is unique in north-western Europe because a complete tidal regime is preserved along the entire fresh-salt water gradient in the river with the typical tidal habitats and communities (*Directie Zeeland & AWZ 2001* [20705]).

14.1 Policy context

The policy and management of the Scheldt Estuary is a cross-border matter that involves both Flanders and the Netherlands. Between both countries, several Treaties and Memoranda of Understanding on the Scheldt Estuary have been concluded (see table 1 and *website VNSC*). Furthermore, Ministerial Declarations and Treaties have been made in the context of integrated water management in the Scheldt basin, which not only involves Flanders and the Netherlands, but also the Walloon Region, the Brussels-Capital Region and France. (see table 1 and *website International Scheldt commission*).

To ensure the coordination between the Flemish and Dutch authorities, a number of specific cross-border organisations for the Scheldt Estuary have been created. In 1948, on the occasion of the foundation of the Benelux Customs Union, the Technical Scheldt Commission (TSC) was established. This commission was composed of Dutch and Belgian/Flemish officials and was responsible for studies about the Scheldt (e.g. the Deltaplan, the Scheldt-Rhine Connection, Long Term Vision (LTV) and the Development Sketch 2010 for the Scheldt Estuary, etc.). After 2008, the TSC was succeeded by the Flemish-Dutch Scheldt Commission (*VNSC*) as stated in the Scheldt treaties that were concluded on 21 December 2005 in Middelburg. The VNSC consists of a political and an official college and promotes the collaboration between Flanders and the Netherlands in the field of the policy and management of the Scheldt Estuary (the preparation of plans, programmes and projects, the establishment and guidance of a common programme for monitoring and research, etc.). Depending on the policy and management questions, the official college can establish a permanent or temporary working group to perform specific tasks. The two permanent working groups are 'Research and Monitoring' and 'Communication'. In 2013, four temporary working groups are active: 'Development sketch 2010 for the Scheldt Estuary', 'The sluice of the Canal Ghent-Terneuzen', 'Inland navigation Scheldt area', and 'Evaluation Policy and Management'.

On a sectoral level, Flanders and the Netherlands collaborate as well. Both countries ensure the organisation of easy and safe shipping from and to the Scheldt ports by means of the Common Nautical Management (*CNM*). The *Permanent Committee of Supervision on Scheldt Navigation*, that was founded pursuant to article 9 of the treaty of 19 April 1839 concerning the separation between the Netherlands and Belgium, is the highest body in the organisation of the CNM and is responsible for a safe and smooth facilitation of shipping traffic. The Common Nautical Authority (*CNA*) ensures the daily nautical management, supervised by the Permanent Committee. The monitoring of shipping on the Scheldt is mainly performed by the Scheldt Radar Chain, a shipping guidance system that is used by the Flemish and Dutch government. The CNA provides information on radar systems and shipping guidance via the Vessel Traffic Service, legislation and procedures.

Table 1. Overview of transborder Treaties and Memoranda for the Scheldt Estuary (*website VNSC*, *website International Scheldt Commission*).

FLANDERS – THE NETHERLANDS (FROM 1960)	
Scheldt treaties	Memoranda of Understanding (MoU)
Pilot rates (*Loodsgeldtarieven*) (2005)	MoU The Hague (*MvO Den Haag*) (2005)
Common Nautical Management (*Gemeenschappelijk Nautisch Beheer*) (2005)	First MoU Vlissingen (*Eerste MvO Vlissingen*) (2002) Second MoU Vlissingen (*Tweede MvO Vlissingen*) (2002)
Common policy and management (*Gemeenschappelijk beleid en beheer*)(2005)	MoU Kallo (*MvO Kallo*) (2001)
Development Sketch 2010 for the Scheldt Estuary (*Ontwikkelingsschets 2010 Schelde-estuarium*) (2005)	
Scheldt treaty (*Scheldeverdrag*) (2002)	
Widening of the Channel 48/43/38 feet (*Verruiming vaargeul 48/43/38 voet*) (1995)	
Improvement of the waterway at Walsoorden (*Verbetering vaarweg te Walsoorden*) (1970)	
Scheldt-Rhine connection (*Schelde-Rijnverbinding*) (1963)	
Canal Ghent-Terneuzen (*Kanaal Gent-Terneuzen*) (1960) • Protocol Canal Ghent-Terneuzen (*Protocol Kanaal Gent-Terneuzen*) (1985)	

BELGIUM – FRANCE – THE NETHERLANDS	
Treaties	Ministerial Declarations
Treaty of Ghent (2002)	*Ministerial Declaration of Liège* (2001)
Treaty of Charleville-Mézières (1994)	*Ministerial Conference in Middelburg* (1998)

The goal of the International Scheldt Commission (*ISC*) is to establish cooperation between riparian states (France, Belgium and the Netherlands) and regions of the Scheldt, in order to achieve sustainable and integrated water management of the international Scheldt river basin district. Since 2000, attention has also been paid to the common aspects of the river basin management plan for the Scheldt basin in the context of the goals of the *Water Framework Directive* (WFD).

In the current policy on the Scheldt Estuary, particular attention is being paid to the Long Term Vision for the Scheldt Estuary (LTV, *Directie Zeeland & AWZ 2001* [20705]). This LTV was established in 2001 by the Netherlands and Flanders and presented to the ministers concerned. The LTV constitutes the basis for the development of a trans-border and integrated policy for the estuary. The vision was conceived from the idea that the different functions of the Scheldt Estuary (within the three main themes of safety, nature, accessibility and other functions such as fisheries, tourism and recreation) have to be taken into account in the future, in a sustainable way. In the LTV a 'Target 2030' was formulated, listing the goals to be achieved in 2030. The *Development Sketch 2010 for the Scheldt Estuary (Ontwikkelingsschets 2010 Schelde-estuarium) (2005)* [75396] indicates which measures and policy efforts are needed in order to achieve the objectives of Target 2030. At present, 21 out of the 26 projects and measures have already been executed. The 5 remaining projects are being prepared and are managed by the Working group 'Development Sketch 2010'. In the context of the LTV, the working group 'Long Term Vision - Research and Monitoring' (LTV- R&M) was founded in 2003. The latter working group aims to provide the necessary scientific support and the facts and figures for managers and policymakers. This requires intensive and cross-border collaboration between researchers, managers and policymakers in Flanders and in the Netherlands. As a consequence of the *Scheldt treaties* of 2005, the working group Research and Monitoring (R&M) was established in the context of the VNSC. This working group not only deals with new research questions and the project of widening the channel, but also with the objectives of the LTV-R&M. In December 2003, the *ScheldeMonitor* was launched to disclose data. The project has gained importance as an information system since 2008, as it places the results of the common monitoring programme (MONEOS, *Meire & Maris (2008)* [123314]) at the disposal of policy makers and researchers. To evaluate the condition and the evolution of the estuary based on the results of this monitoring programme, an evaluation methodology was created in *Holzhauer et al. (2011)* [213039] which is used to assess the functioning of the Scheldt Estuary.

In Flanders two of the LTV themes, safety and nature, are commonly executed in the *updated Sigmaplan (2005)*. The measures set in this plan serve both the safety as well as the nature function of the estuary. The objectives of the LTV with regard to nature in the Sea Scheldt were further refined in the context of the actualised Sigmaplan (*Adriaensen et al. 2005*) [128821] and a series of measures were proposed to realise these goals. Three types of measures are important in this regard: the development of mud flats and salt marshes by allowing controlled reduced tides in a controlled floodplain (CFP), renewing of dikes or depolderisation and the development of wetlands in the valley, whether or not as a controlled floodplain. The goals and measures are part of the *updated Sigmaplan (2005)* as approved by the Flemish government (22 July 2005).

The policy and management with regard to the Scheldt Estuary are largely driven by the international and European legislation such as the *Birds* and *Habitats Directive*, the *Water Framework Directive* (WFD), the *Floods Directive* and the national and regional policy instruments that have to ensure the local execution of these measures (see also theme **Nature and environment**), by means of concrete goals, such as the good ecological and chemical condition (*WFD*) and the conservation status of the Natura 2000 areas in and around the estuary. An overview of the policy framework for the Scheldt Estuary is given in *Debergh et al. (2009)* [138216].

14.2 Spatial demarcation

By definition, an estuary contains the part of the river which is subject to tidal influence (*Fairbridge 1980* [113586]). In the case of the Scheldt Estuary, this is the area from the mouth of the river to the locks in Ghent (Merelbeke), including the Durme, Rupel, Zenne, Dijle and Netes up to where tidal influence can be recorded. Furthermore, the upper limit of the highest high water is regarded as a border (figure 1).

The LTV (Directie Zeeland & AWZ 2001 [20705]) applies to a demarcated geographical area. However, a trans-border perspective is used when this is required for certain aspects. Upstream the border was set at the locks in Ghent (Merelbeke) and the mouths of the tributaries. Downstream the estuary contains the Scheldt and its estuaries, including the *Vlakte van de Raan* and other shallow water areas. The channels are taken into account until the limit of the nautical management (indicative border: the piloting intersections west of '*het Scheur*'). The Zeebrugge Port and its waterway '*Pas van het Zand*' are not included in the area concerned. Except for the river itself, the LTV also covers the banks up to the head weirs.

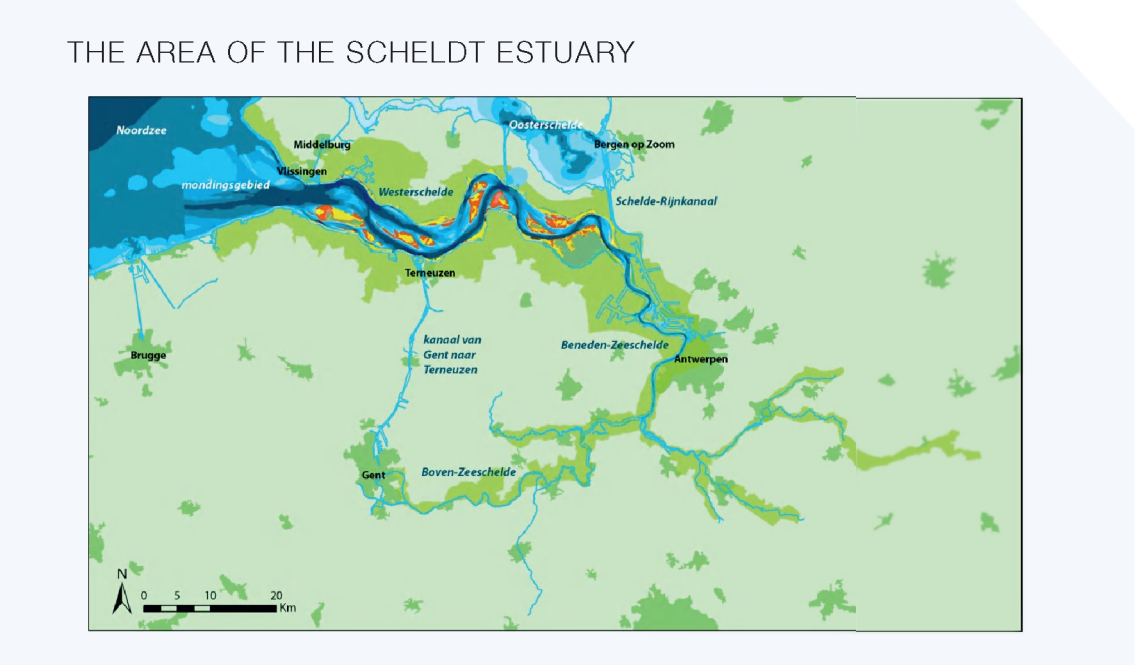

Figure 1. The area of the Scheldt Estuary, with an indication of the estuary area, the Western Scheldt, the Lower Sea Scheldt and the Upper Sea Scheldt (Source: VNSC Communication).

In the context of the LTV goals, a series of indicators for sustainable development have been selected and applied to the entire Scheldt Estuary, in consultation with scientists and policymakers. These indicators fit in with the 3 major themes of the *Working group Research and Monitoring*: safety, nature and accessibility and are available on the *ScheldeMonitor*. For these indicators, the spatial demarcation of the LTV has been used (*Lescrauwaet et al. 2009* [138217], *Indicators for the Scheldt Estuary 2011* [206086]).

In the context of the hydro-morphodynamics, *Meire & Maris (2008)* [123314] stress the importance of the mouth area: the line Zeebrugge-Westkapelle, including the *Vlakte van de Raan*. Besides the Western Scheldt and Sea Scheldt, these authors also take the Rupel into account and consider the other tributaries (Durme, Zenne, Dijle en Netes) as borderland when demarcating the Scheldt Estuary. The latter rivers are included because of their input into the system (fresh water, nutrients) and the impact of the upstream policy (e.g. water treatment, land use, etc.). According to the study about nature development measures for the Scheldt Estuary (*Van den Bergh et al. 2003* [111670]), the area includes the adjacent natural flooding areas, including the 'anthropogenic' development areas (controlled reduced tides area and controlled flood plains) and the valley areas related to the estuarine ecosystem (*Ramsar* areas and Natura 2000) in Flanders, as well as the buffer zones (2 km inland), as defined for the Western Scheldt (Zeeland).

14.3 The ecosystem in the Scheldt Estuary

The Scheldt Estuary is an area with unique natural values. It is one of the most important European estuaries where the tidal regime is preserved along the entire fresh-salt water gradient with the typical tidal habitats and communities (*Directie Zeeland & AWZ 2001* [20705]).

The Scheldt Estuary is by nature a very dynamic system that is strongly affected by the tides and variations in salinity. Mud flats, salt marshes, sandbanks and gullies are constantly subject to changes. The low-dynamic (with a low water velocity) shallow water areas, the intertidal areas (mud flats, sandbanks) and salt marshes constitute ecologically valuable habitats in the Scheldt Estuary. The mudflats and sandbanks are usually rich in benthos and constitute important feeding grounds for birds. In general, the areas with an average exposure rate (the percentage of time the mud flats are surfaced) are the most attractive areas from an ecological point of view (*MER Verruiming vaargeul Beneden-Zeeschelde en Westerschelde 2007* [117580], *Wetsteijn et al. 2007* [109989]). Low-dynamic shallow water areas are essential for the reproduction and growth (nursery function) of fishes, crustaceans and molluscs. Salt marshes offer a suitable nesting area for several bird species and serve as a refuge during high water.

Flanders and the Netherlands collaborate on an ecotope system (i.e. a (hierarchical) classification of ecotopes) for the Scheldt Estuary. This type of system is used to track changes in different habitats throughout time, to predict the impact of certain variations in the system on the present habitats and to evaluate effects on communities (Indicator *Morphology and dynamics in the estuary*, *Indicators for the Scheldt Estuary 2011* [206086]).

Table 2 offers an overview of the available information and data in the *ScheldeMonitor* regarding the different aspects of the ecosystem. Within the topics and subtopics, a listing of the relevant information (persons, institutes, publications, projects and maps), research results and data (parameters, datasets, map layers, images and publications) is provided.

The evaluation methodology for the Scheldt Estuary (*Holzhauer et al. 2011* [213039]) provides instruments to evaluate the functioning of the estuarine system. This methodology is built around the major functions as defined in the LTV and offers the methodological framework for the cyclical, six-yearly evaluation of the system. In the context of the evaluation methodology, a limited set of communication-indicators has been developed. These indicators are reported in the T-2009 report (*Depreiter et al. 2013* [228410]) that offers a description of the contemporary condition of the estuary (including the trends before 2009) before the execution of the Development sketch 2010-projects:

- Sandbank and gully system;
- Water quality;
- Environment;
- Flora and fauna;
- Ecological functioning.

In the indicators, developed in the context of the LTV, time series and trends with regard to nature and ecosystem functioning are presented as well (*Indicatoren voor het Schelde-estuarium 2011* [206086]).

Table 2. Overview of the available information and data in the ScheldeMonitor about the ecosystem.

THE ECOSYSTEM OF THE SCHELDT ESTUARY	
Topic	Subtopic
Hydrodynamics	*Water balance* *Water level and tide* *Waves* *Current*
Morphodynamics	*Geomorphology* *Ecotopes and fysiotopes*
Physico-chemistry	*Physical parameters* *Water quality* *Sediment quality* *Air quality* *Pollution* *Light climate*
Habitat diversity	*Ecotopes and fysiotopes* *Nature development* *Habitats* *Nature areas*
Species diversity	*Vegetation* *Plankton* *Benthos* *Fish* *Birds* *Mammals* *Amphibia* *Macrophytes*
Ecological functioning	

14.4 The use of the Scheldt Estuary

The Scheldt Estuary is not only an important ecosystem, but also hosts several user functions such as shipping, dredging, sand extraction, recreation, protection against floods, fishing, etc. Table 3 gives an overview of the available information and data in the *ScheldeMonitor* concerning these user functions. Within the topics and subtopics, the relevant information (persons, institutes, publications, projects, datasets and maps), and data (parameters, map layers, images, datasets and publications) is listed and linked to a set of indicators (*Indicatoren voor het Schelde-estuarium 2011* [206086]).

Table 3. Overview of the available information and data in the ScheldeMonitor about the different user functions of the estuary.

THE ESTUARINE ECOSYSTEM AND USER FUNCTIONS OF THE SCHELDT	
Topic	Subtopic
Shipping	*Navigation channel* *Harbour development* *Nautical management* *Inland shipping* *Ocean shipping* *Recreation* *Risks*
Safety	*History* *Flooding* *Risks* *Future*
Morphodynamics	*Sand extraction* *Dredging and dumping*

In addition, the following user functions are discussed in the ScheldeMonitor: *Fisheries*, *Socio-economic system*, *Administation and law*, *Recreation and tourism*.

In the methodology for the evaluation of the Scheldt Estuary (*Holzhauer et al. 2011* [213039]) one communication-indicator has been developed in the context of Accessibility and another one in the context of Safety. These indicators are reported in the T-2009 report (*Depreiter et al. 2013* [228410]) that offers a description of the contemporary condition of the estuary (including the trends before 2009) before the execution of the Development sketch 2010-projects.

Legislation reference list

Table with international agreements, conventions, etc.

INTERNATIONAL AGREEMENTS, CONVENTIONS, ...			
Abbreviations (if available)	Title	Year of conclusion	Year of entering into force
	Canal Ghent-Terneuzen (Kanaal Gent-Terneuzen) Protocol Canal Ghent-Terneuzen (Protocol Kanaal Gent-Terneuzen)	1960 1985	
	Scheldt-Rhine connection (Schelde-Rijnverbinding)	1963	
	Improvement of the fairway at Walsoorden (Verbetering vaarweg te Walsoorden)	1970	
RAMSAR Convention	Convention on Wetlands of International Importance especially as Waterfowl Habitat	1971	1975
	Treaty of Charleville-Mézières (Verdrag van Charleville-Mézières)	1994	
	Widening of the Channel 48/43/38 feet (Verruiming vaargeul 48/43/38 voet)	1995	
	Scheldt treaty (Scheldeverdrag)	2002	
	Treaty of Ghent (Verdrag van Gent)	2002	
	Pilot rates (Loodsgeldtarieven)	2005	2008
	Common Nautical Management (Gemeenschappelijk Nautisch Beheer)	2005	2008
	Common Policy and Management (Gemeenschappelijk beleid en beheer)	2005	2008
	Development Sketch 2010 for the Scheldt Estuary (Ontwikkelingsschets 2010 Schelde-estuarium)	2005	2008
Memoranda of Understanding			
	MoU Kallo (2001)		2001
	MoU Vlissingen (2002) (2 MoUs)		2002 (2)
	MoU Den Haag (2005)	2005	2005
Ministerial Decrees			
	Ministerial Conference in Middelburg (Ministersconferentie te Middelburg)	1998	
	Ministerial Declaration of Liège (Ministeriële Verklaring van Luik)	2001	

Table with European legislation. The consolidated version of this legislation is available on *Eurlex*.

EUROPEAN LEGISLATION			
Abbreviations (if available)	Title	Year	Number
Directives			
Habitats Directive	Council Directive on the conservation of natural habitats and of wild fauna and flora	1992	43
Water Framework Directive	Directive 2000/60/EC establishing a framework for Community action in the field of water policy	2000	60
Floods Directive	Directive 2007/60/EC on the assessment and management of flood risks	2007	60
Birds Directive	Directive on the conservation of wild birds	2009	147

15 Integrated coastal zone management

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Maelfait, H., Belpaeme, K., Lescrauwaet, A.K., 2013. Integrated coastal zone management. In: Lescrauwaet, A.K., Pirlet, H., Verleye, T., Mees, J., Herman, R. (Eds.), Compendium for Coast and Sea 2013: integrating knowledge on the socio-economic, environmental and institutional aspects of the Coast and Sea in Flanders and Belgium. Oostende, Belgium, p. 251-260.

Integrated Coastal Zone Management (ICZM) or Integrated Coastal (Zone) Management (ICM), coastal zone management for short, represents "*a continuous process with the general aim of implementing sustainable development in coastal zones through optimal management of human activities in this area in order to improve the state of the coastal environment and maintain its diversity*" (European Commission EC, 1999). The European Union originally focused on ICZM in a recommendation (non-legally binding policy), which aimed at developing a common vision in drafting and implementing national strategies for ICZM. Out of the 20 coastal EU Member States, nine countries – representing for 64% of the European coastline[1] – already had a national ICZM strategy in 2005. Belgium, as well as seven other Member States (all in all 18% of the EU coastline), does not have an ICZM strategy but performs additional actions for achieving integrated coastal zone management within the existing policies and legislation. Meanwhile, significant progress has been made in the legal anchoring of ICZM at a regional level in the EU. Moreover, the validity of the recommendation expired in 2006 and the European ICZM instrument was subject to a review. An evaluation was carried out after 10 years of ICZM in Belgium as well (*Belpaeme 2011* [208453]). On 12 March 2013, the EC gave its approval for a draft proposal for a Directive establishing a framework for maritime spatial planning and ICZM (see also theme **Marine Spatial Planning**). The proposed instrument will require Member States to establish strategies for ICZM, building on the principles and elements of the Council Recommendation on ICZM in 2002. In 2010, the EC also signed the ICZM Protocol for the Mediterranean. This protocol is a legally binding document for all Member States.

15.1 Policy context

In the global context, ICZM was put on the agenda at the UN World Conference on sustainable development (Rio, 1992). In *chapter 17* of Agenda 21 (a UN action plan for sustainable development, adopted at the Rio Conference in 1992) the objectives for the protection of oceans, seas and coastal areas were developed. A specific reference to the importance of an integrated approach was included. UNESCO adopted Integrated Coastal Area Management (ICAM) as an independent programme in the 19th session of the Intergovernmental Oceanographic Commission (IOC) meeting in 1997. The objective of this programme is to support the IOC Member States in their efforts to develop marine scientific and technological capabilities with regard to ICZM, following Agenda 21.

In the European Member States, ICZM is mainly stimulated by the Recommendation concerning the implementation of Integrated Coastal Zone Management in Europe (*2002/413/EC*). The '*ICZM recommendation*' serves as a policy framework to provide a common vision and standard for all Member States. The European '*ICZM recommendation*' (*2002/413/EC*) was preceded by a series of European charters and decisions focused on spatial planning and the protection of the coastline (table 1), and was drafted in response to Chapter 17 of Agenda 21.

Prior to the European recommendation, Belgium played an active role *inter alia* by participating in the 'TERRA CZM' project (commissioned by the European Commission (1996-1999)) to gather technical information regarding ICZM, and to stimulate a wider debate on sustainable coastal management through the *Demonstration programmes* [18627]. Since the adoption of the recommendation - a non-binding legal instrument - significant progress has been made at the level of the regional seas in the development and endorsement of legally binding regulations on ICZM (*ICZM Protocol to the Barcelona Convention on Integrated Coastal Zone Management* for the Mediterranean, regulations which are part of *HELCOM* for the Baltic sea, and the *Bucharest Convention* for the Black Sea). In the recommendation, the EU invited the Member States to develop national strategies and measures and to report about the progress by 2006 (*COM (2007) 308*).

In order to further promote sustainable development of coastal areas, the European Commission approved a draft proposal for a directive establishing a framework for maritime spatial planning and integrated coastal zone management on 12 March 2013 (*COM (2013) 133*). The proposed instrument will require the Member States to develop ICZM strategies, building on the principles and elements of the Council Recommendation on ICZM in 2002 (*2002/413/EC*) and of the *Protocol of the Barcelona Convention* for the ICZM, as ratified by the EU in 2010.

In Belgium, the *Coordination Centre for Integrated Coastal Zone Management* is the contact point for ICZM. The Coordination Centre was established in 2001 - a year before the ICZM recommendation - as a project of the 'Objective 2' programme of the EC. After an initial assessment in 2006, the partners decided to sign the 'ICZM Protocol', which confirmed the role of the Coordination Centre as an important instrument for ICZM in Belgium. The Protocol was signed in 2007 by the Provincial Government (*Province of West Flanders*), the Agency for Nature and Forest (*ANB*,

1 coastline as defined by EUROSION: http://www.eurosion.org

YEAR	POLICY INSTRUMENT	OBJECTIVE/DESCRIPTION
1973	Decision (73) 29 of the European Council	Decision concerning the protection of the coastline.
1981	*European Coastal Charter* [226578], prepared by the Conference of Peripheral Maritime Regions of Europe	Outlines the basic principles for integrated management of coastal areas.
1982	*Resolution of the EU Parliament* to support the European Coastal Chapter	Supports the principles as described in the 'Coastal Charter'. Both the Charter and Decision (73) 29 underline the need for integrated coastal planning in Europe.
1983	European Charter for Regional Planning (CEMAT)	Emphasises the need for spatial planning in European coastal areas.
1992	*Chapter 17 of Agenda 21*	Precursor of a specific European policy on ICZM. Calls for the coastal states to draw up ICZM strategies. Chapter 10 of Agenda 21 also stresses the importance of integrated and sustainable management of land use.
1992	Resolution of the European Council on the future Community policy concerning the European coastal zone (*92/C 59/01*)	Partly in succession to Agenda 21, the European Council recognizes the need for an integrated approach in addressing the challenges of coastal management, and urges the Commission to make a proposal for action in Europe.
1994	Resolution of the European Council on a Community strategy for integrated coastal zone management (*94/C 135/02*)	The EU requests the Member States to protect the coastal zone through a common strategy for integrated management of coastal zones.
1996-1999	The European Commission launched a *Demonstration programme* [18627] on sustainable coastal management	35 projects are approved and 6 thematic studies are drafted. The Flemish Region conducts the project TERRA-CZM 'to gather technical information regarding ICZM, and to stimulate a wider debate'.
1999	European Council: *Model Law on Coastal protection* [64989]	A proposal for elements of a future model law for coastal protection.
1999	European Council: *Code of conduct for coastal zones* [20650]	A proposal for 'good practice' concerning ICZM.
2000	A proposal to the EU Parliament and the EU Council for an EU Recommendation on Integrated Coastal Zone Management in Europe (*COM (2000) 545*)	
2000	Communication from the Commission to the Council and the European Parliament on Integrated Coastal Zone Management (*COM (2000) 547*)	Proposed strategy to promote a common approach at European level with regard to the planning and management of the coastal zone.
2001	Coordination Centre for Integrated Coastal Zone Management	In the framework of the European 'Objective 2' programme for coastal areas, the Coordination Centre for Integrated Coastal Zone Management is founded in Belgium.
2002	Recommendation concerning the implementation of Integrated Coastal Zone Management (ICZM) in Europe approved by the European Parliament and the European Council, 30 May 2002 (*2002/413/EC*)	Recommendation based on Article 175 of the European Treaty that gives the European Council the possibility to adopt measures in order to protect the environment. In this Recommendation, the EU Member States are requested to develop a national strategy for their coastal policy which takes into account the sustainable development strategy. Furthermore, the preparation of a national inventory of major actors, laws and institutions related to the management of the coastal area is requested.
2002	The 6th *Environment Action Programme of the European Community*, 2002-2012 (*Decision 1600/2002/EC*)	Confirms ICZM as a priority action, cf. Article 3.10 and 6.2 (g).
2006	National reporting by Member States on the progress of the implementation of ICZM	*Belgian report on the implementation of the ICZM Recommendation* [101811]
2007	Communication from the Commission. Report to the European Parliament and the Council: An evaluation of Integrated Coastal Zone Management (ICZM) in Europe (*COM (2007) 308*)	Evaluation of the national implementation of ICZM.

YEAR	POLICY INSTRUMENT (continuation)	OBJECTIVE/DESCRIPTION
2008	*Marine Strategy Framework Directive (Directive 2008/56/EG)*	Directive establishing a framework for common measures with regard to the policy on the marine environment.
2008	Roadmap for Maritime Spatial Planning (MSP). Communication from the Commission (*COM (2008) 791*)	Proposal by the European Commission to apply common principles for MSP in the EU, with reference to the relationship between ICZM and MSP (section 5.9).
2011	Evaluation of 10 years of ICZM in Belgium (September 2011)	Report '*10 jaar Coördinatiepunt, een kwestie van evenwicht*' (*Belpaeme 2011* [208453])
2011-2012	Impact analysis, *Consultation process* [226580] and revision of the ICZM Recommendation	Is carried out in consultation with the evaluation on future action on MSP (see theme **Marine Spatial Planning**).
2013	Draft proposal of the European Commission and the Council for a directive establishing a framework for maritime spatial planning and integrated coastal zone management (*COM (2013) 133*)	

Flemish Government, Ministry of Environment, Nature and Energy), the *Coastal Division* (MD&K, Flemish Government, Department of Mobility and Public Works), and the Flanders Marine Institute (*VLIZ*) as a scientific partner (Flemish Government, Department of Economy, Science and Innovation). In 2009, the *Marine Environment Department* (Federal Public Service of Health, Food Chain Safety and Environment) also became a partner (Belpaeme 2011 [208453]).

Belgium is a coastal Member State with limited coastal and marine areas where a multitude of policy levels are active (see **Chapter 3** of the Compendium for Coast and Sea). Given the fragmentation of competences, the integration and deliberation of sectoral visions and plans in the coastal area are crucial. In this regard, the various competent authorities each have an internal responsibility to implement ICZM. Although an administrative anchoring of ICZM in Belgium is not on the agenda (at the moment), the policy framework and the principles of ICZM are gradually incorporated into the sectoral policy for the coast.

Belgium does not have an ICZM strategy, but performs additional actions for achieving ICZM in the context of existing policies and legislation. In 2006, the validity of the recommendation (*2002/413/EC*) expired. In anticipation of the revision process, the Member States were asked to work on a second national report covering the period from 2006 to 2010. In 2011, the ICZM recommendation was subjected to a revision. An evaluation was carried out after 10 years of ICZM in Belgium as well (*Belpaeme 2011* [208453]).

15.2 Spatial use

ICZM cannot be regarded as a user of space; rather it is a process to optimize the spatial use in the coastal zone on land and at sea, and in particular at the interface between land and sea. The definition and delimitation of the geographical concept of 'coastal zone' was not a straightforward process both on an international and European level (*EU Code of Conduct for Coastal Zones, 1999* [20650]). For the operation of the Coordination Centre for Integrated Coastal Zone Management in Belgium, a definition of "coastal zone" was chosen stretching from the polders to the territorial sea (figure 1).

In practice, this means that the coastal zone policy involves the 10 coastal municipalities (De Panne, Koksijde, Nieuwpoort, Middelkerke, Oostende, Bredene, De Haan, Blankenberge, (Zeebrugge), Knokke-Heist) and 9 hinterland municipalities (Damme, Brugge, Zuienkerke, Jabbeke, Oudenburg, Gistel, Diksmuide, Veurne, Alveringem and Lo-Reninge). On the seaward side, the coastal area is bordered by the 12-mile zone.

Other definitions of the 'coast' or 'coastal zone' are available on: *http://www.coastalatlas.be/en/themes/general-setting/definitie-kust/*.

15.2.1 Implementation of the policy context in Belgium

The fragmentation of the different competent authorities within the various policy areas and geographic areas of the coastal area constitutes a major challenge for most Member States whose target is to achieve an effective coastal zone management. This is also the case for Belgium (table 2).

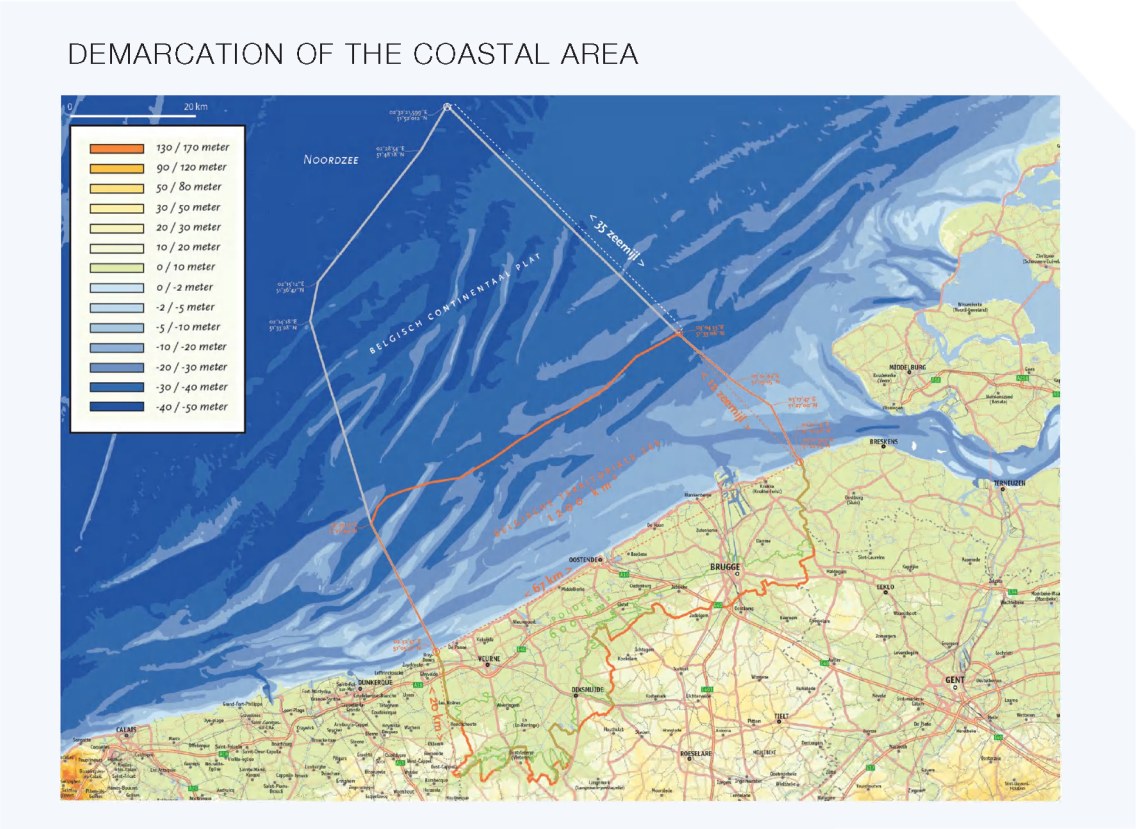


Figure 1. Demarcation of the coastal area, as defined by the Coordination Centre for Integrated Coastal Zone Management in Belgium, showing the 12-mile zone at sea and the 10 coastal municipalities and 9 hinterland municipalities on the landward side of the 'coastal zone' (*www.coastalatlas.be*).

The issues for integrated coastal zone management in Belgium are partly addressed in the following publications: *Tussen Land en Zee: dringend... nood aan een integraal kustzonebeheer: 10-puntenprogramma voor integraal kustzonebeheer in België (Natuurreservaten vzw en WWF 1994)* [19104], *Belpaeme 2001* [22507], *Advies van de Mina-raad van 5 april 2001 over het geïntegreerd beheer van kustgebieden* [66206] and *Cliquet et al. 2002* [30285] (Legal inventory of the coastal zone in Belgium).

Although Belgium has no strategy for ICZM, the recommendations and the principles stipulated in the EU recommendation (*2002/413/EC*) are followed up by the Coordination Centre for ICZM (*website*). Through the Protocol (2007), the partnership of the Coordination Centre for ICZM was given an organizational structure (figure 2) and strategic objectives that are achieved through a multi-year plan.

The three strategic objectives of the Coordination Centre for ICZM are:

- To contribute to the implementation of the European Recommendation concerning the implementation of ICZM in Europe (*2002/413/EC*);
- To promote the integration of planning and policy in the coastal zone;
- To create a platform for integrated management of the coastal zone.

To achieve these objectives, the following operational objectives have been established:

- To communicate and raise awareness about the ICZM;
- To act as contact point for the ICZM;
- To provide a platform for discussion with regard to ICZM;
- To monitor the sustainability indicators of the coastal zone;
- To contribute to the achievement of the recommendations of the European Recommendation on the implementation of ICZM in Europe.

Table 2: An overview of the competences in the coastal area in Belgium (*Belpaeme et al. 2011* [207333]). A detailed overview of the competences with regard to the coast and sea is given in Chapter 3 of the Compendium for Coast and Sea.

	SEA		LAND	
	Legal description	Ecological description	Legal description	Ecological description
	Territorial sea	Seawater	Internal waters	Intertidal
	EEZ	Seabed and substrate	Territory of the coastal and hinterland municipalities	Mudflats and salt marshes
	Continental shelf			Beach
				Dunes
				Coastal polders
Competent authority				
Federal	Shipping		Shipping	
	Defense		Defense	
	Seabed exploitation		Energy	
	Energy (offshore wind)		Control (police)	
	Cables and pipelines		Disaster management	
	Marine environmental protection			
	Control (police)			
	Disaster management			
	Science policy			
Flemish Region	Dredging		Environment and nature conservation	
	Piloting		Spatial planning	
	Rescue at sea		Groundwater extractions	
	Shipping assistance		Tourism	
	Removal of wrecks		Harbours	
	Commercial marine fisheries		Coastal defence	
			Public domain management	
			Science policy	
Province W. Fland.	Assistance in disaster management		Implementation of higher legal standards	
Coastal municipalities			Implementation of higher legal standards	
			Police	
			Maintenance beaches (in concession)	

In September 2011, Belgium celebrated the 10th anniversary of ICZM and a critical reflection was made in the publication '*10 jaar Coördinatiepunt een kwestie van evenwicht*' (*Belpaeme 2011* [208453]). See also the publications: *Cliquet et al. (2002)* [105155] and *Cliquet et al. (2004)* [72542] for a reflection on the administrative context of ICZM in Belgium.

15.3 Societal interest

Integrated management does not only provide a more qualitative and sustainable policy but is, according to a scientific study by the European Commission, also cost-effective. The study shows that investments in integrated coastal management provide social benefits in the long term that are on average 10 times higher (*An Assesment*

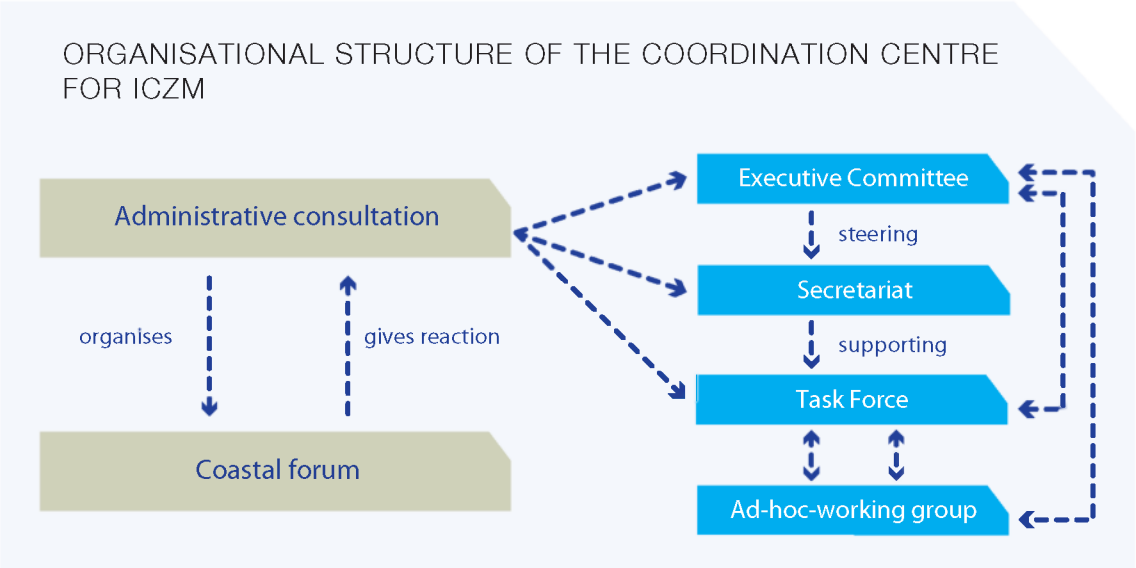


Figure 2. Organisational structure of the Coordination Centre for ICZM.

of the Socio-Economic Costs & Benefits of Integrated Coastal Zone Management: Final Report To The European Commission, 2000 [27587]). In the *Belgian ICZM Recommendation Report of 2006* [101811], a number of recommendations are made to address the coastal policy together and in a sustainable way. The stimulation of specific projects on sustainable coastal management, the use of indicators as a scientific instrument, and a higher involvement of the coastal actors through a coastal forum are some of them. A shared long-term vision for the coast is also one of the targets, as well as closer cooperation between the competent authorities. In the *Belgian ICZM recommendation report of 2010* [226549], the realizations for the period 2006-2010 in response to the recommendations are further elaborated (see **Sustainable use**).

15.4 Sustainable use

Based on the national reports, the European Commission concluded that a continuous effort is required to put effective ICZM in Europe into practice. An overview of 'good practices' with regard to ICZM in the EU Member States can be found in the European database *OURCOAST*.

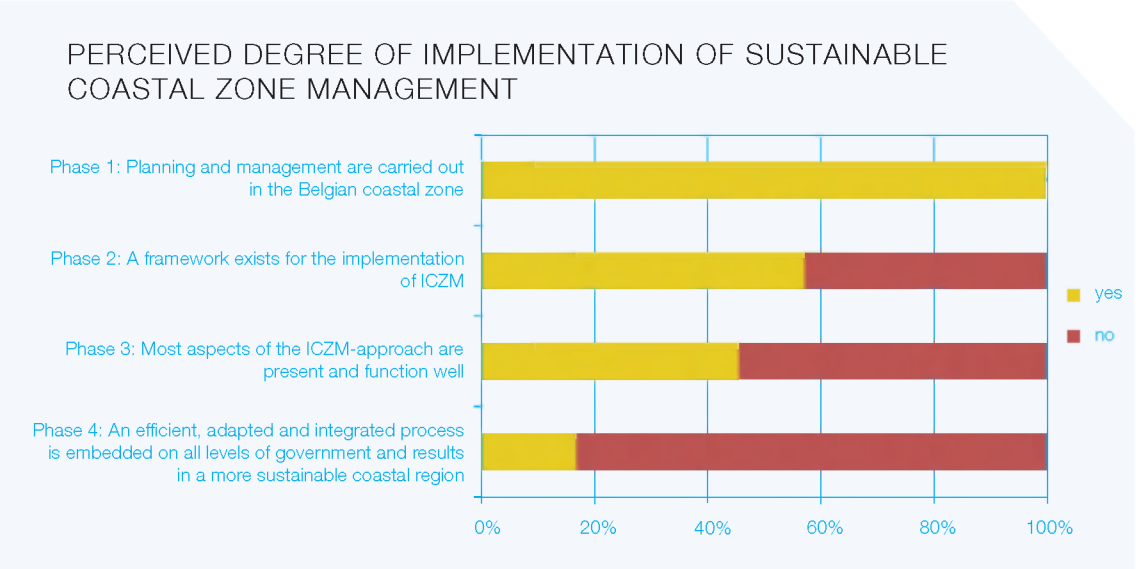


Figure 3. Perceived degree of implementation of sustainable coastal zone management (*Maelfait et al. 2012* [221016]).

For the monitoring of the ICZM implementation, the European Commission has developed an instrument through an ICZM Expert Group for the Member States. The 'ICZM progress indicators' were also applied in Belgium. During the first assessment, the participants-evaluators indicated that effective planning and management are carried out in the Belgian coastal zone through structural plans, monitoring, protection statutes and other legal instruments, but they equally believed that these instruments are not or insufficiently integrated (figure 3). Although all the elements for ICZM are available, the implementation of the process is still insufficient with regard to the involvement of coastal actors, openness in communication from the competent authorities and especially with regard to the legal anchoring of ICZM plans and strategies. The accessibility and timely availability of quality-controlled information to underpin coherent and effective decisions were positively evaluated (*Maelfait et al. 2012* [221016]).

The report '*10 jaar Coördinatiepunt een kwestie van evenwicht*' (*Belpaeme 2011* [208453]) provides an overview of the main achievements and measurable effects of ICZM in the Belgian coastal area.

15.4.1 Visions for the development of the coastal region

Recently, several visions from different perspectives (academia, policy, industry, etc.) have been drafted for the development of the coastal zone. Some of these initiatives are listed below:

- In the policy document of the Architect of the Flemish Government, Peter Swinnen (*Swinnen 2010* [226551]), the coast is defined as an area with a potentially strong appeal and international recognition. The Flemish Government Architect wants to scan the architectural and spatial margins of Flanders on the coast with a study of regional or cross-border areas in the report *'Metropolitaan Kustlandschap 2100'* [225477] (not finished yet).
- The *Kappaplan* [220908] of 'Natuurpunt' provides a vision and an overview of existing and potential measures to prepare the coast for the impacts of climate change.
- In the context of a European project '*Coastal Communities 2050* [128455]', it has been examined whether the different visions that are currently being developed can be aligned and may reinforce each other.
- The department of Mobility and Public Works coordinates the project *Flanders Bays* (included in the coalition agreement of the Flemish Government, *regeerakkoord van de Vlaamse regering (2009-2014)* [225478]). The project aims at developing a vision of the future of the Flemish coast, with the recovery of a wide and 'soft coast' and the protection against a changing environment. The vision also provides space for the development of the seaports.
- The coast as an area for development was also the basis of the CcASPAR project. The CcASPAR project (Climate change and changes in spatial structures in Flanders, funded by the Agency for Innovation by Science and Technology (IWT)) has conducted research on the spatial impact of climate change in order to formulate spatial adaptation strategies and sustainable policy implications for Flanders at different spatial scales. The strategies developed were tested on the coast and in the Yser estuary (*Allaert et al. 2012* [221516]).
- Initiatives of '*Oostende Werft*' and the Coordination Centre for ICZM: workshop '*Beeldkwaliteit aan de Kust*' (2010, *website Coordination Centre*) and workshop '*De Kust moderniteit*' (2013).

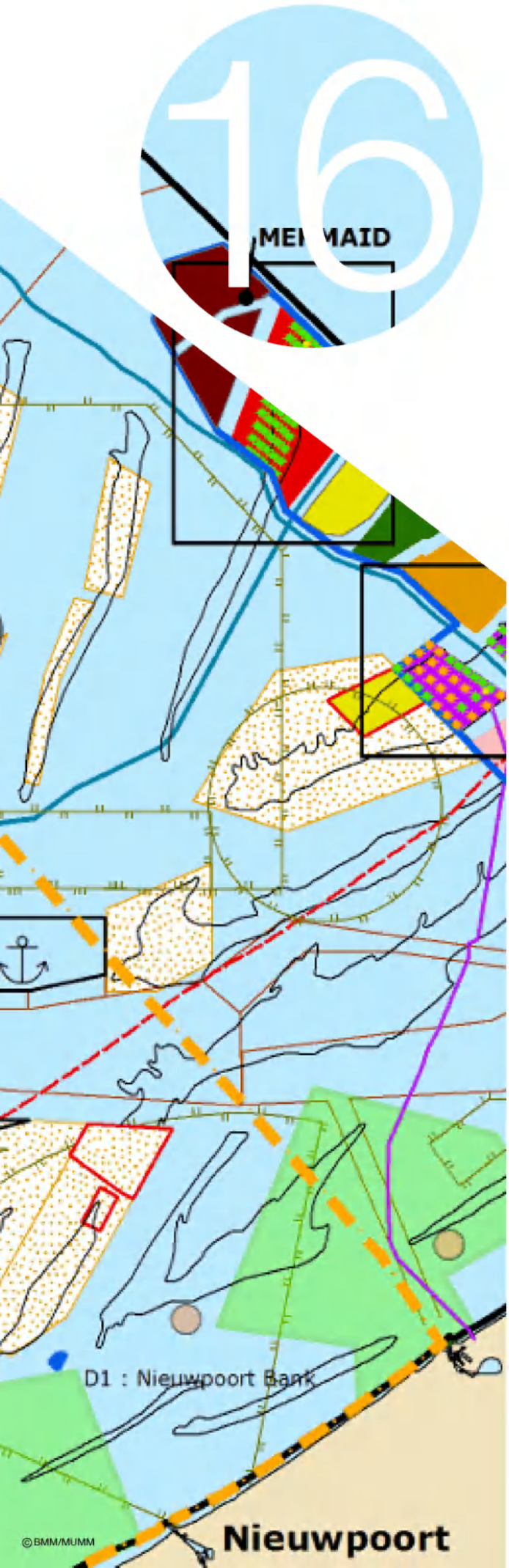
Legislation reference list

Table with European legislation. The consolidated version of this legislation is available on *Eurlex*.

EUROPEAN LEGISLATION			
Abbreviations (if available)	Title	Year	Number
Directives			
Marine Strategy Framework Directive	Directive 2008/56/EC establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive)	2008	56
Other (Decisions, Communications, White Papers, etc.)			
	Council resolution of 25 February 1992 on the future Community policy concerning the European coastal zone	1992	92/C 59/01
	Council resolution of 6 May 1994 on a Community strategy, for integrated coastal-zone management	1994	94/C 135/02
	Proposal for a European Parliament and Council Recommendation concerning the implementation of Integrated Coastal Zone Management in Europe	2000	545
	Communication from the Commission to the Council and the European Parliament on integrated coastal zone management: a strategy for Europe	2000	547
	Recommendation of the European Parliament and of the Council of 30 May 2002 concerning the implementation of Integrated Coastal Zone Management in Europe	2002	413
	Decision No 1600/2002/EC of the European Parliament and of the Council of 22 July 2002 laying down the Sixth Community Environment Action Programme	2002	1600
	Communication from the Commission - Report to the European Parliament and the Council: an evaluation of Integrated Coastal Zone Management (ICZM) in Europe	2007	308
	Communication from the Commission - Roadmap for Maritime Spatial Planning: Achieving Common Principles in the EU	2008	791
	Proposal for a directive of the European Parliament and of the Council establishing a framework for maritime spatial planning and integrated coastal management	2013	133

16

Marine Spatial Planning



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Citation:

Maes, F., Vanhulle, A., Lescrauwaet, A.K., 2013. Marine Spatial Planning. In: Lescrauwaet, A.K., Pirlet, H., Verleye, T., Mees, J., Herman, R. (Eds.), Compendium for Coast and Sea 2013: integrating knowledge on the socio-economic, environmental and institutional aspects of the Coast and Sea in Flanders and Belgium. Oostende, Belgium, p. 261-273.

Maritime/Marine Spatial Planning (MSP) is a planning process during which the public authorities analyse and organise the human activities in marine areas in space and time, in order to achieve ecological, economic and social targets (*Ehler & Douvere 2009* [140628], *COM (2010) 771*). MSP offers an instrument and an assessment framework in order to achieve the proposed policy objectives, in the context of the growing demand for marine space. Currently, MSP is being developed in the European Union (EU) Member States, but also in the United States and other regions around the world. In this regard, European and international initiatives, *inter alia* within the context of the Intergovernmental Oceanographic Commission (IOC) of UNESCO, are trendsetting. Initially, MSP originated from the global need for the demarcation of marine protected areas (MPAs). More recently, the active planning and management of multifunctional spatial use, especially in important conflict areas, receives particular attention due to the developments in offshore wind energy. Over the past few years, the European Commission (EC) has taken the initiative for the legal anchoring of the concept of MSP in European regulation by means of the European *Integrated Maritime Policy* (IMP) (*COM (2010) 771*) and has proposed common principles with regard to MSP in the waters of the European Member States. In European regulation (see below), the term 'Maritime Spatial Planning' (MSP) is used to stress the holistic approach to the process (roadmap (*COM (2008) 791*), Action plan (*SEC (2007) 1278*)) (see below).

The sea constitutes approximately 10% of the Belgian territory: 3,457 km² (VLIZ 2010). The maritime sectors of the Belgian economy contribute significantly to national prosperity with a turnover of nearly 15 billion euros (*WES 2010* [203225]). The technological progress as well as new societal challenges increasingly put pressure on the available marine space. Belgium was one of the first countries in the EU that drafted a marine spatial plan (the so-called Masterplan North Sea, 2005). The *law of 20 July 2012* concerning the organisation of the MSP introduces the concept of MSP in the *law of 20 January 1999* concerning the marine environment. The law focuses on the planning process, stakeholder participation, public consultation and the strategic environmental impact assessment (EIA). The law defines the Marine Spatial Plan for Belgium as a plan that organises the desired spatial, three-dimensional and temporal structure of the human activities, based on a long-term vision and by means of clear economic, social and ecological objectives. The law gives a legal character to the marine spatial plan and will be revised every six years.

16.1 Policy context

On an international level, a great deal has been accomplished with regard to the development of legislation and policy in support of MSP (*Maes 2008* [136406]). Since 1990, several efforts and agreements have been made in anticipation of an ecosystem-based approach to the conservation of marine ecosystems, seas and oceans. In this context, MSP is considered an important cornerstone (*Rio Declaration, 1992*, *Convention on Biological Diversity 1992* (*CBD*), World Summit on Sustainable Development 2002 (*WSSD*), IOC UNESCO directives on MSP (*Ehler & Douvere 2009* [140628])). Effective implementation of MSP on an international level has mainly been the result of the decisions of the Conference of the Parties (such as COP VII/11) of the *Convention on Biological Diversity* (CBD), which emphasised the importance of MSP principles, based on an ecosystem approach. These principles *inter alia* include integrated management of marine and coastal areas, the application of an EIA for individual projects and a Strategic Environmental Assessment (SEA) for plans and programmes, and the need for an ecologically representative network of MPAs.

In October 2007, the EC drafted the main policy lines for the future *IMP* for the European Union (*COM (2007) 575*) and the related Action Plan (*SEC (2007) 1278*), based on a common vision and common principles. This vision is explained in the 'Roadmap for Maritime Spatial Planning: Achieving Common Principles in the EU' (*COM (2008) 791*). With this roadmap, the EC wants to encourage the Member States to apply the principles on a national level, in coordination with a common approach in the regional seas and European waters. The EC also provides guidance for the application of these principles within the guidelines for an integrated approach to maritime policy (*COM (2008) 395*). For Europe, MSP is an important instrument to realise the objectives of the *IMP*: it promotes the coordination of the different authority levels and of the various activities that take place in the marine ecosystem. With this approach, Europe wants to manage the maritime activities in an ecosystem-based way. The ecosystem is thus considered as the basis for the management of human activities at sea (see also theme **Nature and environment**). A few European countries are currently developing MSP following this ecosystem-based approach. These countries include Belgium, the Netherlands, the United Kingdom, Norway and Germany (more information: *http://www.unesco-ioc-marinesp.be*). In 2011, the EC launched a public consultation to investigate the different options for the promotion and development of MSP and the interaction with Integrated Coastal Zone Management (ICZM, see theme **Integrated coastal zone management**). On 12 March 2013, the EC approved a proposal for a directive establishing a framework for MSP and ICZM (*COM (2013) 133*), in view of the further development of the regulation on MSP in the European waters and the alignment of the approaches to MSP and ICZM.

In Belgium, two important laws have been approved with regard to MSP, driven by the *United Nations Convention on the Law of the Sea* (*UNCLOS*, 1982):

- The law concerning the Exclusive Economic Zone (EEZ) of Belgium (*law of 22 April 1999*) and modifying the *law of 13 June 1969*;
- The law concerning the protection of the marine environment and the organisation of MSP in the Belgian part of the North Sea (BNS) (*law of 20 January 1999*, modified by the *law of 20 July 2012*).

These laws constitute a framework for decisions with regard to new users of the sea, such as the construction of offshore wind farms, the growing demand for space for submarine cables and pipelines, new types of recreation at sea and the demarcation of MPAs. The construction of offshore wind farms requires a domain concession as well as an environmental permit. This is also the case for submarine cables to transport the electricity generated at sea to shore.

In 2003, a policy for the BNS was specifically included in the federal coalition agreement (July 2003), and a federal minister was appointed to coordinate all federal competencies on the BNS. The Minister of the North Sea is also responsible for MSP. Hence, the development of a sustainable vision for the North Sea was placed high on the agenda. The *cooperation agreement of 8 July 2005* between the Federal State and the Flemish region concerning the foundation and the collaboration within the structure of the 'Coast Guard', ensured an organised framework for the coordination and mutual consultation between the different policy domains with regard to the sea (*law of 4 April 2006*, *Decree of 17 March 2006*).

The *Royal Decree of 7 September 2003* and the *Royal Decree of 9 September 2003* introduced a procedure for the acquirement of a licence and the obligation to carry out an EIA for activities covered by article 25 of the *law of 20 January 1999*. These obligations do not apply to commercial fisheries, (marine) scientific research and shipping. Table 1 includes a list of the activities that are or are not subject to the licence and EIA obligation of the above-mentioned Royal Decrees.

Table 1. Activities that, according to the *law of 20 January 1999*, are subject or not subject to a licence or EIA obligation.
Note: the specific 'sectoral' legislation is discussed in more detail in the respective themes of Chapter 2.

SUBJECT TO THE LICENCE AND EIA OBLIGATION	NOT SUBJECT TO THE LICENCE AND EIA OBLIGATION
Civil engineering projects	Commercial fisheries
Trenching and raising of the seabed	(Marine) scientific research
The use of explosives and acoustic devices with a high power	Shipping
The abandonment and destruction of shipwrecks and sunken ship cargoes	Activities that are necessary for the execution of matters of the Flemish Region
Industrial activities	Individual activities without profit
Activities mentioned in the *Law of 13 June 1969*	
Publicity and trade associations activities (a part of which is covered by a simplified procedure)	

Licenses and EIAs ensure the alignment of the different user functions in the North Sea. In order to obtain a licence, the applicant needs to draw up an environmental impact report together with the application. This report estimates the impact of the proposed activity and proposes alternatives if need be. On the basis of this report and the application, the Management Unit of the North Sea Mathematical Models (*MUMM*) (RBINS) makes an EIA. This EIA is the scientific advice of the licence application. The advice is forwarded to the Marine Environment Department of the FPS Health, Food Chain Safety and Environment. The latter department can also add its advice. Subsequently, the application is delivered to the competent minister who makes a final decision.

In the national legislation, marine sand and gravel extraction is covered by the *law of 13 June 1969* that regulates the exploration and the exploitation of the non-living resources of the territorial sea and the continental shelf. The geographical demarcation and the accessibility of the zones where exploration and exploitation of the mineral and other non-living resources of the territorial sea and the continental shelf can take place, are stipulated in the *Royal Decree of 1 September 2004 - procedure* and are also governed by the *Royal Decree of 1 September 2004 - EIA* (specific 'sectoral' legislation is discussed in detail in the respective themes of Chapter 2, see themes **Sand and**

gravel extraction, Dredging and dumping). The *Royal Decree of 11 April 2012* (in implementation of the *law of 13 June 1969*), delimits safety zones around artificial islands, installations and devices for power generation from water, currents and the wind in the BNS.

Belgium has already completed an important trajectory concerning MSP. In 2003, Belgium was one of the first Member States with an operational spatial plan for the marine areas, including the territorial sea and the EEZ. The 'Masterplan North Sea' (2003-2005) mainly originated from the demand for clear delimitations for the installation of offshore wind farms and MPAs (*Douvere et al. 2007* [221555]). In the Masterplan, the minister of the North Sea established some of the main tasks of his policy, such as the construction of a wind farm at the Thornton Bank, the demarcation of MPAs, enhanced monitoring and prosecution in case of oil pollution at sea ('zero tolerance policy'), and a policy plan for sustainable sand and gravel extraction. The 'Masterplan North Sea', which may be considered as the first spatial plan for the BNS, has been gradually implemented since 2003, and has led to a zoning system for sand and gravel extraction in new management areas. In this regard, a sequential rotation system has been used for the most intensively exploited zones, zones which are temporarily closed during the spawning season of fishes, and an exploration zone where research is conducted to investigate potential future extraction. Furthermore, work has also been done on the multifunctional use of the sea, the protection of wrecks from both an archaeological and ecological perspective, a seaward extension of the terrestrial protected area in Knokke-Heist and the demarcation of zones for research on alternative fishing methods.

The Masterplan was a static plan that was not embedded in a framework with a vision for the future, a specific policy framework and an organised planning process (*Belpaeme et al. 2011* [209076]). The *GAUFRE* project (*GAUFRE project BELSPO*) developed alternative scenarios for a spatial structure plan for the BNS (Maes et al. 2005 [78467]). This policy-preparing research produced breakthrough results that have been a source of inspiration far beyond Belgium. With only 3,457 km² and a potential use of 260% of the available space, Belgium faces an important challenge. An area with numerous intensive maritime user functions such as the BNS, requires a detailed MSP process (*Belpaeme et al. 2011* [209076]). The BNS can also serve as an example for the implementation of the *IMP*, in particular in the European maritime areas with intensive spatial use.

The subsequent ministers for the North Sea further shaped the policy concerning the North Sea (table 2) and in 2009, MSP was put back on the agenda (*Policy Document Marine Environment 2009* [225442]). The MSP initiative was coordinated by the *Marine Environment Department*. With the appointment of the new federal Minister of Economy, Consumers and the North Sea in 2011, a new marine spatial plan was announced in the *Policy Document Economy, Consumers and the North Sea 2011* [226536] which takes into account:

- The possible delimitation of a new area for wind turbines;
- The possible development of offshore renewable energy sources other than wind energy;
- The possibility to create cross-border MPAs;
- The possible construction of a logistic platform for sea shipping.

Table 2. Overview of the historical trajectory of the implementation of MSP in Belgium and the interaction with the developments on the European level.

YEAR	POLICY INSTRUMENT	OBJECTIVE/REFERENCE TO MSP OR ASPECTS OF THE MSP PROCESS
2003	Masterplan North Sea	First spatial plan for the BNS
2003-2004	*Policy document of the FPS Mobility and Transport of the minister of Mobility and Social Economy 2004* [226534]	Development of a longtermvision for the North Sea, based on the sustainable management of shipping and the coordination of the different competencies on the North Sea policy (emergency response, licences and concessions)
2004-2005	*Policy document Mobility 2004* [226529]	No reference to the North Sea policy
2005-2006	*Policy document of the minister of Mobility 2005* [226530]	(Title 3.8): monitoring of the voluntary agreements with the recreational users of the sea in the context of the protected marine reserve 'Baai van Heist' and the Birds and Habitats Directive areas; monitoring of the planned implementations such as the protection of wrecks with an important archaeological value.
2006	Green Paper - Towards a future Maritime Policy for the Union: A European Vision for the Oceans and Seas (*COM (2006) 275*)	MSP for the first time on the European political agenda

YEAR (continuation)	POLICY INSTRUMENT	OBJECTIVE/REFERENCE TO MSP OR ASPECTS OF THE MSP PROCESS
2006-2007	*Policy document of the minister of Mobility 2006* [226531]	(Title 3.8): the sustainable implementation of the Masterplan concerning sand extraction, concessions of wind farms, consultation with the Netherlands with regard to the demarcation of *Vlakte van de Raan*, the demarcation of zones for the protection of wrecks with an important archaeological value.
2007	Communication of the EC on an IMP for the EU and a Roadmap/action plan (*COM (2007) 575* and *SEC (2007) 1278*)	'Blue paper' refers to MSP as a cornerstone for the European *IMP*.
2007-2008	*Policy document of the prime minister concerning the Marine Environment 2008* [226532] DOC 52 0995/015 (2007/2008)	(Title 3.1) Reference to the demand for marine space and the need for sustainable development and impact assessment, and the drafting of a marine cadastre, (title 3.2) the drafting of policy plans for the MPAs that were designated in 2005. Monitoring of the quality of the marine environment and prevention of and protection against marine pollution.
2008-2009	*Policy document of the prime minister concerning the Marine Environment 2008-2009* [226533]	(Title 3.1) Simplification of the licence procedures and environmental impact reporting, the initiation of consultation with the users and the authorities involved in anticipation of an integrated and balanced spatial planning policy in the BNS.
2008	Roadmap to maritime spatial planning. Communication of the Commission (*COM (2008) 791*)	Proposal of the EC for the application of common principles on MSP in the EU.
2009-2010	*Policy document Marine Environment 2009* [225442] DOC 52 2225/023	Refers to the masterplan of 2003 and to an extension of this masterplan with *inter alia* a sustainable transport policy in the Belgian EEZ, the reform of the existing demarcation for offshore wind energy, taking into account an integrated vision for the marine environment.
2009-2010	*Policy document Marine Environment 2009* [225442] DOC 52 2225/024	Refers to 4 policy pillars for a sustainable policy in the BNS and the importance of the *Marine Strategy Framework Directive* (*2008/56/EC*) (MSFD) as a milestone for the implementation of the MSP. Highlights the necessity for a renewed MSP and the commitment to deliver a significant contribution to a new MSP process, and to keep this process high on the agenda.
2010	Decision of the EC (01/09/2010) in implementation of the *MSFD* (*2010/477/EC*)	Annex part A (title 6) and part B (descriptive element 7) refer to MSP as an instrument supporting an ecosystem-based approach, the evaluation of the size and the cumulative aspects of the impact of human activities and for the achievement of a good environmental status in the *MSFD*.
2010	Communication of the EC on the MSP in the EU (*COM (2010) 771*)	Situation and new insights with regard to MSP in Europe, the relation of MSP to other policy instruments (*Common Fisheries Policy*, *MSFD*, ICZM), and the future perspective for MSP in Europe and the regional seas.
2011	EU Regulation establishing a Programme to support the further development of an Integrated Maritime Policy (*1255/2011/EC*)	Establishes a programme to support the further development of the *IMP*.
2011	*Policy document Economy, Consumers and the North Sea 2011* [226536]	Announcement of a new marine spatial plan for the BNS.
2012	Amendment of the *law of 20 January 1999*	Legislative base for the marine spatial plan and the legally binding character, a review every 6 years.
2012	Royal Decree in implementation of the MSP	An advisory commission and a procedure for the adoption of the marine spatial plan in the BNS.
2013	The draft of the Marine Spatial Plan (*Ontwerp van koninklijk besluit tot vaststelling van het marien ruimtelijk plan, 2013* [227527]) *Milieueffectenrapport van het ontwerp van marien ruimtelijk plan, 2013* [227526]	Public consultation based on the draft of the Marine Spatial Plan (*Ontwerp van koninklijk besluit tot vaststelling van het marien ruimtelijk plan, 2013* [227527]) and the associated SEA (*Milieueffectenrapport van het ontwerp van marien ruimtelijk plan, 2013* [227526]).

The zoning in the Masterplan was not legally anchored as an integral plan: the different zones were indicated by different Royal Decrees. A procedure was lacking to give the plan a legal status and therefore it was not possible to modify or evaluate it timely.

The *law of 20 July 2012* introduces the organisation of the MSP into the *law of 20 January 1999* concerning the protection of the marine environment. The law focuses on the planning process, stakeholder participation, public consultation and the strategic EIA. This law attributes a legally-binding character to the marine spatial plan. The procedure for the marine spatial plan is established by the King by means of a Ministerial Council decision. The marine spatial plan is also set by the king, with a decision of the council of ministers. The plan is evaluated every six years and adapted if need be, but the King can also insert an interim modification procedure. Finally, by means of the *Royal Decree of 13 November 2012*, an advisory commission was established by the King. At the moment (September 2013), public consultation is taking place based on the draft of the Marine Spatial Plan (*Ontwerp van koninklijk besluit tot vaststelling van het marien ruimtelijk plan, 2013* [227527]) and the associated SEA (*Milieueffectenrapport van het ontwerp van marien ruimtelijk plan, 2013* [227526]).

16.2 Spatial use

The many involved actors and authorities that claim the use of (a part of) the BNS, evolved in the need for MSP. The original Masterplan North Sea (2003) was drafted on an '*ad hoc*' basis, taking into account the different sectoral regulations. This way, consultation with other users of the sea was not always necessary in case of modifications. Given the growing demand for marine space over the past few years, with the demarcation of MPAs, the zones for offshore wind energy, new concession zones for sand extraction, etc., the '*ad hoc*' model seemed to have reached its limits.

The BNS is, in compliance with the *UNCLOS Convention*, divided into five marine zones, each with a different legal character (*Maes & Cliquet 1997* [24406], *Somers 2004* [143607]). These zones are: the territorial sea, the contiguous zone, the continental shelf, the fisheries zone and the exclusive economic zone (EEZ) (the last three zones have the same geographical delimitation). The continental shelf only concerns the exploration and the exploitation of the non-living resources of the seabed and its subsoil, while the EEZ refers to exploration and exploitation of the living and non-living resources of the water as well as the seabed and the subsoil. A complete overview of the different legal zones of the BNS is given in *Maes et al. (2005)* [18619] and with regard to the legislation in *Maes & Cliquet (2004, 4 parts)* [1573] and *Somers & Maes (2011)* [221400].

The zoning plan (Maes et al. 2005 [78467], *GAUFRE project BELSPO*) shows the limitations of the legislative demarcations, the existing nature conservation areas at sea (Natura 2000 and *Ramsar* areas) and delimits areas for sand and gravel extraction, anchorages and shipping routes, zones for renewable energy, aquaculture, protection of the maritime heritage, military use and other users. A detailed description of the spatial use of each of the user functions is available in the respective themes of **Chapter 2**.

Several research projects have been conducted on the management of spatial use in the BNS[1]. The *GAUFRE* project (2003-2005) (*GAUFRE project BELSPO*) was aimed at establishing the scientific basis to develop a spatial structure plan for the BNS. GAUFRE also initiated a structure plan which takes into account the conflicts between several stakeholders, and active participation of these groups and the general public. The results published in the book 'A Sea of Space' (Maes et al. 2005 [78467], *GAUFRE project BELSPO*) showed that the potential demand for space was approximately 2.6 times higher than the available space (allocation of space based on the legislation which existed at that moment, and on the condition that this space would be used). Since this study, a significant seaward extension of the former Trapegeer-Stroombank area has been realised. The entire MPA now covers a surface of 1,099.939 km^2 (an extension of approximately 920 km^2) and covers more than a third of the total surface of the BNS. The *BWZee* project (April 2004 - March 2006) developed a scientifically underpinned methodological framework for the execution of a biological valuation and applied this to the BNS. The final product was a biological valuation map that revealed the relative importance of the entire BNS in terms of natural values and biological diversity for the first time, at least on the basis of an (incomplete) number of relevant taxonomic groups. In the *BALANS* project (2002-2006) (*BALANS project BELSPO*), a conceptual policy model was developed that strived for a balance between the social, economic and ecological indicators with regard to a sustainable North Sea policy. The model is considered as support for the marine policy and was tested on real data of shrimp fishing and sand extraction.

1 Other research and monitoring projects that contribute indirectly to MSP, or projects which are not integrative or specifically aimed at the BNS, are discussed in Chapter 1.

THE DIFFERENT USERS OF THE BNS

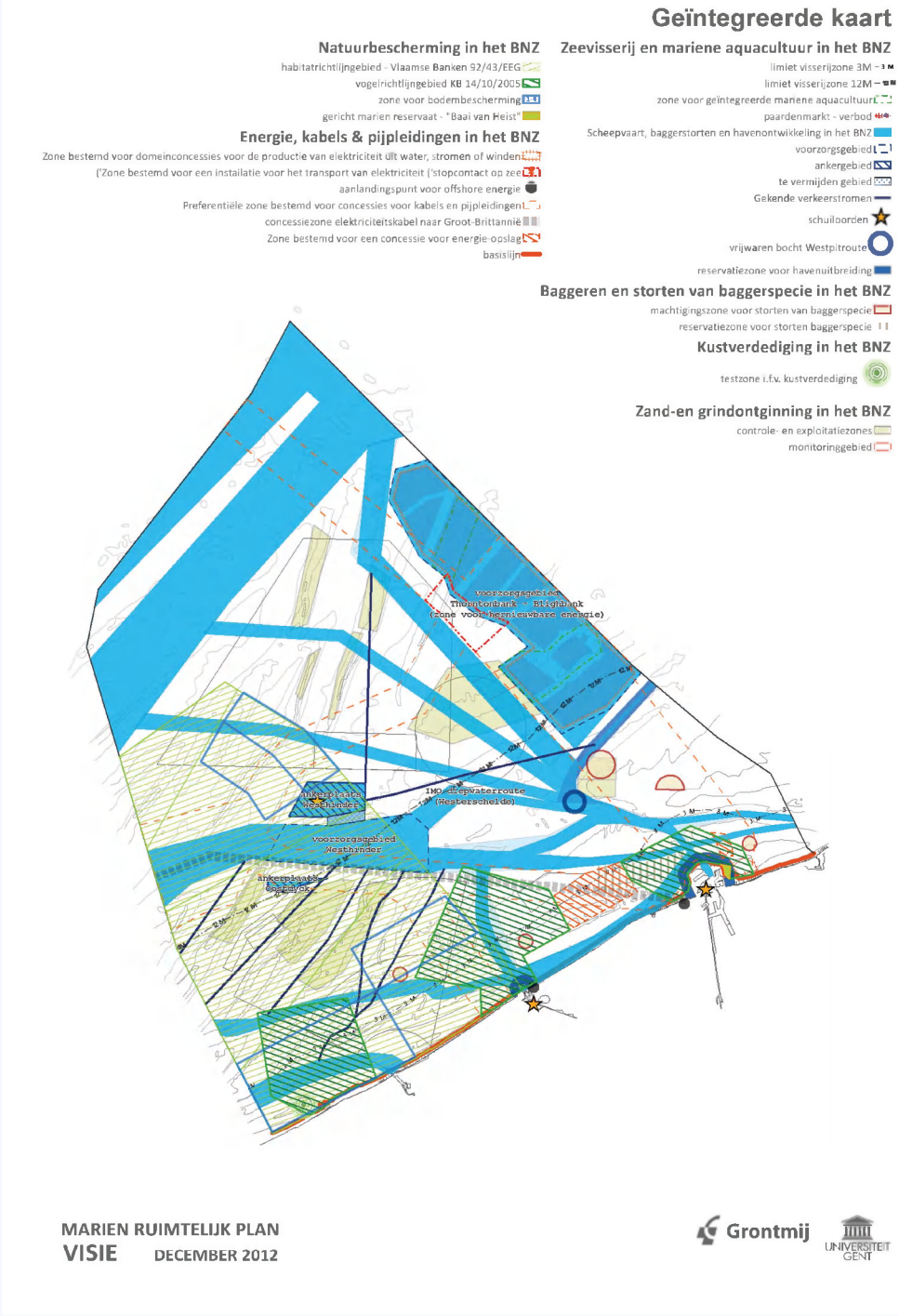

Figure 1. An integrated map with the different users of the BNS as included in the draft of the marine spatial plan (*Ontwerp van het koninklijk besluit tot vaststelling van het marien ruimtelijk plan, 2013* [227527]).

16.3 Societal interest of MSP

(Adapted from the Position paper on MSP, *Belpaeme et al. 2011* [209076]).

MSP offers a legal procedure and an assessment framework to achieve the policy goals on the economic, social and ecological level for the BNS, in the context of the growing demand for marine space. The societal benefits of MSP are mainly situated in the following aspects:

- A **transparent framework** for a spatial and temporal alignment of the (co-)users and (co-)user functions in the BNS, in the **land-sea** transition zone as well as in the **border areas**;
- A legal framework that allows the government, investors and operators to plan investments and initiatives more efficiently in the long term;
- Support of an **ecosystem-based approach** to management at sea, with attention to the carrying capacity of the marine environment;
- A platform for the **alignment of the competent authorities** (including the sectoral legislation and licence procedures) with a centralised licence policy and clear procedures;
- A platform for the **integration of scientific knowledge** and information in the policy and decision-making processes;
- A **monitoring and evaluation system** supporting an adaptive policy and management;
- A **vision for the future** that includes the social and economic needs and benefits in the **long term.**

(adapted from *Belpaeme et al. 2011* [209076])

An exhaustive explanation of the societal benefits of MSP, as well as an overview of the MSP processes in Belgium, in the neighbouring countries or on a worldwide scale (including reference material) can be found in *Dahl et al. (2009)* [140628], *Douvere (2010)* [195891] and *Belpaeme et al. (2011)* [209076]. The *MESMA* project (EU FP-7, 2010-2014) intends to develop an instrument for the alignment of various aspects of the spatial management of the marine environment in Europe. The BNS is included as a case study in the project. The elaboration of an 'open' data system with information on (1) the distribution of marine habitats and species, (2) economic values and benefits and (3) human activities and effects is an important aspect in this context. This database should constitute an interface between science, politics and policy-makers.

16.4 Current status

Belgium is working on an integrated maritime spatial use plan and planning process. An SEA of the draft marine plan concerning the impact of an MSP process in the BNS is currently open for public consultation (*Milieueffectenrapport van het ontwerp van marien ruimtelijk plan, 2013* [227526]). The concept of MSP has been discussed in several national and international organisations, working groups and societal think-tanks. These exercises offer interesting perspectives and challenges that can be taken into account during the current preparation of the MSP process in the BNS (table 3).

Table 3. Initiatives and processes preparing MSP with regard to the BNS.

INITIATIVE	PRODUCT
(2003-2005) *GAUFRE* project (*GAUFRE project BELSPO*)	The *GAUFRE* project developed the scientific basis and initiated a spatial structure plan for the BNS, including conflict analysis and participation. The results were aggregated in the publication ' A Sea of Space' (*Maes et al. 2005* [78467]).
(2008) Private enterprises "*Flanders bays 2100*"	A consortium of Flemish dredging companies and consultants proposed 'Flanders Bays 2100' as a vision for a sustainable future of the coast. The Flemish government investigated the feasibility of the project and its subprojects.
(2009) Spatial designers: Office for Metropolitan Architecture (OMA)	The *Masterplan Zeekracht* of the OMA thought about the possible location of windmills in the North Sea, and about the creation of new space for multifunctional use.
(2009-2010) MARIPAS project: shared spatial use of fisheries and energy production in the BNS	A feasibility study for the development of fisheries and aquaculture in offshore wind farms: an overview of the opportunities and restrictions with regard to fisheries and mariculture, the regulation and the opinion of all stakeholders; explore opportunities to link sustainable fisheries / mariculture in the long term to sustainable energy production in the BNS in order to realise an additional commercial value.

INITIATIVE (continuation)	PRODUCT
(2010-2011) The *ad-hoc* working group MSP, composed of independent experts, academics and scientists, aiming to formulate recommendations with regard to MSP in Belgium	An *inventory of MSP in Belgium* [221481] based on the UNESCO guide for MSP (*Ehler & Douvere 2009* [140628]). A position paper (*Belpaeme et al. 2011* [209076]) that discusses the future approach to MSP. The task force is established by the Coordination Centre for ICZM in the context of the C-scope project.
(2009-2012) *C-scope project*: combining sea and coastal planning in Europe (INTERREG 2 Seas Programme)	A final report with the experiences of the project concerning integrated planning on land and at sea, based on two case studies in the *Baai van Heist* nature reserve (Belgium) and Dorset (UK). In these case studies, the way in which land and sea planning can be linked was investigated.
(2009-2013) *MESMA project*: Monitoring and Evaluation of Spatially Managed marine Areas (EU FP7 Programme)	European collaboration and alignment of MSP and the development of integrated management tools (concepts, models, directives) for monitoring, evaluation and implementation of MSP in marine areas. Includes a case study in the southern part of the North Sea.
(2010) Spatial designers: Spatial manifest, *M.U.D.* (multi-user-dimension)	FLC – an independent association of designers, urbanists and artists – opened a debate on planning in the coastal zone in order to develop a proactive image of the coast. FLC started from a scenario of sea level rise. The final product was graphic work (exhibition, video, leaflet, etc.).
(2010) Architects and spatial planners Charlotte Geldof and Nel Janssens	A critical essay concerning spatial planning at sea: MSP – developing a critical vision and the importance of the commons (*Geldof & Janssens 2010* [199919]).
(2010-2012) The *MASPNOSE* project (EU co-financing)	Test project on MSP in the North-Eastern Atlantic Ocean with partners from the Netherlands, Belgium, Germany and Denmark, aiming to gain experience in the implementation of cross-border MSP. There were two study areas: the Dogger Bank and the Belgian-Dutch border at the Thornton Bank. MASPNOSE initiated a dialogue between Belgian and Dutch MSP experts and offered the basis for a potential Dutch wind energy zone that is connected to the Belgian offshore wind energy zone.
(2010-2011) TransMasp (Transboundary Maritime Spatial Planning) project (Marie Curie Fellowship)	TransMasp conducted a scientific analysis of the cross-border aspects of MSP as well as the interaction with spatial planning on land for a case study in the French-Belgian marine areas and coastal zone (Nord-Pas-de-Calais and the Belgian coastal zone).
(2012) Flanders Bays. Towards an integrated vision for the coast (Flemish Government).	The project *Flanders Bays* [222799] develops a future vision for the Flemish coast and benchmarks the feasibility of future projects in relation to five pillars: safety, sustainability, naturalness, attractiveness and development.

16.5 Sustainable use

16.5.1 Sustainable management of the human activities at sea

MSP will have an impact on the success of a number of other policy domains as well. The European *Marine Strategy Framework Directive* (*2008/56/EC*) (MSFD) constitutes the basis for the carrying capacity of the marine ecosystem. This is the environmental pillar of the *IMP* which also offers a framework for the economic potential. A Good Environmental Status (GES) has to be achieved and maintained and all relevant human activities need to be executed in coordination with the required protection and conservation of the marine environment as well as in coordination with the concept of sustainable use of marine goods and services.

The legal implementation of the *MSFD* in the national legislation is a cornerstone for the further elaboration and coordination of MSP in the BNS. Besides the legal transposition (*Royal Decree of 23 June 2010*), the following projects were commissioned in the period 2010-2012: an *initial assessment of the status of the marine environment (2012)* [220230], an analysis of the pressures, influencing factors and human activities, a *socio-economic analysis of the users of the BNS (2012)* [220231] and an analysis of the costs related to the destruction of the marine environment. Moreover, a *description of the GES and the Environmental Goals* [220232] has been drafted. These elements contribute directly to the definition of the GES (July 2012) which will be used to benchmark marine activities from 2012 onwards. The implementation of the *MSFD* and the definition of the GES thus constitute the basis for an ecosystem-based

approach to the sustainable use of the marine environment. The implementation of the *MSFD* also requires integration and adaptation of the existing specific regulations, if need be. In this context, certain elements of the *Water Framework Directive* (*2000/60/EC*) (WFD) that are valid in the marine waters were explicitly incorporated in the regulation.

Finally, the BNS is a limited marine area that is fully surrounded by the EEZs of the neighbouring Member States. Hence, the sustainable use of space and the drafting of a long-term vision for marine spatial use are significantly influenced by the policy choices and management of the marine areas of the surrounding Member States. Therefore, cross-border consultation and alignment with the MSP in the border regions is taking place within the scope of the current legislation.

On 12 November 2009, the United Kingdom approved the UK Marine and Coastal Access Act. This law offers a framework for MSP. The Marine and Coastal Access Act also includes the foundation of the Marine Management Organisation (*MMO*) (1 April 2010), a cross-sector body for the planning, regulation and licensing of marine activities with a focus on sustainable development. In 2011, the MMO started with the first of eleven regional maritime spatial plans which also contained a cross-border component. In 2008, the Netherlands expanded the Dutch law on Spatial Planning towards the EEZ. In parallel with this law, the existing maritime spatial plan for the Dutch part of the North Sea was revised. Moreover, the revised maritime spatial plan was integrated into the *Dutch National Waterplan 2009-2015* [205141]. This also includes the spatial management of the coastal zone, estuaries and rivers. The visionary 'integrated management plan North Sea 2015' introduces an integrated evaluation framework for all activities subject to a licence obligation. Until 2005, maritime spatial plans in France were covered by the central government. Since 2005, the local authorities can also initiate and develop maritime spatial plans. The approach is based on the principles of planning on land, using *schémas de cohérence territoriale* (SCOT), offering local coastal authorities the possibility to join. The *Façades Maritimes* constitute the cornerstones of the maritime policy. An approach has been developed, based on the marine activities and their connection to the land (Queffelec & Maes 2013). More information on MSP worldwide is available on the following website: *http://www.unesco-ioc-marinesp.be/msp_around_the_world*.

Legislation reference list

Table with international agreements, conventions, etc.

INTERNATIONAL AGREEMENTS, CONVENTIONS, ...			
Abbreviations (if available)	Title	Year of conclusion	Year of entering into force
Ramsar Convention	Convention on Wetlands of International Importance especially as Waterfowl Habitat	1971	1975
UNCLOS	United Nations Convention on the law of the Sea	1982	1994

Table with European legislation. The consolidated version of this legislation is available on *Eurlex*.

EUROPEAN LEGISLATION			
Abbreviations (if available)	Title	Year	Number
Directives			
Water Framework Directive	Directive 2000/60/EC establishing a framework for Community action in the field of water policy	2000	60
Marine Strategy Framework Directive	Directive 2008/56/EC establishing a framework for Community action in the field of marine environmental policy (Marine Strategy Framework Directive)	2008	56
Regulations			
	Regulation establishing a Programme to support the further development of an Integrated Maritime Policy	2011	1255
Other (Decisions, Communications, White Papers, etc.)			
	Communication from the Commission - Towards a future Maritime Policy for the Union: A European Vision for the Oceans and Seas	2006	275
IMP	Communication from the Commission - An Integrated Maritime Policy for the European Union	2007	575
	Commission staff working document (SEC) - An Integrated Maritime Policy for the European Union	2007	1278
	Communication from the Commission - Guidelines for an integrated approach to maritime policy: towards best practice in integrated maritime governance and stakeholder consultation	2008	395
	Communication from the Commission - Roadmap for Maritime Spatial Planning: Achieving Common Principles in the EU	2008	791
	Commission Decision of 1 September 2010 on criteria and methodological standards on good environmental status of marine waters	2010	477
	Communication from the Commission - Maritime Spatial Planning in the EU - achievements and future development	2010	771
	Proposal for a directive of the European Parliament and of the Council establishing a framework for maritime spatial planning and integrated coastal management	2013	133

Table with Belgian and Flemish legislation. The consolidated version of this legislation is available on *Belgisch staatsblad* and the *Justel-databases*.

BELGIAN AND FLEMISH LEGISLATION	
Date	Title
Laws	
Wet van 13 juni 1969	Wet inzake de exploratie en exploitatie van niet-levende rijkdommen van de territoriale zee en het continentaal plat
Wet van 20 januari 1999	Wet ter bescherming van het mariene milieu en ter organisatie van de mariene ruimtelijke planning in de zeegebieden onder de rechtsbevoegdheid van België
Wet van 22 april 1999	Wet betreffende de exclusieve economische zone van België in de Noordzee
Wet van 4 april 2006	Wet houdende instemming met het Samenwerkingsakkoord van 8 juli 2005 tussen de federale Staat en het Vlaamse Gewest betreffende de oprichting van en de samenwerking in een structuur Kustwacht
Wet van 20 juli 2012	Wet tot wijziging van de wet van 20 januari 1999 ter bescherming van het mariene milieu in de zeegebieden onder de rechtsbevoegdheid van België, wat de organisatie van de mariene ruimtelijke planning betreft
Royal Decrees	
KB van 20 maart 2000	Koninklijk besluit ter definiëring van de procedure voor machtiging van het storten in de Noordzee van bepaalde stoffen en materialen
KB van 12 augustus 2000	Koninklijk besluit tot instelling van de raadgevende commissie belast met de coördinatie tussen de administraties die betrokken zijn bij het beheer van de exploratie en de exploitatie van het continentaal plat en van de territoriale zee en tot vaststelling van de werkingsmodaliteiten en –kosten ervan
KB van 20 december 2000	Koninklijk besluit betreffende de voorwaarden en de procedure voor de toekenning van domeinconcessies voor de bouw en de exploitatie van installaties voor de productie van elektriciteit uit water, stromen of winden, in de zeegebieden waarin België rechtsmacht kan uitoefenen overeenkomstig het internationaal zeerecht
KB van 12 maart 2000	Koninklijk besluit betreffende de nadere regels voor het leggen van elektriciteitskabels die in de territoriale zee of het nationaal grondgebied binnenkomen of die geplaatst of gebruikt worden in het kader van de exploratie van het continentaal plat, de exploitatie van de minerale rijkdommen en andere niet-levende rijkdommen daarvan of van de werkzaamheden van kunstmatige eilanden, installaties of inrichtingen die onder de Belgische rechtsmacht vallen
KB van 7 september 2003	Koninklijk besluit houdende de procedure tot vergunning en machtiging van bepaalde activiteiten in de zeegebieden onder de rechtsbevoegdheid van België (vergunningsbesluit)
KB van 9 september 2003	Koninklijk besluit houdende de regels betreffende de milieueffectenbeoordeling in toepassing van de wet van 20 januari 1999 ter bescherming van het mariene milieu in de zeegebieden onder de rechtsbevoegdheid van België (MEB-besluit)
KB van 1 september 2004 – toekenningsprocedure	Koninklijk besluit betreffende de voorwaarden, de geografische begrenzing en de toekenningsprocedure van concessies voor de exploratie en de exploitatie van de minerale en andere niet-levende rijkdommen in de territoriale zee en op het continentaal plat (vergunningsbesluit)
KB van 1 september 2004 – milieueffectenbeoordeling	Koninklijk besluit houdende de regels betreffende de milieueffectenbeoordeling in toepassing van de wet van 13 juni 1969 inzake de exploratie en exploitatie van niet-levende rijkdommen van de territoriale zee en het continentaal plat (MEB-besluit)
KB van 23 juni 2010	Koninklijk besluit betreffende de mariene strategie voor de Belgische zeegebieden
KB van 11 april 2012	Koninklijk besluit tot instelling van veiligheidszones rond de kunstmatige eilanden, installaties en inrichtingen voor de opwekking van energie uit het water, de stromen en de winden in de zeegebieden onder Belgische rechtsbevoegdheid
KB van 13 november 2012	Koninklijk besluit betreffende de instelling van een raadgevende commissie en de procedure tot aanneming van een marien ruimtelijk plan in de Belgische zeegebieden
Decrees	
Decreet van 17 maart 2006	Decreet houdende instemming met het samenwerkingsakkoord van 8 juli 2005 tussen de federale Staat en het Vlaamse Gewest betreffende de oprichting van en de samenwerking in een structuur Kustwacht.

BELGIAN AND FLEMISH LEGISLATION (continuation)	
Date	Title
Other	
Samenwerkingakkoord van 8 juli 2005	Samenwerkingsakkoord tussen de federale Staat en het Vlaamse Gewest betreffende de oprichting van en de samenwerking in een structuur Kustwacht

Chapter 3

The marine science-policy interface

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Citation:

Maes, F., Cliquet, A., Van Gaever, S., Lescrauwaet, A.K., Pirlet, H., Verleye, T., 2013. The marine science-policy interface. In: Lescrauwaet, A.K., Pirlet, H., Verleye, T., Mees, J., Herman, R. (Eds.), Compendium for Coast and Sea 2013: integrating knowledge on the socio-economic, environmental and institutional aspects of the Coast and Sea in Flanders and Belgium. Oostende, Belgium, p. 274-307.

1 Relevant policy instruments and authorities

1.1 Introduction

The seas and oceans act as a very important component regarding the global level of well-being and prosperity. They form a great source of food supply and natural resources, supply a lot of ecosystem services, are the global trade routes, offer a wide range of recreational possibilities and have a climate regulating effect. The persistent intensification of the use of the sea and coastal areas has led to a package of legislative and regulating instruments in order to guarantee the sustainable use of the marine space and its resources. The chapter 'Relevant policy instruments and authorities' provides an overview of a selection of marine and maritime policy instruments and rules of law that relate to topics discussed in **Chapter 2**. This overview shows the measures taken by different policy levels, i.e. the international, European, federal and Flemish level.

1.2 International treaties

Written agreements with a binding character between two or more nations (and international organisations) are called treaties or conventions. Following the acceptance and signature of a negotiated text at an international conference by the delegations of the participating countries, the respective governments need to officially ratify the treaty through its implementation into national legislation. The signing of the text by a negotiating delegation only concerns the formal closure of the negotiations and has no legal binding value. The Belgian Constitution (*Art. 167*) states that Belgium can only be officially bound by a convention after the approval by the federal parliament, consisting of the Senate and the Chamber of Representatives.

Most multilateral conventions state that the treaty will enter into force after a certain number of nations (usually in the context of the United Nations and the Council of Europe) or all parties (common for bilateral or trilateral conventions) have ratified the convention. The international entry into force of a convention is not necessarily the entry into force for Belgium. If a treaty does not require the ratification by all nations before it enters into force, it is possible that the treaty has entered into force between a number of nations excluding Belgium. For our country, this will only be the case when we have ratified the treaty ourselves.

The main aim of marine/maritime international conventions includes the harmonisation of the marine/maritime policies and the related strategies, including the development of programmes and measures, which is necessary given the transboundary and international character of maritime activities such as shipping and the protection of the marine environment. The guiding principle of marine multilateral environmental agreements (MEAs) is the ecosystem-based approach. This approach was accepted as a strategic policy principle in the *Convention on Biological Diversity* of 1992. This principle is based on a healthy ecosystem as a basis for the economic use, also in the long term. The *OSPAR* Convention (see **Regional conventions and agreements**) defines the ecosystem approach as the '*the comprehensive integrated management of human activities based on the best available scientific knowledge about the ecosystem and its dynamics, in order to identify and take action on influences which are critical to the health of marine ecosystems, thereby achieving sustainable use of ecosystem goods and services and maintenance of ecosystem integrity*'.

Below, several types of conventions are distinguished, i.e. (1) United Nations (UN) conventions, (2) non-UN conventions with a global geographical perspective, (3) regional conventions and (4) bi- or trilateral conventions.

UNITED NATIONS

The most important organisation responsible for the construction of international treaties is the United Nations (*UN*). The UN is an intergovernmental organisation and, within a marine/maritime context, it aims to promote and facilitate collaboration in the field of international law (*Law of the Sea*), economic development (*green economy*), global safety (*shipping and ports*) and working conditions (*shipping and ports*).

In September 2003, the Ocean and Coastal Areas Network (*UN-Oceans*) was founded within the UN. This network aims at (1) strengthening the coordination and collaboration between several authorities concerning ocean- and coast-related UN activities; (2) evaluating the executed UN programmes and activities that are set within the UN

contribution to the implementation of the *Convention of the Law of the Sea of 1982*; (3) identifying emerging issues (common actions, task forces); (4) promoting the integrated management of the oceans on an international level; (5) facilitating the input for the annual report on oceans and the Law of the Sea of the UN secretariat and (6) fostering the cohesion of the oceanic and coastal UN activities. The network deals with a broad range of marine and coastal topics, and consists of the following UN and UN-related authorities (see also figure 1):

- Departments of the UN secretariat
  - Division for Ocean Affairs and the Law of the Sea (*UN-DOALOS*)
  - United Nations Department of Economic and Social Affairs (*UN-DESA*)
- UN programmes
  - United Nations Development Programme (*UNDP*)
  - United Nations Environment Programme (*UNEP*)
- Specialised UN organisations
  - Food and Agriculture Organization (*FAO*)
  - Intergovernmental Oceanographic Commission of the United Nations Educational Scientific and Cultural Organization (*IOC-UNESCO*)
  - World Bank (*WB*)
  - International Maritime Organization (*IMO*)
  - World Meteorological Organization (*WMO*)
  - International Labour Organization (*ILO*)
  - United Nations Industrial Development Organization (*UNIDO*)
- Related organisations
  - International Atomic Energy Agency (*IAEA*)
- Secretariats of relevant international conventions
  - International Seabed Authority (*ISA*)
  - Convention on Biological Diversity (*CBD*)

For a detailed description of all these organisations we refer to their respective websites or to the *UN-Oceans website* for an overview. Some UN organisations are discussed in more detail below, given their important contribution to the construction of international conventions within a marine/maritime context.

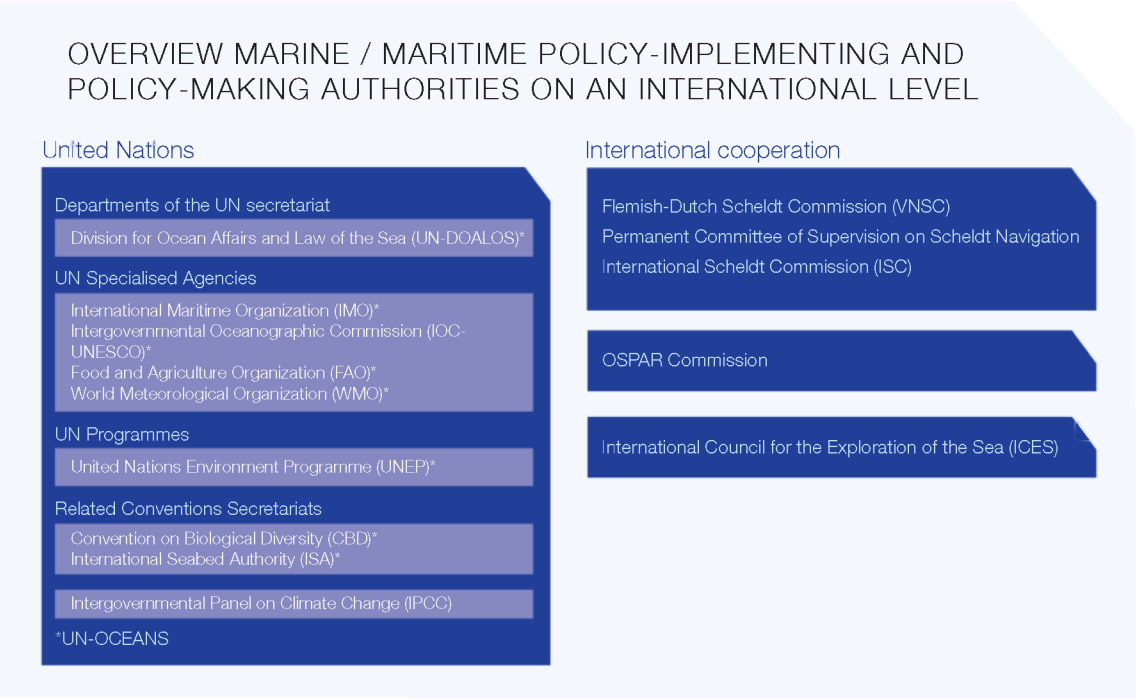

Figure 1. An overview of policy-implementing and policy-making authorities on an international level.

Convention on the Law of the Sea 1982

The Division for Ocean Affairs and the Law of the Sea (*UN-DOALOS*) plays a leading role in the widespread adoption and the substantiated, consistent application of the *United Nations Convention on the Law of the Sea* (*UNCLOS*), and operates as the secretariat for this convention. The division monitors developments in all relevant areas in order to report annually to the General Assembly on matters relating to the law of the sea and ocean affairs. Further, it formulates recommendations to the Assembly and other intergovernmental forums aimed at promoting a better understanding of the convention, and ensures that the organisation has the capacity to respond to requests for advice and assistance from states in the implementation of the convention.

UNCLOS defines the rights and responsibilities of nations in their use of the sea and its natural resources. The classic international Law of the Sea originated in the 17th century, and was largely based upon the *Mare liberum* principle (liberty of the sea) of Grotius. This principle was based upon two main premises, according to which (1) no occupation and exclusive jurisdiction by a nation were possible and (2) marine resources were unlimited (*Somers, 2010* [213864]). A fundamental change in the use of the sea regarding the exploitation of marine resources, pollution, trade, etc. resulted in gradual regulation of the use of the (high) seas in the second half of the 20th century, and was finally written down in *UNCLOS*.

More specifically, *UNCLOS* includes stipulations on topics such as borders, maritime trade and transport (including safety), the maintenance of the marine environment and ecosystems, fisheries and the exploitation of natural resources on the seabed, as well as marine scientific research, economic and commercial activities and the mediation of disputes with regard to the oceans. The operational role concerning the implementation of this convention lies with organisations such as the International Maritime Organization (*IMO*), International Seabed Authority (*ISA*) and the International Whaling Commission (*IWC*).

The convention forms a legal framework for the demarcation of maritime areas subject to the territorial or functional jurisdiction of the coastal state (figure 2). *UNCLOS* determines the rules for the demarcation of the baseline (average low low-water line at spring tide), which acts as the seaward border of the internal waters (figure 2). The territorial sea has been defined as the area extending up to 12 nautical miles (22.224 km) seawards from the baseline (figure 2). The territorial sea is regarded as the sovereign territory of the state (*Somers, 2010* [213864]), although foreign merchant ships are allowed innocent passage through it. The contiguous zone can reach maximum 24 nautical miles (44.448 km) measured from the baseline (figure 2). In this area, the jurisdiction of the coastal state is rather limited and of fragmentary nature. The coastal state has control and prevention competencies such as supervision regarding fiscal, customs, immigration or health regulations (*Somers, 2010* [213864]). The contiguous zone is also part of the exclusive economic zone (EEZ). This zone extends from the outer limit of the territorial sea to a maximum of 200 nautical miles seaward from the baseline. The EEZ is a functional marine area where the coastal state has certain sovereign rights

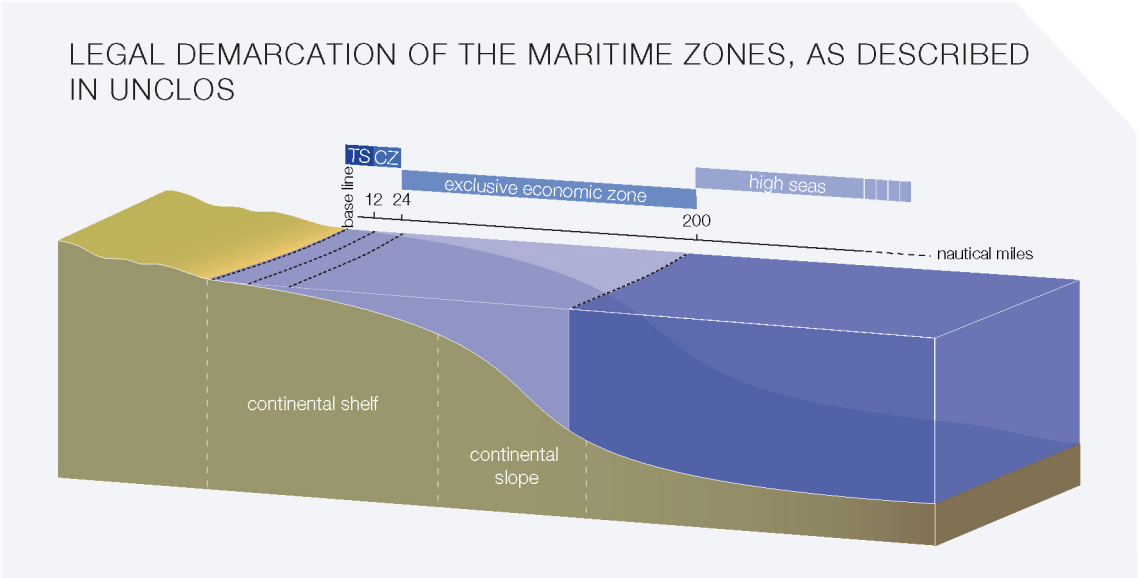

Figure 2. Legal demarcation of the maritime zones, as described in *UNCLOS*. Abbreviations: TS, territorial sea; CZ, contiguous zone.

over the exploration, exploitation, conservation and management of the living and non-living resources of the sea bottom and the seabed, as well as the overlying waters (for other competences, see **Federal legislative framework**). Other nations have the right of freedom of navigation and overflight in the EEZ, as well as the freedom to install cables and pipelines. However, these freedoms have some restrictions. For example, the trajectory of pipelines requires the permission of the coastal state. The Belgian continental shelf (figure 2), which is a seaward continuation of the continental landmass, has the same demarcation as the Belgian EEZ. For defining the demarcation of the continental shelf, we refer to the *Convention of Geneve on the Continental Shelf (1958)*. The coastal state has exclusive sovereign rights over the continental shelf for the exploration and exploitation of the natural resources (living and non-living resources of the sea bottom or surface). This is limited by the fact that no unjustifiable inconvenience may be caused to shipping, fisheries, conservation of living resources and scientific research aimed at publishing the results. The coastal state is free to grant a concession for the exploration and exploitation of resources, and to gain compensations from this (*Somers, 2010* [213864]). Finally, the high seas (figure 2) include all parts of the sea that do not belong to the EEZ, the territorial sea and the internal waters. The high seas are open to all states, and no state can claim sovereignty over any part of this area. The freedoms of the high seas include: freedom of navigation, freedom of fishing, freedom to lay submarine cables and pipelines, freedom to fly over the high seas, freedom of scientific research and freedom to construct artificial islands and other installations permitted under international law.

Sectoral UN conventions

Apart from the integrated *UNCLOS*, the UN conventions focus on topics such as shipping and ports, nature and environment, heritage and the dumping of waste and other materials (dredging and dumping) (figures 3 and 4, table 1).

The specialised UN organisations *IMO* and *ILO* have prepared numerous international conventions. The IMO is responsible for the safety and security of ships, as well as for the prevention of marine pollution by ships (including dumping of waste and other materials). International standards are crucial since the ownership and the ship management often include several countries and ships navigate through various jurisdictions during their economic life. Furthermore, IMO also adopts conventions covering liability and compensations for oil pollution damage. The

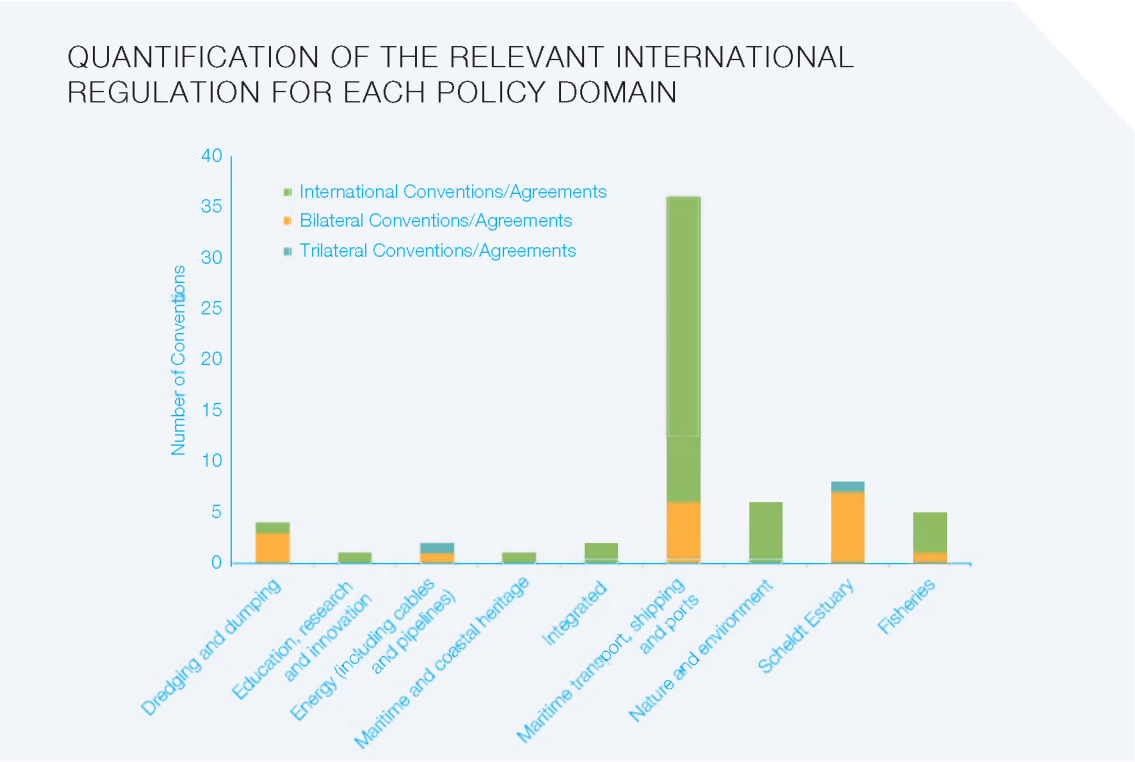

Figure 3. Quantification of the relevant international regulations for each policy domain. Notwithstanding this is a non-exhaustive representation, it indicates which topics are regulated on the international level. For details about the regulation included in this figure, we refer to Annex 3.

Table 1. Selection of the sectoral UN conventions.

TOPIC	INSTRUMENT	CONTEXT
Shipping and ports	MARPOL	The international *Convention for the prevention of pollution by ships* (*MARPOL* 1973), as amended by the Protocol of 1978 and the Protocol of 1997, aims at protecting the marine environment. This is includes the determination of discharge standards and technical requirements.
Shipping and ports	SOLAS	The most important goal of the international *Convention for the safety of life at sea* (*SOLAS* 1974) is to specify minimum standards for the construction, equipment and operation of ships, compatible with their safety, in order to promote the safety of human life at sea. This convention also includes control measures, known as the port state control.
Shipping and ports	STCW	The international *Convention on standards of training, certification and watchkeeping for seafarers* (*STCW* 1978) describes minimum standards for seafarers, allowing individual countries to set higher standards for their seafarers.
Shipping and ports / Dredging and dumping	London Convention	The *Convention on the prevention of marine pollution by dumping of wastes and other matter* (1972) and the Protocol (1996) regulate the dumping of waste and other matter at sea. The protocol replaces the entire convention, and is based upon the precautionary principle.
Heritage	UNESCO Convention on Underwater Cultural Heritage	The *UNCLOS* already required that Member States protect their underwater heritage, without stating how to regulate this protection measure. This allowed the preparation of a specific international regulation for the protection of the underwater cultural heritage, namely the *UNESCO Convention on the Protection of the Underwater Cultural Heritage* (2001).
Nature and environment	Convention on Biological Diversity	The *Convention on Biological Diversity* (1992) meant a big step forward in the protection of biological diversity, the sustainable use of its components and the honest and equitable division of benefits resulting from the use of genetic resources. The *Secretariat of the Convention on Biological Diversity* is institutionally linked to the UNEP .
Nature and environment	Bonn Convention	The *Convention on the conservation of migratory species of wild animals* (*Bonn Convention* 1979) focuses on the protection of migratory aquatic, terrestrial and bird species, as well as their habitats. The secretariat also functions under the authority of UNEP.

most important IMO conventions are the *MARPOL*, *SOLAS* and *STCW* conventions and the *London Convention* (table 1). For an overview of all conventions, we refer to the *IMO website*.

The ILO in turn deals with international labour standards and decent work for all, including ship crews. The ILO aims to obtain social justice and similarity of working conditions in countries competing for markets. More than 40 conventions have been adopted with a maritime focus, such as the accommodation on board fishing vessels, minimum standards for crews on merchant ships, seafarers' hours of work and the manning of ships, etc. For an overview, we refer to the *ILO website*.

Conventions with respect to nature and the environment mainly result from efforts of UNEP. Under the supervision of this UN programme, conventions have been adopted with respect to the protection of biological diversity and wild migratory species (table 1). The future role of ecosystems supporting our prosperity depends largely on the future management of human activities and their associated effects, in order to ensure that the ecosystem integrity and self-healing capacity will not be affected (ecosystem approach). Sustainable exploitation of the sea requires a transformation from sectoral maritime and coastal policies towards an integrated policy based upon a spatial planning perspective. Within this context, UNEP published the guide '*Taking Steps toward Marine and Coastal Ecosystem-Based Management*' to assist countries and communities in implementing the marine and coastal ecosystem management.

The maritime heritage section is treated by UNESCO (table 1).

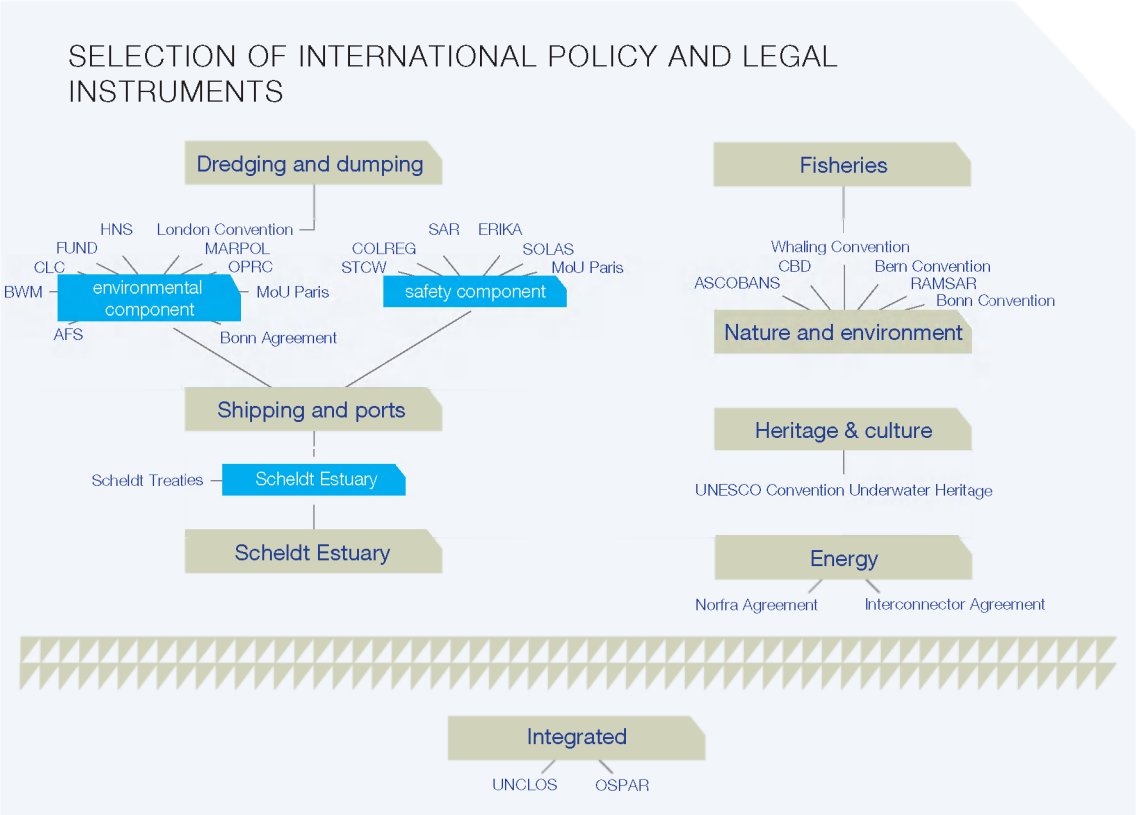

Figure 4. Selection of international policy and legal instruments. Abbreviations: AFS, Anti-Fouling Systems; BWM, Ballast Water Management; CBD, Convention on Biological Diversity; CLC, Civil Liability Convention; COLREG, Collision Regulations; FUND, Compensation fund for oil pollution damage; HNS, Hazardous and Noxious Substances; MARPOL, Marine Pollution; OPRC, Oil Pollution Preparedness, Response and Co-operation; SOLAS, Safety of Life at Sea; STCW, Standards of Training, Certification and Watchkeeping.

INTERNATIONAL NON-UN CONVENTIONS

Besides UN multilateral agreements, non-UN conventions with a global geographical perspective have been adopted as well. Within the marine context, this particularly concerns the multilateral environmental agreements (MEAs) regarding the protection of wetlands (*Ramsar*) and the regulation of whaling (table 2).

Table 2. Selection of the non-UN MEAs.

TOPIC	INSTRUMENT	CONTEXT
Nature and Environment	Ramsar	The *Convention on wetlands of international importance* (1971), also called the *Ramsar Convention*, states that the convention parties need to maintain the ecological character of their wetlands of international importance and need to manage all wetlands in a sustainable way. In contrast with other global environmental conventions, *Ramsar* is not affiliated with the UN-system of MEAs, but there is intense collaboration with the cluster of biological diversity-related MEAs (*Convention on Biological Diversity, Convention on the conservation of migratory species of wild animals*, etc.).
Nature and Environment	International Convention for the Regulation of Whaling	The *international Convention for the regulation of whaling* (1946) regulates whaling activities and is the foundation document of the *International Whaling Commission* which is responsible for the conservation of whales and the management of whaling.

REGIONAL CONVENTIONS AND AGREEMENTS

Contrary to the global international conventions (see above) which can be signed by every nation, the regional conventions and agreements only have a limited (regional) geographical dimension. The most important regional conventions that also impact the Belgian part of the North Sea (BNS) can be divided in two main groups: the integrated conventions such as the *OSPAR Convention*, and the sectoral conventions and agreements such as the *Paris Memorandum of Understanding on Port State Control* (shipping and ports), the *Bonn Agreement* (shipping and ports) and *ASCOBANS* (nature and environment) (table 3).

Table 3. Selection of the regional conventions and agreements.

TOPIC	INSTRUMENT	CONTEXT
Integrated	OSPAR Convention	The *Convention on the protection of the marine environment in the North-East Atlantic* or the *OSPAR Convention* (1992) combines and updates the Oslo Convention (1972) for the prevention of marine pollution by dumping from ships and aircraft and the Paris Convention (1974) for the prevention of marine pollution from land-based sources. The overall goal of the OSPAR Commission as stated in the *North-East Atlantic Environment Strategy 2010-2020* is to conserve marine ecosystems and safeguard human health and, when practicable, restore marine areas which have been adversely affected by preventing and eliminating pollution and by protecting the maritime area against the adverse effects of human activities. Using the *ecosystem approach* to manage human activities is the basic principle. The OSPAR Commission developed and implemented a series of five thematic strategies in order to focus on the most important identified threats to the marine environment. The strategies relate to the following topics: *Biological diversity and ecosystems*, *Eutrophication*, *Hazardous Substances*, *Offshore Oil and Gas Industry* and *Radioactive Substances*. The sixth strategy is the *Strategy for the Joint Assessment and Monitoring Programme (JAMP)* that provides a framework for work to develop OSPAR's monitoring and assessment programmes, with a particular focus on supporting the work to implement the *EU Marine Strategy Framework Directive* (see **Integrated maritime policy**) that needs to be done by Contracting Parties that are EU Member States over the period 2010-2014.
Shipping and ports	MoU Paris	The *Paris Memorandum of Understanding on Port State Control* (MoU Paris 1982) acts as a regional coordinated control mechanism for the conditions set by the *IMO* and *ILO* conventions. Its geographical scope includes the waters of the European coastal states and the North Atlantic, from North America to Europe. The MoU obliges Member States to construct a control system in order to ensure compliance with the *international Convention on load lines*, *SOLAS*, *MARPOL*, *STCW*, *COLREGs* and the *Convention concerning minimum standards in merchant ships* (*Somers, 2010* [213864]).
Shipping and ports	Bonn Agreement	The *Bonn Agreement for co-operation in dealing with pollution of the North Sea by oil and other harmful substances* (1983) promotes the collaboration between the coastal states of the North Sea during the detection, reporting and combating of pollution in the North Sea by oil and other harmful substances, originating from ships and offshore installations.
Nature and environment	ASCOBANS	The *Agreement on the conservation of small cetaceans of the Baltic, North-East Atlantic, Irish and North Seas* (*ASCOBANS*) was adopted in the context of the *Convention on the conservation of migratory species of wild animals* (*Bonn Agreement 1979*). The *ASCOBANS Agreement* covers all species, subspecies or populations of toothed whales (Odontoceti) in the agreement area, with the exception of the sperm whale. The *ASCOBANS Agreement* includes a concise Conservation and Management Plan that describes the conservation, research and management measures that should be implemented by the Parties.

BI- AND TRILATERAL AGREEMENTS

Belgium entered into several bilateral and trilateral agreements, such as the *Scheldt Agreements* (policy and management, nautical management, widening and improvement of the waterway, pilotage charges, Scheldt-Rhine connection), conventions dealing with submarine gas pipelines (Interconnector, Norfra, Zeepipe) and conventions with regard to fisheries in the territorial sea (e.g. the Agreement of 30 September 1975 for the catch of herring and sprat in the Belgian and French territorial waters). A concise selection of the above-mentioned agreements is shown in table 4, for a detailed overview of the Scheldt Agreements, we refer to the *VNSC website*.

Table 4. Selection of the bilateral and trilateral agreements.

TOPIC	INSTRUMENT	CONTEXT
Scheldt Estuary	Scheldt Agreement	According to the *Scheldt Agreement* of 3 December 2002, convention parties (Belgium, Flemish Region, Walloon Region, Brussels Capital Region, the Netherlands and France) must implement sustainable and integrated water management in the international Scheldt basin in accordance with the *Water Framework Directive*, particularly taking into account the multifunctional use of the respective waters.
Fisheries	Agreement of 30 September 1975 for the catch of herring and sprat in the Belgian and French territorial waters	This agreement allows French fishermen to catch herring and sprat in the Belgian territorial sea and vice versa. Between 3 and 6 nautical miles, fishing vessels with a tonnage smaller than or equal to 60 gross tons or a power smaller than or equal to 400 hp are allowed to fish. Up to 3 nautical miles, fishing is allowed for fishing vessels with a tonnage smaller than or equal to 35 gross tons or with a power smaller than or equal to 250 hp.

1.3 European policy and legal instruments

The European Union (EU) exerts increasing influence on the policies and management in different policy domains and sectors. The EU uses different legal instruments to coordinate or harmonise Member States policies. Two major categories of European legal instruments can be distinguished: the non-legally binding and the legally binding instruments. Examples of non-legally binding instruments are recommendations, communications, Green Papers and White Papers. A recommendation is a non-binding instrument, but the EU expects that the respective Member States follow the recommendations on a voluntary basis. A Green Paper is a discussion document in which the European Commission (EC) inventories the state-of-the-art of a problem or topic, and may give rise to legislative developments that are then outlined in White Papers. The latter explains how to reach certain goals, and thus includes more concrete propositions. Communications in turn do not include specific propositions for future policy, but are used for policy evaluations, the explanation of Action Programmes and as a discussion document for future or current policies.

The legally binding instruments include, amongst other things, the directives, regulations, conventions and protocols. In contrast with the regulations, which have binding legal force throughout every Member State without national governments having to take action to implement them, the directives need to be implemented in the national and regional legislation. The directive prescribes the goals that have to be achieved by the EU Member States, but allows the national authorities to choose the form and means. A directive is the main legal instrument in Europe used for the conservation of marine biological diversity and for the substantiation of the ecosystem approach in the EU marine waters (see also figure 7). It is an essential pillar for the protection of marine ecosystems and resources which support our marine/maritime economy and social activities.

INTEGRATED MARITIME POLICY

The ecosystem approach is a guiding principle for the European marine/maritime regulations and policies, and is the basis for, amongst other things, the future *Integrated Maritime Policy* (IMP) (*COM (2007) 575*) and the *Common Fisheries Policy (CFP)* (*Regulation 2371/2002*; *COM (2011) 417*). While pursuing an ecosystem approach, the importance of an integrated approach is ever more important, where the policy aligns and sets goals of different domains and sectors. The future *IMP*, coordinated by the Directorate-General for Maritime Affairs and Fisheries (*DG MARE*) (figure 5), is an example of a policy instrument that focuses on the protection and the conservation of the coastal and marine environment on the one hand, and on sustainable use of the economic potential of seas and oceans on the other hand (figure 6). It concerns a holistic approach of all maritime policy matters, and believes that such an approach will lead to higher yields with less damage to the environment. An *IMP* of the EU needs to keep in mind the following goals:

- Maximising the sustainable use of the oceans and seas while enabling growth of the maritime economy and coastal regions;
- Building a knowledge and innovation base for the maritime policy (impact of human activities, climate change, etc.);
- Delivering a higher quality of life in coastal and outermost regions, reconciled with economic development and environmental sustainability;
- Promoting its leading position in international maritime affairs;
- Raising the visibility of Maritime Europe and improving the image of this sector's activities and professions.

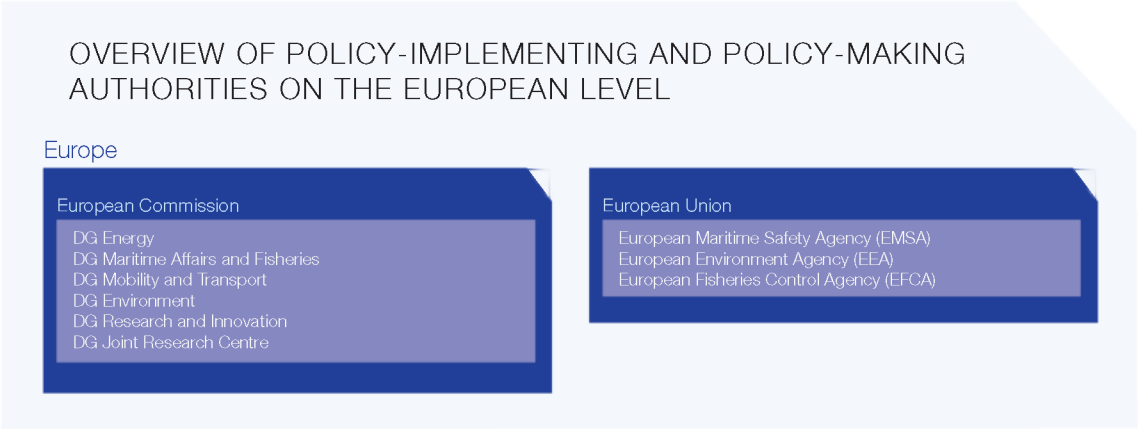

Figure 5. Overview of policy-implementing and policy-making authorities on the European level.

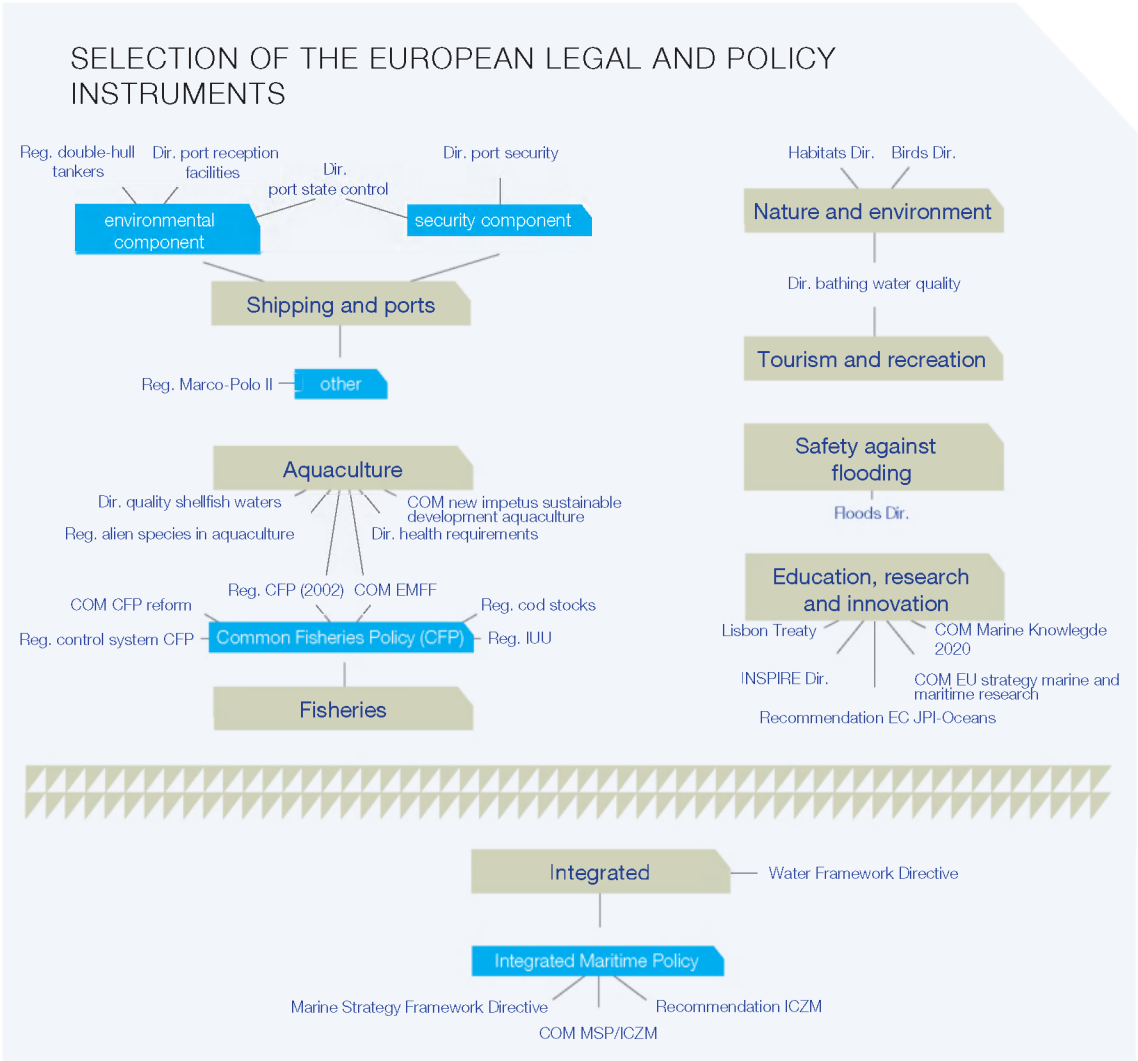

Figure 6. Selection of the European legal and policy instruments. Abbreviations: EMFF, European Maritime and Fisheries Fund; ICZM, Integrated Coastal Zone Management; CFP, Common Fisheries Policy; IUU, Illegal, Unreported and Unregulated fishing; MSP, Maritime Spatial Planning; Dir, Directive; Reg, Regulation.

Three instruments are of particular importance for creating *IMP*. These are (1) a European network for maritime surveillance to ensure the safe use of the sea and the security of the EU's maritime borders; (2) integrated coastal zone management (land and sea) to enable maritime spatial planning and (3) a complete and accessible source of data and information on natural and human activities on the oceans to facilitate strategic decision-making on maritime policy.

For the marine environment, a first step towards an integrated approach was taken with the *Water Framework Directive* (WFD; *2000/60/EG*) (figure 6), which applies to the coastal waters up to 1 mile seaward from the baseline for a good ecological status, while for certain aspects of chemical water quality it applies to the entire territorial sea. The road towards an ecosystem and integrated approach was officially pursued with the publication of the *Marine Strategy Framework Directive* (MSFD; *2008/56/EC*), the environmental pillar of the EU *Integrated Maritime Policy* (IMP; *COM (2007) 575*), which aims for efficient protection of the marine environment in the EU marine waters by 2020. The Directorate-General for the Environment (*DG Environment*) is responsible for the follow up of both directives (figure 5). In particular, the *MSFD* aims for a 'good environmental status' (GES) for all seas under the jurisdiction of the Member States by 2020, with the maintenance of biological diversity as the main objective. The Member States need to develop marine strategies, taking into account their national socio-economic and regulating context. Regional collaboration is a necessity and should result in consistent measures. These strategies need to promote the integration of environmental considerations into all relevant policy domains. By doing this, the ecosystem approach to the management of human activities (according to the precautionary principle) is set within a legal framework, in which the central concepts are 'environmental protection' and 'sustainability'. The *MSFD* is therefore complementary to the existing directives on the conservation of the marine environment, such as the *Habitats Directive* (*92/43/EEC*), the *Birds Directive* (*2009/147/EC*) and the *Water Framework Directive* (*2000/60/EC*) (figure 6).

The improvements in the spatial planning of maritime activities and coastal zone management are considered an important instrument within the scope of the *IMP*, as mentioned above (figure 6). The *Proposal for a directive establishing a framework for maritime spatial planning and integrated coastal management* (*COM (2013) 133*) (DG MARE, DG Environment) focuses on the support of the *EU blue growth strategy* (*COM (2012) 494*) which, in turn, contributes to achieving the goals of the *Europe 2020 - A strategy for smart, sustainable and inclusive growth* (*COM (2010) 2020*), and focuses on the sustainable growth of maritime activities and sustainable use of natural marine resources. The integrated coastal management strategies have to be based upon the principles and elements as described in the *Recommendation concerning the implementation of integrated coastal zone management in Europe (2002/413/EC*) (figure 6). This conceptual framework results into an efficient use of the space, and can therefore contribute to a better implementation of the EU environmental laws, such as the *MSFD* (*2008/56/EC*) and the *Habitats Directive* (*92/43/EEC*) by means of reducing environmental effects, in order to fulfil the ecological and socio-economic goals.

The EU *IMP* aims to create optimum conditions for the growth of the maritime sectors on the one hand, and aims to achieve the EU environmental goals (such as *MSFD*) on the other hand. Science and technological innovation are essential to reconcile the increasing marine activities and the environmental goals. In this respect, a more eco-efficient production and efficient coordination of marine research activities are the main points of interest. Therefore, *A European strategy for marine and maritime research* (*COM (2008) 534*) was published, coordinated by the Directorate-General for Research and Innovation (*DG Research*) (figure 5). It is an essential pillar of the *IMP* and offers a broad reference framework for European marine research priorities (figure 6). The strategy focuses on the complexity of marine ecosystems and aims at a more purposeful integration and gathering of knowledge and research, and the stimulation of long-term partnerships dealing with research needs and priorities. The strategy also highlights the need for new types of governance in the field of research, focusing on a permanent dialogue between scientists, policymakers, industrialists and societal interest groups. These elements also form the pillars of the *Ostend Declaration* (2010) and of the implementation and funding mechanisms of the EU science policy (see **Chapter 1**).

SECTORAL POLICY

The sectoral marine/maritime policy objectives are the basis of the above-mentioned *IMP*. The *IMP* is aimed at the integration and alignment of sectoral policy goals in order to prevent or reduce intersectoral conflicts, and therefore contributes to the sustainability of marine activities and the achievement of the goals of EU marine/maritime sectoral policy.

Besides on the international level (see **United Nations**), the policy domain Maritime transport, shipping and ports is also regulated on the EU level, which mainly includes a ratification by the EU of UN conventions (figure 7). Shipping and ports are considered as a catalyst for the economic development and prosperity in the EU, given the importance of the sector in the intra- and extra-European trade (see Chapter 2, theme **Maritime transport, shipping and ports**). The EC (DG MARE) focuses, amongst other things, on the compliance of strict safety standards for ships and ports (e.g. *Port Security Directive, 2005/65/EC*; *Port State Control Directive*, *2009/16/EC*), reducing the risk of serious maritime accidents (e.g. *Monitoring and Information Directive*, *2002/59/EC*), minimising the environmental impact of shipping and ports (e.g. *Phasing-in of double-hull oil tankers* through *Regulation 530/2012*) and the elaboration of the Motorways of the Sea, which are considered an integrating and important part of the trans-European transport network (e.g. Marco-Polo II, *Regulation 1692/2006*) (figure 6).

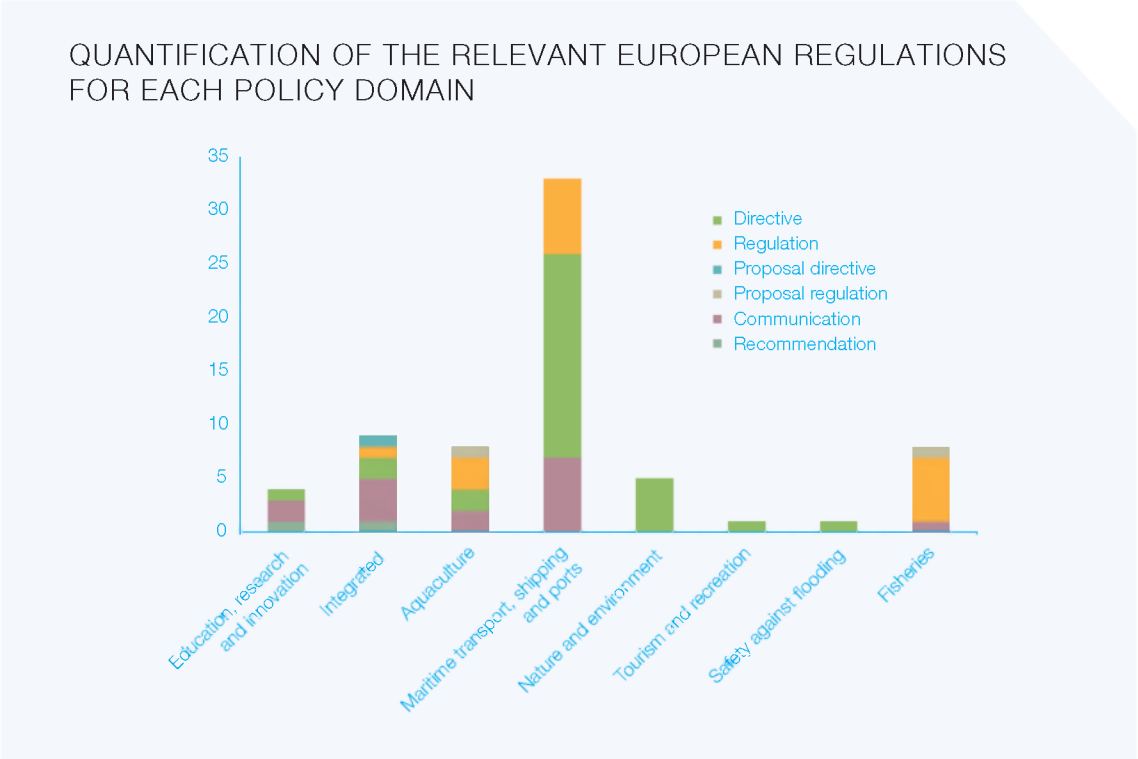

Figure 7. Quantification of the relevant European regulations for each policy domain. Notwithstanding this is a non-exhaustive representation, it indicates which topics are regulated on the European level. For details about the regulation included in this figure, we refer to Annex 3.

Fisheries management on EU level (DG MARE) is regulated by the *Common Fisheries Policy* (*CFP*) (*Regulation 2371/2002*) due to the transboundary character of fisheries. The *Green Paper on the reform of the fisheries policy* (*COM (2009) 163*) and the subsequent EC consultation (*SEC (2010) 428*) concluded that the essential *CFP* goals were not achieved, leading to the reform of the *CFP*. The *Reform of the CFP* (*COM (2011) 417*) particularly focuses on the goal alignment with the *MSFD* and other environmental legislations, as well as on the application of the ecosystem approach. The measures accepted within the scope of the *CFP* need to ensure that fish stocks are at a level in accordance with the principle of the 'maximum sustainable yield' (MSY) by 2015, in accordance with *UNCLOS* article 61 part 3 and as stated during the World Summit for Sustainable Development in Johannesburg in 2002. The reform of the *CFP* focuses on a sustainable exploitation of living marine resources, which makes this reform a prominent part of the Europe 2020 flagship initiative 'An efficient use of resources'. The compliance with *CFP* regulations is guaranteed by a EU fisheries control system, that amongst other things, combats illegal, unreported or unregulated fishing (IUU fishing; *Regulation 1005/2008*) (figure 6).

The most important directives dealing with the conservation of the marine environment on the European level are the *Habitats* (*92/43/EEC*) and *Birds Directives* (*2009/147/EC*) (DG Environment). The network of special protection areas is known as the European ecological *Natura 2000 network*, which is the centrepiece of EU nature and biodiversity policy. The *Habitats Directive* and the Natura 2000 network result from the EU obligations regarding habitat protection

within the scope of the *Bern Convention* (1989) in which the EU is a convention party. The *Emerald Network* (*Bern Convention*) and the Natura 2000 network are therefore based upon the same principles, while the first is *de facto* an extension to non-EU Member States. The main aim of the *Habitats Directive* is to promote the maintenance of biodiversity in the Member States, through the maintenance and restoration of European endangered natural habitats and the associated wild fauna and flora. The conservations status of an area must be analysed in line with the scientific standards as determined by the conservation objectives. The *Birds Directive* aims at the protection of all wild bird species. Special protection measures are taken for habitats of bird species listed in Annex I of the directive as well as for areas with a significant proportion of the international migratory birds population. For further information on this topic, we refer to Chapter 2, theme **Nature and environment**.

1.4 Federal and Flemish policy and legal instruments

The legal rules that have been drawn up and adopted by the federal legislative body (*Belgian Constitution art. 36*) are called 'laws'. Laws are adopted by the federal parliament (legislative body), in which both parliamentarians and the government have the right to take initiative. A law approved by the parliament enters into force subsequent to the signing by the government, i.e. the ministers and the king. The federal government makes sure that the legislation is complemented by implementation measures; Royal Decrees (*Belgian Constitution art. 108*), which are signed by the king as well as by the competent minister (*Belgian Constitution art. 106*). Hence, a Royal Decree (RD) is only legal when a law already exists. The responsible federal minister can further elaborate detailed measures by means of a Ministerial Decree (MD).

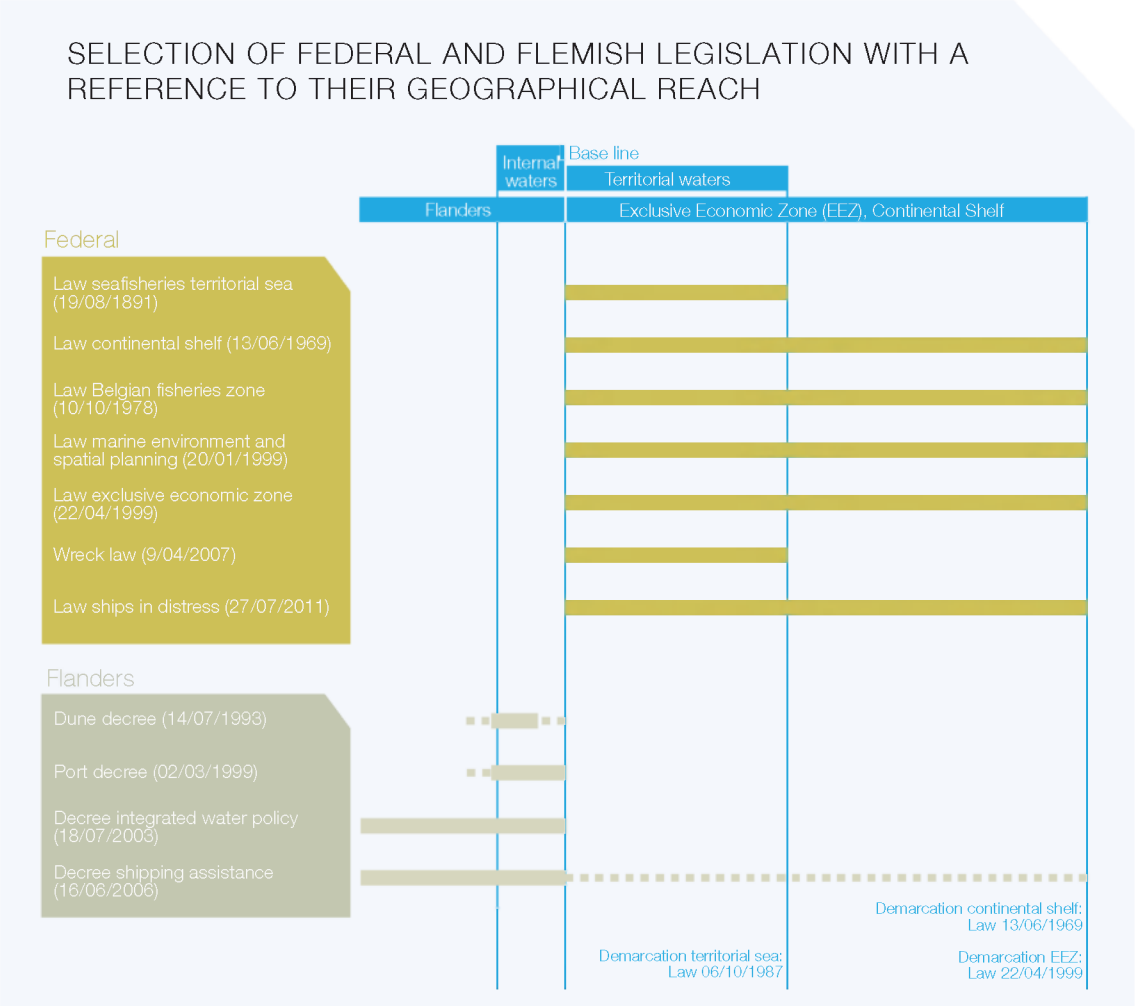

Figure 8. Selection of federal and Flemish legislation with a reference to their geographical reach.

On the Flemish level, 'decrees' are promulgated. A decree of the Flemish parliament is a Flemish law with the same legality as a law promulgated by the federal parliament. Similar to the federal level, the Flemish representatives as well as the Flemish government have the right of initiative. The representatives file a 'proposition for a decree' while the government elaborates a 'design for a decree'. A decree enters into force after the ratification and promulgation by the Flemish government. Comparable to the federal level, the policies written in decrees are elaborated by means of implementing decrees (decision of the Flemish government and Ministerial Decrees).

DIVISION OF COMPETENCES

In general, we can say that the federal authorities are responsible for the activities that take place seaward from the baseline, in particular in the territorial sea, the EEZ and on the continental shelf, to the extent that national sovereign rights are valid in the latter zones (see *Convention on the Law of the Sea*) (figure 8). However, there are a few exceptions. The *law of 8 August 1988* amending the special *law of 8 August 1980* for the institutional reform gives Flanders the authority to work in the territorial waters and on the continental shelf, and to carry out activities necessary for the execution of these matters. The law states that waterways and their appurtenances, the ports and their appurtenances, pilotage services and beaconing services from and to the ports, the rescue and the towing services at sea as well as dredging activities are covered by the Flemish region, within the policy domain Mobility and Public Works (MOW) (figure 10). Moreover, MOW is in charge of the determination of the exact locations of shipwrecks in the BNS that can potentially cause nuisance to shipping as well as of the storage of obstacles that impede maritime access.

The agricultural and sea fisheries policy was regionalised through the *special law of 13 July 2001*, transferring several matters to the regions and communities within the scope of the reform of the special *law of 8 August 1980* for the institutional reform (art. 6, §1, V). This means that the Flemish Region (*Policy Domain Agriculture and Fisheries*) has to regulate fisheries in the sea areas covered by the Belgian legislation (figure 10). The sea fisheries policy of the Flemish government still finds its legal base in federal laws adopted before the regionalisation. For this purpose, the *decree of 28 June 2013* concerning the agriculture and fisheries policy was drafted (entry into force on 1 January 2014), aiming to transform the still existing federal legal framework concerning regional matters into a legal regional (Flemish) framework. This reform has resulted in increased legal certainty and impedes vagueness with regard to the scope of the articles of law that include both federal and Flemish matters.

The activities in the BNS (seaward from the baseline) regulated on the federal level are (figure 9):

- Shipping
  FPS Mobility and Transport; *DG Maritime Transport*
- Military activities
  Ministry of Defence; *Naval Component*
- Sand extraction
  FPS Economy, SMEs, Self-employed and Energy; *Continental Shelf Service*
- Energy
  FPS Economy, SMEs, Self-employed and Energy; *DG Energy*
- Cables and pipelines
  FPS Economy, SMEs, Self-employed and Energy; *DG Energy*
- Protection of the marine environment
  FPS Health, Food Chain Safety and Environment; *Marine Environment Department*
- Combating pollution
  FPS Health, Food Chain Safety and Environment; *Marine Environment Department*
  Ministry of Defence; *Naval Component*
  FPS Mobility and Transport; *DG Maritime Transport*
  FPS Home Affairs; *Civil Security*
- Science policy
  PPS Science Policy
- Control (police)
  FPS Mobility and Transport; *DG Maritime Transport*; Shipping Control
  FPS Home Affairs; Shipping Police
  Ministry of Defence; *Naval Component*

Figure 9. Overview of policy-implementing and policy-making bodies on the federal level.

FEDERAL LEGISLATIVE FRAMEWORK

Integrated legislation

The Belgian policy for protection of the marine environment is determined by international treaties and organisations, the European Union, and regional partnerships, as discussed above. The statements made at the North Sea Ministerial Conferences also play an important role in the protection strategy of the North Sea environment (*Calewaert et al. 2005* [78564]). The Belgian policy for marine pollution, nature conservation and spatial planning in the Belgian part of the North Sea is mainly determined by the *law of 20 January 1999 for the protection of the marine environment and the organisation of marine spatial planning in the sea regions under jurisdiction of Belgium* (*MMM law*) (figure 11). This law aims to protect the marine environment through sustainable management and enforcement measures and to preserve the unique, pristine character and the biodiversity of the marine environment through prevention, limitation and remediation of environmental damage. This is the basis for the establishment and demarcation of marine protected areas, the drafting of area-specific policy plans including the ban on certain activities in these regions (*RD of 15 October 2005* and *RD of 16 October 2012 – special protection areas*; *RD of 14 October 2005 – policy plans*; *RD of 5 March 2006 – marine reserve*) (see Chapter 2, theme **Nature and environment**), the introduction of objective liability in case of environmental damage (*RD of 25 October 2007*) as well as the coupling of concessions for maritime activities

Figure 10. Overview of policy-implementing and policy-making bodies on the Flemish level.

to an environmental impact assessment (*RD of 7 September 2003*; *RD of 9 September 2003*). Besides the principle of objective liability, users of the sea should also take into account the prevention principle, the precautionary principle, the sustainable management principle, the polluter pays principle and the restoration principle.

The *law of 20 January 1999* was amended and completed by the *law of 20 July 2012* concerning legislation for the organisation of marine spatial planning in the Belgian part of the North Sea. The latter includes regulations regarding the adoption procedure of a marine spatial plan (*RD of 13 November 2012*) as well as demands related to the content of this plan, such as a spatial analysis of the Belgian marine areas, a long-term perspective for spatial use, clear economic, social, environmental and safety goals (including indicators) and measures, instruments and actions for policy implementation (*art. 5bis*).

The *law of 22 April 1999* (*EEZ law*) puts the EEZ under a specific legal regime. In the EEZ, whose borders match those of the continental shelf as established by bilateral agreements with the neighbouring countries, Belgium has sovereign rights for exploration and exploitation, and for protection and management of the natural living and non-living resources in the entire water column, the sea floor and the subsoil, as stipulated in *UNCLOS*. Furthermore, Belgium has exclusive jurisdiction over the construction and use of artificial islands, installations and equipment for *inter alia* the production of water and wind energy, marine scientific research, and the protection and conservation of the marine environment. Belgium also has other jurisdictions as formulated in *UNCLOS*, including the right to survey in the contiguous zone to (1) prevent violations of laws and decrees, which is supervised by national customs in Belgian territory and the territorial sea; and (2) punish violations of these laws and decrees, committed in Belgian territory or territorial seas (*UNCLOS art. 33*; *EEZ law art. 47*).

Sectoral legislation

The majority of federal legislation on **shipping and ports** includes the ratification of international treaties and protocols established by the IMO and the implementation of European directives (figure 11). Considering the international character of this activity, national programmes and policies are synchronised by means of international and European policy and legal instruments. An important legislative instrument on the federal level is the *law of 6 April 1995 regarding the prevention of pollution by ships* (*MARPOL law*). This law stipulates the regulations for ships to prevent discharge of harmful substances. It also determines construction, accommodation, equipment and operation requirements with which ships under the Belgium flag must comply. Furthermore, the law discusses the supervision of compliance with this law, including procedures of appeal and penalty clauses. Other important laws are the *law of 16 February 2009 on the ratification of the international Convention on the supervision of harmful anti-fouling systems on ships* (*AFS law*); the *law of 16 June 1989 on the ratification of the Agreement on cooperation for controlling pollution in the North Sea by oil and other harmful substances* (*Bonn law*); the *law of 20 July 1976 on the ratification and implementation of the international Convention concerning civil liability for damages by pollution by oil* and the *law of 10 August 1998* on the approval of the Protocol of 1992 to amend this international Convention *(CLC law*) (figure 11).

The *law of 9 April 2007 regarding the finding and protection of shipwrecks* (figure 11) stipulates the procedure to be followed in case of finding or salvaging wrecks in the territorial sea of Belgium. This law also includes stipulations on **archaeologically and historically valuable wrecks** and the designation of protected wrecks (see also Chapter 2, theme **Maritime and coastal heritage**). Until now, this law has not been provided with the necessary implementing measures (i.e. RDs).

An important law with regard to the **exploitation of non-living resources** is *the law of 13 June 1969* on the exploration and exploitation of non-living resources of the territorial sea and the continental shelf (figure 11). This law was amended in 1999 by both the *EEZ law* and the *MMM law*. The law states that the aforementioned activity necessitates a concession, granted under the conditions and rules determined by the king (*RD of 1 September 2004 – concessions*). Every application for a concession or authorisation has to include an environmental impact assessment (*RD of 1 September 2004 - EIA*). An authorisation is also needed for the construction of cables and pipelines, granted or revoked by the rules determined by the king. For pipelines, the law states that a royal approval is needed regarding the proposed trajectory.

The federal government is also responsible for the **protection of the marine environment**. The main law is the aforementioned *law of 20 January 1999 for the protection of the marine environment and the organisation of marine spatial planning in the sea regions under jurisdiction of Belgium* (*MMM law*) (figure 11). The law was already discussed above due to its integrated character (see **Federal legislative framework – integrated legislation**). This law provides the basis for measures necessary in order to comply with the international and European (directives/regulations) obligations with regard to the protection of the marine environment, such as the *Birds* (*2009/147/EC*) and *Habitats Directives* (*92/43/EEC*), the *Ramsar Convention*, the *Bern Convention*, the *Bonn Convention*, the *Convention on Biological Diversity* and *the Law of the Sea Convention*. In the theme 'nature and environment' we also include the *law of 9 July 2004 on the accession of Belgium to the international Convention for the regulation of whaling* (1946) and to the *Protocol* (1956). Thereby Belgium acceded to the International Whaling Commission, composed of a representative of every participating government, potentially accompanied by experts and advisors.

On 12 July 1973, the *law on nature conservation* was adopted (figure 11). This law aimed to maintain the integrity, diversity and pristine nature of the natural environment by taking measures for the protection of flora and fauna, their communities and habitats, and the soil, subsoil, water and air. For the Flemish Region, the law on nature conservation

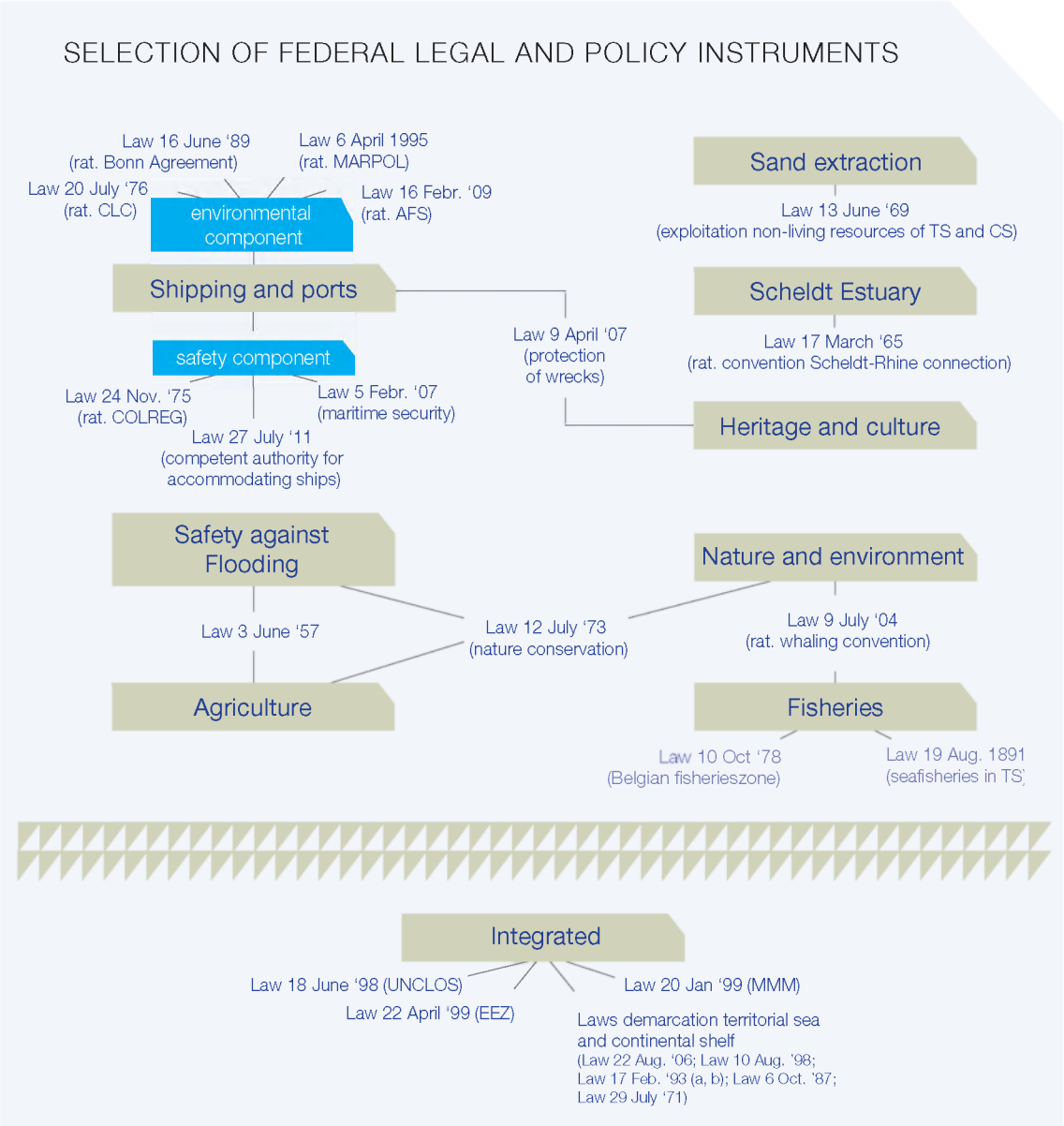

Figure 11. Selection of federal legal and policy instruments. Abbreviations: AFS, Anti-Fouling Systems; COLREG, Collision Regulations; CLC, Civil Liability Convention; CS, Continental Shelf; EEZ, Exclusive Economic Zone; MARPOL, Marine Pollution; TS, Territorial Sea.

is practically abolished and replaced by decrees of the Flemish High Council, namely by the *Forest Decree of 13 June 1990* and the *decree of 21 October 1997 on nature conservation and the natural environment* (*Nature Decree*). Therefore, only a few stipulations of the initial law have been retained, such as stipulations on the preservation of coastal dunes (set by the *decree of 14 July 1993 on measures for the protection of coastal dunes – the Dune Decree*).

FLEMISH LEGISLATIVE FRAMEWORK

Integrated legislation

On the Flemish level there are two important decrees with an integrated character: *the decree of 14 July 1998 on ratification of the United Nations Convention on the Law of the Sea 1982* and *the decree of 18 July 2003 on integrated water policy* (figure 12), which is the regional implementation of the European *Water Framework Directive*

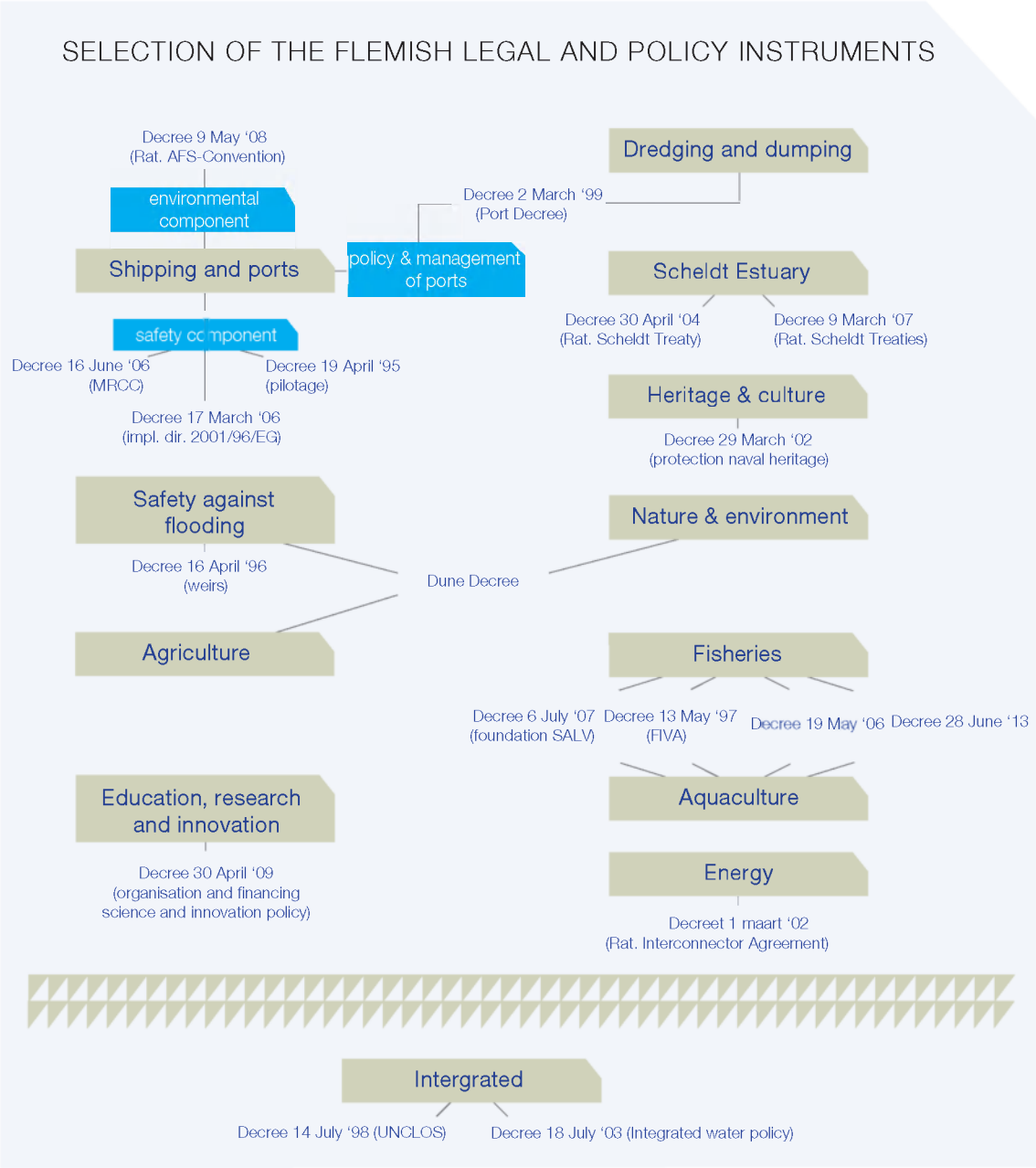

Figure 12. Selection of the Flemish legal and policy instruments. Abbreviations: A&F, Agriculture and Fisheries; AFS, Anti-Fouling Systems; FIVA, Flemish Fisheries and Aquaculture Financing Instrument; MRCC, Maritime Rescue and Coordination Centre; SALV, Strategic Advisory Council for Agriculture and Fisheries.

(WFD; *2000/60/EC*). In accordance with the constitutional division of competences, the Regions are responsible for the implementation of the *WFD* regarding water policy (including drinking water policy), rural development, nature conservation, public works and transportation on their territory (on land). The coordination of the entire water policy within the Flemish Region lies with the Coordination Committee on Integrated Water policy (CIW). The secretariat and presidency of the CIW have been entrusted to the Flemish Environment Agency (VMM). The federal state is responsible for the implementation of the *WFD* at sea (for the geographical application of the *WFD* see **European policy and legal instruments – integrated maritime policy**), product policy (authorisations), protection against ionising radiation (including radio-active waste) and the economic aspects of drinking water provision (pricing) in the entire Belgian territory (*FPS Health, Food Chain Safety and Environment 2009*). The Belgian coastal waters belong to the International River Basin District of the Scheldt, governed by the three Regions, the federal government, France

and The Netherlands. The International Scheldt Commission is responsible for the international coordination (i.e. Scheldt Treaty), while the Coordination Committee for International Environmental Policy (CCIM), led by the federal state, coordinates on the national level (*cooperation agreement of 5 April 1995*).

Sectoral legislation

A decree with regard to **research and innovation** is the *decree of 30 April 2009 on the organisation and financing of science and innovation policies* (figure 12), which stipulates, among other things, the goals, tasks, governance and function of the agency for Innovation by Science and Technology (IWT) and the Fund for Scientific Research – Flanders (FWO – Flanders). The decree also describes the establishment, tasks, competences and composition of the strategic advisory board for science and innovation policy. Within the marine framework, the decree stipulates the functioning of the strategic research centres (*inter alia*, the Flemish Institute for Technological Research – VITO and the Flanders Marine Institute – VLIZ).

In the policy domain of **shipping and ports**, the *decree of 2 March 1999 regarding the policy and management of seaports* (*Port Decree*) constitutes the basis for a modern port policy with a global perspective with regard to maritime matters in Flanders (figure 12) (see also Chapter 2, theme **Maritime transport, shipping and ports**). Hereby, the *Port Decree* follows *six important principles* (Flemish Port Commission, FPC):

- Greater autonomy in management and exploitation for the local port authorities;
- Uniform operating conditions for all seaports;
- More possibilities for a flexible staff policy for port authorities;
- Mandatory legal personality for all port authorities;
- A clear and transparent relation between the Flemish Region and port authorities;
- Objectification of the financial policy for ports.

On the Flemish level, the decrees on shipping and ports are mainly implementations and ratifications of European directives or international treaties with regard to activities regulated by Flanders, for example: *the decree of 17 March 2006 regarding the implementation of Directive 2001/96/EG on establishing harmonised requirements and procedures for the safe loading and unloading of bulk carriers*, *the decree of 16 June 2006 regarding shipping guidance on maritime waterways and the organisation of the Maritime Rescue and Coordination Centre* (the *Shipping Guidance Decree*, an implementation of *Directive 2002/59/EC*), and the *decree of 9 May 2008 on the ratification of the international Convention on supervision on harmful anti-fouling systems of ships* (*decree on ratification of the AFS Convention*) (figure 12). The *AFS Convention* was also ratified on a federal level (see **Federal legislative framework**) because the federal state warrants its enforcement.

Because of the Flemish competence as to pilotage services, the organisation and scope of pilotage services have been established by the *decree of 9 April 1995 on the organisation and functioning of the pilotage services* (*Pilotage Decree*).

Prior to 13 July 2001 **sea fisheries** were regulated on a federal level, only the investment policy was already regionalised before by the *decree of 13 May 1997* (*FIVA decree*) (figure 12). Notwithstanding the fact that sea fisheries are nowadays organised on a Flemish level, the legal basis of the policy is still often included into federal laws predating the regionalisation, such as the *law of 10 October 1978 on the establishment of the Belgian fishing area* and the *law of 19 August 1891 on sea fisheries in the territorial sea* (figure 11). The *decree of 28 June 2013* on agricultural and fisheries policies aims at the formation of a regional (Flemish) legal framework regarding the regional competences for sea fisheries and the abolition of the aforementioned federal legislation (figure 12).

Flanders is responsible for land use and **nature conservation** in its territory, and thus also for nature conservation in the **maritime dune area**, which is regulated by the *decree of 14 July 1993 on measures for the protection of coastal dunes* (*Dune Decree*) (figure 12). This decree consists of stipulations for the demarcation of protected dune areas and agricultural areas important for the dune areas (see also Chapter 2, theme **Nature and environment**). The decree also regulates a ban on building in the aforementioned areas, and stipulates that this ban is not applicable to, *inter alia*, coastal defence projects (see also Chapter 2, theme **Safety against flooding**).

2 Overview of existing mechanisms, authorities and platforms for the implementation of research results into marine/maritime policy choices and policy decisions

2.1 Mechanisms for the incorporation of science into policy

In several policy instruments on the international, European, federal or Flemish level, specific mechanisms are available for the implementation of scientific knowledge into the marine policy. It usually concerns the knowledge and research results of monitoring of the marine environment, an assessment of the impact of a user function on the (marine) environment or the scientific underpinning of thresholds that were imposed by policy. Furthermore, mechanisms such as public consultations ensure the incorporation of scientific knowledge into certain policy processes and instruments as well. The connection between scientific research on the one hand and the needs of marine policy on the other are increasingly fine-tuned, mostly on the level of research projects and certain research programmes.

On a European level, the alignment between marine/maritime science and policy occurs within the framework of initiatives such as the European *Integrated Maritime Policy* (*IMP*), the *communication concerning a European strategy for marine and maritime research* (*COM (2008) 534*), the *communication concerning Marine Knowledge 2020* (*COM (2010) 461*), the Framework Programmes and the marine observation and data infrastructures (see **Chapter 1**). Well-known examples of the incorporation of science into policy on a European level include:

- The *Common Fisheries Policy* (*CFP*), in which detailed guidelines (*Data Collection Framework, DCF*) stipulate the scientific information EU Member States are obliged to collect in support of the policy (see Chapter 2, theme **Fisheries**);
- In the *Habitats* and *Birds Directives*, scientifically based conservation objectives have to be established, against which the conservation status of habitats and species should be measured (see Chapter 2, theme **Nature and environment**);
- In the *Water Framework Directive* (*WFD*) the good ecological status (GES) and the good chemical status (GCS) of surface waters (the coastal waters (1 and 12 nautical miles)) are determined on the basis of scientific research and should subsequently be monitored (see Chapter 2, theme **Nature and environment**);
- The *Marine Strategy Framework Directive* (*MSFD*) aims to achieve a 'good environmental status' (GES) of the EU's marine waters as far as 200 nautical miles off the coast. In order to achieve the GES by 2020, scientifically underpinned environmental goals and indicators have been determined and a programme of measures is being developed. The incorporation of scientific research into the *MSFD* is discussed in detail in the **Case study – Marine Strategy Framework Directive**.

An important mechanism regarding the implementation of research results and knowledge into the policy is the environmental impact assessment (EIA), which lists the consequences of a particular decision for the environment. On a European level, the procedures that should be met by an EIA have been established in *Directive 85/337/EEC*. The *Strategic Environmental Assessment (SEA) Directive* (*Directive 2001/42/EC*) constitutes an addition to the aforesaid *EIA Directive* and obliges authorities to conduct an environmental assessment of certain plans and programmes which may have significant effects on the environment.

Table 5. Overview of the activities in the BNS subject to a permit procedure (cf. *RD of 9 September 2003*).

LAW OF 20 JANUARY 1999	
Activities subject to an EIA	Activities not subject to an EIA
Civil engineering	Commercial fisheries
Trenching and the raising of the seabed	Marine scientific research
The use of high-powered explosives and acoustic devices	Shipping
The abandonment or destruction of wrecks and sunken cargoes	Activities referred to in the *law of 13 June 1969*
Industrial activities	Non-profitable individual activities
Activities of publicity and commercial enterprises	Activities necessary for the exercise of the competence of the Flemish Region

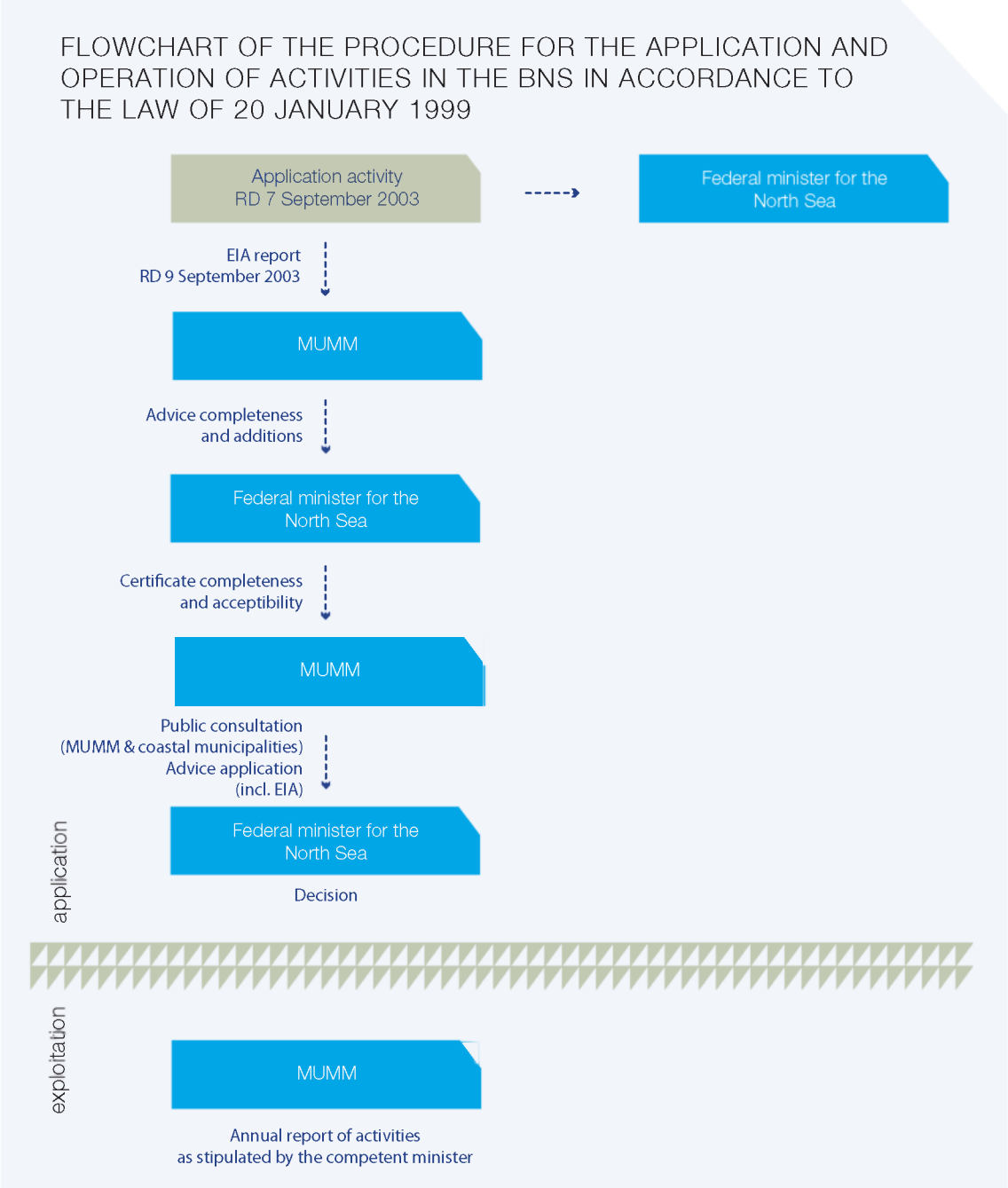

Figure 13. Flowchart of the procedure for the application and operation of activities in the BNS in accordance to the *law of 20 January 1999*.

The *law of 20 January 1999* stipulates the activities in the Belgian part of the North Sea (BNS) for which a permit procedure is mandatory (*RD of 7 September 2003*), including an EIA as stipulated in the *RD of 9 September 2003* (see figure 13, table 5). The EIA should include a section about the activities as such, a section about the effects of the activities on the marine environment and a non-technical summary of both previously mentioned sections. The Management Unit of the North Sea Mathematical Models and the Scheldt estuary (MUMM) verifies whether the EIA is complete and if additions are necessary. Subsequently, the MUMM gives advice about the acceptability of the proposed activity with regard to the marine environment. Based on this advice, the responsible authority takes the actual decision. The *MD of 8 July 2005* and the *MD of 3 June 2009* identify a number of activities that are subject to a simplified procedure and stipulate a model form for the EIA. Activities in the BNS that comply with the *law of 13 June*

1969, such as sand and gravel extraction, require an EIA as defined by the *RD of 1 September 2004* (see Chapter 2, theme **Sand and gravel extraction**).

Subsequent to the granting of permits or authorisations concerning a certain activity in the BNS, the *law of 20 January 1999* stipulates that these activities are subject to monitoring programmes and permanent environmental impact examinations (figure 13). If this examination reveals that new disadvantageous consequences for the marine environment occurred, the permits or authorisations for the activities can be suspended. The monitoring of the activities of the various user functions in the BNS, required by international, European, federal and/or Flemish legislation, is discussed in the relevant themes of **Chapter 2**.

2.2 Authorities and platforms for the incorporation of science into policy

In addition to mechanisms in policy instruments, several authorities (international, European, federal, Flemish, etc.) ensure that science is incorporated into the marine policy. Firstly, this concerns organisations involved in or consulted during the preparation and evaluation of the policy. Furthermore, certain authorities have a mandate to observe monitoring results, to report them and to include them in the policy cycle. Table 6 contains a non-exhaustive list of authorities with a specific mandate to conduct scientific research or disseminate scientific information in support of the policy. Obviously, this does not mean that no inflow of marine/maritime science into policy occurs in other competent administrations.

Tabel 6. A non-exhaustive list of authorities responsible for the incorporation of science into the marine policy.

LEVEL	AUTHORITY	EXPLANATION
International		
	International Council for the Exploration of the Sea (*ICES*)	ICES is an intergovernmental organisation consisting of an international network of marine scientists who aim for a sustainable use of the oceans. ICES wants to increase the scientific knowledge with regard to the marine environment and its living resources and to use this knowledge to advise the competent authorities. The decision and policy-making body of ICES is the Council, with two delegates from each of the 20 Member States. The work of the Council is carried out by the Advisory Committee, the Science Committee and the Data and Information Group. ICES plays a significant role in the policy concerning fisheries (see Chapter 2, theme **Fisheries**).
	Intergovernmental Oceanographic Commission (*IOC*) - UNESCO	The IOC is the UN body for ocean science, ocean observation, ocean data and information exchange, and services such as Tsunami warning systems. IOC promotes international cooperation and coordinates programmes in research, services and capacity building concerning oceans and coastal areas. This knowledge is applied to the management, sustainable development and protection of the marine environment and to the decision making processes of the States.
European		
	Joint Research Centre (*JRC*)	The JRC is the research centre of the European Commission (EC). The centre takes care of the scientific and technological support of the European policy. Specifically for the coast and sea, JRC focuses on research concerning renewable marine energy, climate changes, floods, fisheries, marine ecosystems, etc.
	European Environment Agency (*EEA*)	The European Environment Agency (EEA) is an agency of the European Union with the task to provide sound, objective information about the environment. Their work is a major information source for everyone involved in developing, adopting, implementing and evaluating environmental policy, as well as for the general public. Specifically for coast and sea, EEA produces coastal and marine indicators, maps and information, and compiles these policy-relevant figures in the publication *The changing faces of Europe's coastal areas (2006)* [100281]. Furthermore, EEA coordinates Eionet, the European Environment Information and Observation Network that collects data about the environment (including the marine environment) in Europe and aims to develop a better environmental policy.

LEVEL	AUTHORITY	EXPLANATION (continuation)
Federal		
	Royal Belgian Institute of Natural Sciences (*RBINS*)	The Management Unit of the North Sea Mathematical Models and the Scheldt Estuary (MUMM) is part of the RBINS and has a threefold task: Modeling, Monitoring as well as the Management of the BNS. MUMM is responsible for the monitoring within the framework of specific policy instruments (e.g. *OSPAR* and the *MSFD*) and the monitoring of the impact of certain activities on the marine environment. MUMM is also involved in the EIA of activities in the BNS. Furthermore, MUMM represents Belgium in several intergovernmental conventions concerning the protection of the marine environment and determines the Belgian positions that have to be defended, as well as the adaptation of the decisions which were taken. This management is under the authority of the minster responsible for the environmental policy.
Flemish		
	Research Institute for Nature and Forest (*INBO*)	INBO is the Flemish research and knowledge centre for nature and its sustainable management and use. INBO conducts research and provides information to those who prepare or implement the policy, as well as to interested persons. Specifically for the coast and sea, INBO focuses on research about coastal and sea birds, fauna and flora in the coastal area, the development of an ecosystem vision for the Flemish coast, etc.
	Institute for Agricultural and Fisheries Research (*ILVO*)	ILVO conducts research aimed at economically, ecologically and socially sustainable agriculture and fisheries. Based on this research, ILVO accumulates fundamental and applied knowledge which is *inter alia* used for the improvement of policy instruments as a basis for sector development and agricultural policy for rural areas. Specifically for the coast and sea, ILVO conducts research regarding fisheries biology, fishing techniques, aquaculture, biological and chemical research concerning the BNS and product technology of fish products.
	Flanders Hydraulics Research (*Watlab*)	Watlab is a centre of expertise which carries out scientific research on the effects of water dynamics. The research is conducted in support of the Flemish Government but also supports private and international organisations. Specifically for the coast and sea, Watlab focuses on research concerning hydraulic structures, water management, nautical aspects, the Scheldt Estuary, coastal protection, maritime accesses, etc.
	Flanders Marine Institute (*VLIZ*)	VLIZ is the coordination and information platform for marine scientific research in Flanders. The institute is *inter alia* responsible for the dissemination of scientific information concerning the sea, coast and tidal systems to those responsible for policy, in a way that is useful for policy making and policy support regarding marine matters. VLIZ informs policy makers by means of products such as the Compendium for Coast and Sea, policy informing briefs and indicators for policy (*Maelfait et al. 2012* [221016], *Indicatoren voor het Schelde-estuarium* [206086], etc.).
	Flanders Heritage Agency	Flanders Heritage Agency identifies, investigates and protects valuable buildings, landscapes, archaeological sites and maritime heritage. Furthermore, the agency supports the management of immovable heritage and conducts research in view of policy and management. Specifically for the coast and sea, Flanders Heritage Agency focuses on maritime archaeology, late medieval fishing communities, maritime heritage, etc.
	Flemish Institute for Technological Research (*VITO*)	VITO is a leading European, independent research and advice centre which develops sustainable technologies in the field of energy, environment, materials and earth observation. The institute conducts objective research and disseminates studies and advice that allow industry and governments to develop their policy. Specifically for the coast and sea, VITO focuses on remote sensing in coastal areas and water quality measurements.

LEVEL	AUTHORITY	EXPLANATION (continuation)
	The Flemish Environment Agency (*VMM*)	The mission of VMM is to contribute to the realisation of the environmental policy objectives by reporting on the state of the environment and by preventing, limiting and reversing harmful impacts on water systems and pollution of the atmosphere, and to the realisation of the integrated water policy objectives. The VMM formulates policy proposals, participates in the international environmental policy and ensures the inflow of scientific information into the policy by means of the Flanders State of the Environment Report (MIRA). Specifically for the coast and sea, VMM focuses on the water quality and published MIRA theme Coast and Sea (*Goffin et al. 2007* [114225]).
	Flemish Port Commission (*VHC*)	The Flemish Port Commission (VHC) is part of the Flemish Socio-Economic Council (*SERV*, advisory body). The VHC contributes to the preparation of port policy by means of advice and recommendations. Furthermore, VHC publishes information and statistics concerning the Flemish and European port policy and studies about port-related problems (see Chapter 2, theme **Maritime transport, shipping and ports**).

Several consultation platforms are involved in the marine and coastal policy in Belgium and also play a role in the incorporation of science into policy (table 7). These are often multilateral platforms mandated to provide advice, obtain (externally produced) scientific knowledge/insights and research results. Generally, one or more of the organisations listed above are involved in the consultation platforms. These platforms can be sector-specific or have an integrated approach (table 7).

Table 7. Non-exhaustive list of consultation platforms which play a role in the incorporation of marine/maritime science into the policy.

THEME	CONSULTATION PLATFORM	REPRESENTATION OF MARINE RESEARCH	EXPLANATION
Integrated	*Coast Guard*	PPS Science Policy (*MUMM*, part of *RBINS*)	The coordination and consultation between the federal and Flemish authorities with competences related to the North Sea and the province of West Flanders (see *cooperation agreement of 8 July 2005*) occurs within the *Coast Guard*. The Coast Guard consists of a policy-making body, a consultation body and a secretariat. The policy-making body coordinates the cooperation between the different partners and advises the competent ministers (article 6 of the *cooperation agreement of 8 July 2005*). The consultation body of the Coast Guard investigates files and collects information for the policy-making body (article 12 of the *cooperation agreement of 8 July 2005*).
Integrated	*Coordination Centre for Integrated Coastal Zone Management*	Flanders Marine Institute (*VLIZ*)	The Coordination Centre for Integrated Coastal Zone Management is the point of contact for integrated and sustainable coastal zone management in Belgium. Major challenges consist of the (inter-administrative) alignment and (horizontal) integration of the various policies. The Coastal Compass (*Maelfait et al. 2012* [221016]), an initiative by the Coordination Centre for Integrated Coastal Zone Management, provides scientifically based policy-relevant information.
Integrated	Federal Council for Sustainable Development (*FRDO*)	4 scientific advisors are part of the Council	The Belgian Federal Council for Sustainable Development advises the Belgian federal authorities about the federal policy on sustainable development. Particular attention is paid to the implementation of international commitments of Belgium, such as *Agenda 21*, the *United Nations Framework Convention on Climate Change* and the *Convention on Biological Diversity*. The members of FRDO are representatives from various organisations: environmental organisations, development organisations, consumers' unions, trade unions, employers' federations, energy producers and the scientific world. Federal and regional government representatives and delegates from environmental and socio-economic councils are members without voting rights.

THEME	CONSULTATION PLATFORM	REPRESENTATION OF MARINE RESEARCH	EXPLANATION (continuation)
Scheldt Estuary	The Flemish-Dutch Scheldt Commission (*VNSC*)	*Working Group Research and Monitoring*	VNSC was established to promote the cooperation between Flanders and the Netherlands in the field of the policy and management with regard to the Scheldt Estuary. One of the objectives of VNSC is the creation and support of common physical monitoring and joint scientific research. To this end, the Working Group Research & Monitoring was established within the framework of the VNSC. A major project is *ScheldeMonitor*, a knowledge and information system that disseminates the results of the common monitoring programme (MONEOS, *Meire & Maris (2008)* [123314]) to the policy makers and scientific research. To assess the state and evolution of the estuary, an evaluation methodology was established in *Holzhauer et al. (2011)* [213039], which is used to evaluate the functioning of the Scheldt Estuary (*Depreiter et al. 2013* [228410], see Chapter 2, theme **Scheldt Estuary**).
Marine Spatial Planning	Advisory commission on marine spatial planning (*Royal Decree of 13 November 2012*)	PPS Science Policy (*MUMM*, part of *RBINS*)	This commission provides advice with arguments on the preliminary draft of the marine spatial plan to the competent minister.
Nature and environment	Milieu- en Natuurraad van Vlaanderen (*Minaraad*)	The Council has four independent experts on environment and environmental policy	The Minaraad is the strategic advisory council for the policy areas Environment, Nature and Energy. Representatives from society and independent experts consult on environmental policy. The advice and studies from these consultations are provided to the Flemish Government and the Flemish parliament.
Agriculture, Fisheries and Aquaculture	Strategic Advisory Council for Agriculture and Fisheries (*SALV*)	Platform for agricultural research	SALV advises the Flemish Government and the Flemish parliament on agriculture and fisheries in the broad sense of the word. The advice of the stakeholders represented in SALV, are part of a supported decision making process. The council takes into account all the ecological, economic, social and societal aspects.
Aquaculture	*Flemish Platform for Aquaculture*	*List of scientific partners*	In 2012, a Flemish Platform for Aquaculture was established to create sufficient support from policy, research and education, which is crucial to achieve more synergies within the research community and to stimulate sustainable aquaculture within the government (see Chapter 2, theme **Aquaculture**).
Sand and gravel extraction	Advisory commission to coordinate the administrations involved in the management of exploration and operations on the Belgian continental shelf and in the territorial sea (*Royal Decree of 12 August 2000*)	PPS Science Policy (*MUMM*, part of *RBINS*)	The commission has the following tasks: • Coordination of the investigations of the concession requests and formulating advice about these applications; • Follow-up of the various studies conducted on the effects of sand extraction on the continental shelf; • The research for the three-yearly report; • Recommendation of corrective measures if a negative impact would occur; • Formulation of policy advice relating to all aspects of sand extraction.
Safety against flooding	*Flanders Bays*	Working groups on the Coast, Harbours, Islands, Western Scheldt Estuary and Nature & Landscape Planning	Within the concept of Flanders Bays, which investigates the possibility of islands off our coast, 11 sub-projects are scientifically investigated to determine which of these concepts and sub-projects have potential to be further developed. Based on the research, the Flemish Government wants to develop a package of measures for the medium term (until 2050) in the so-called 'Masterplan Flanders Bays'.

3 Case study - Marine Strategy Framework Directive

The flow of knowledge and information in support of maritime policy in Belgium is based on established procedures (EIA, advisory boards, etc.) and targeted consultation of scientific expertise. The EU *Integrated Maritime Policy* (IMP; *COM (2007) 575*) sets guidelines for an integrated approach in which coordination and integration of existing scientific knowledge and information is embedded in the policy framework. A recent and striking example of this integration is the cooperation between the marine research network and the competent authorities in Belgium, in preparation of the *Marine Strategy Framework Directive* (MSFD; *2008/56/EC*) for the Belgian marine waters.

3.1 Marine Strategy Framework Directive: context and objective

The *MSFD* aims for an effective protection of the marine environment in the European marine waters by 2020. This directive is the legal instrument in Europe for the protection of marine biodiversity, and is referred to as the environmental pillar of the *IMP*. The main objective of the *MSFD* is a 'good environmental status' or GES for all marine waters under the jurisdiction of the Member States up to 200 nautical miles from the coast by 2020. Within the EU policy context, GES means protecting marine species and habitats, halting further loss of biodiversity by human intervention, and ensuring that the various biological components of the ecosystem function in balance (*Belgian State 2012* [220232]). The *MSFD* is therefore complementary to existing directives for the preservation of the EU marine environment. The adoption of the *MSFD* on 17 June 2008 was the result of years of preparatory work (figure 14). After the mandatory transposition of this directive into the national legislation of the Member States (by 23 July 2010) the European Commission promulgated a set of criteria and methodological standards for the description of the GES in marine waters, as described in the Commission Decision of 1/09/2010 (*2010/477/EU*).

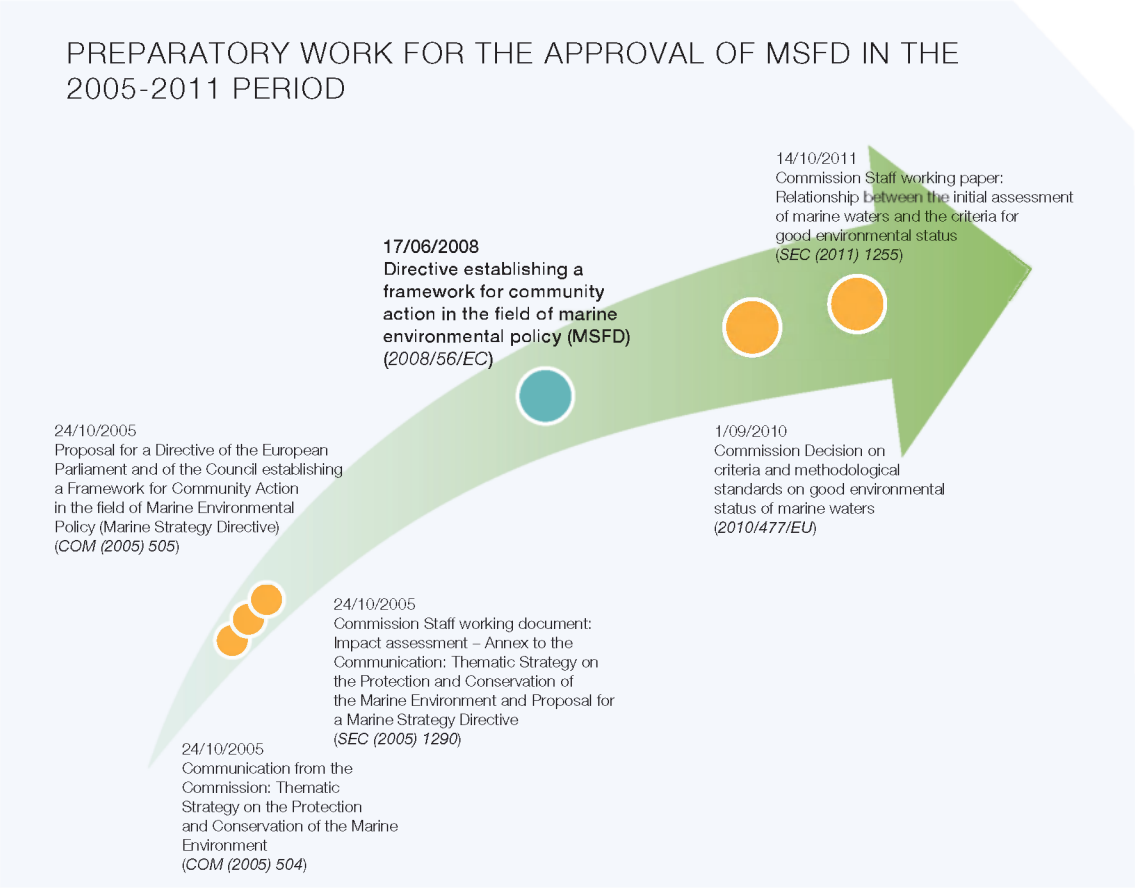

Figure 14. Preparatory work for the approval of *MSFD* in the 2005-2011 period.

Defining the GES and the environmental objectives of the *MSFD* is a national duty. The objectives of the *MSFD* have been elaborated for the four marine regions in European waters: the Baltic Sea, the North-East Atlantic, the Mediterranean Sea and the Black Sea. These regions have been demarcated on the basis of common geographical and environmental criteria. Alignment on the level of regional seas is necessary for a common evaluation and for the development of effective measures. The *MSFD* relies on existing coordination structures within the context of the *Regional Sea Conventions* for the coordination, implementation and monitoring of the objectives. For the North Sea, this is the *Convention for the protection of the marine environment of the North-East Atlantic* (*OSPAR* 1992; see **International treaties – regional conventions and agreements**), of which the EU is also a member. Article 6 of the *MSFD* also specifically refers to the cooperation with non-EU neighbouring countries which also have powers in these regional seas.

The Belgian part of the North Sea only covers a very small part of the North Sea and borders the national waters of 3 neighbouring countries. A strong international and cross-border cooperation in marine research is therefore a necessity for achieving the proposed environmental targets.

According to the requirements of the *MSFD*, Belgium and other EU Member States have committed themselves to performing the actions mentioned in table 8 by 2020.

Table 8. Timeframe for the preparatory phase (until 2015) and the implementation phase (from 2016 onwards) of *MSFD*.

TIME	ACTIONS
July 2012	Initial assessment for the Belgian marine waters pursuant Art. 8 (section 1a & 1b) of the *MSFD* (*Belgian State 2012* [220230]). This evaluation also includes a socio-economic analysis of the use of the Belgian marine waters and of the costs associated with damage inflicted on the marine environment, pursuant to Art. 8 (section 1c) of the *MSFD* (*Belgian State 2012* [220230])
	Description of the GES and the establishment of environmental targets and associated indicators for Belgian marine waters pursuant to clauses in Art. 9 & 10 (*Belgian State 2012* [220230])
July 2014	Development of a monitoring programme to measure the evolution of the state of the environment
July 2015	Development of a programme of measures to achieve or maintain GES
July 2018 (2024, 2030, etc.)	Six-yearly revision of the past evaluation in view of the results of the monitoring programme
July 2020 (and beyond)	Achieving GES

Following the transposition of the *MSFD* into national legislation (*RD of 23 June 2010*), Belgium has performed an *initial assessment on the state of the marine environment* (2012) [220230], including a *socio-economic analysis of the use of the BNS* (2012) [220231]. *The description of the GES and the establishment of environmental targets* [220232] in the BNS is as much as possible in line with the Commission Decision on the common criteria and methodological standards (*2010/477/EU*).

The GES and the environmental targets for the BNS have been defined on the basis of the eleven qualitative descriptors (D) of Annex I of the directive. The list in Annex I includes descriptors that refer to the state of the marine environment (biological diversity (D1), elements of marine food webs (D4), sea-floor integrity (D6) and the population of commercially exploited fish and shellfish (D3)), as well as descriptive elements that refer to the most important or relevant anthropogenic pressures (non-indigenous species (D2), the population of commercially exploited fish and shellfish (D3), eutrophication (D5), physical damage (D6 and D7), contaminants (D8 and D9), marine litter (D10) and the introduction of energy, including underwater noise (D11)) (*Belgian State 2012* [220232]). Based on the description of the GES and environmental targets, MUMM (RBINS) is developing a monitoring programme by July 2014 allowing to measure the evolution of the state of the environment. Then, the Marine Environment Department (FPS Health, Food Chain Safety and Environment) is responsible for coordinating the development of a programme of measures by July 2015. After the first initial assessment, the environmental status is again measured in 2018 (figure 15). In each policy cycle of the *MSFD* (2018, 2024, etc.) evaluations will be performed for the revision of the definition of GES, the environmental targets and indicators, and the programme of measures (*DG Environment 2012* [216779]).

The GES and the environmental targets serve as a framework and objective criteria to substantiate the EIA procedures, the conditions for granting authorisations, the development of management plans, the definition of compensation and/or mitigation measures, and procedures in marine spatial planning in the BNS.

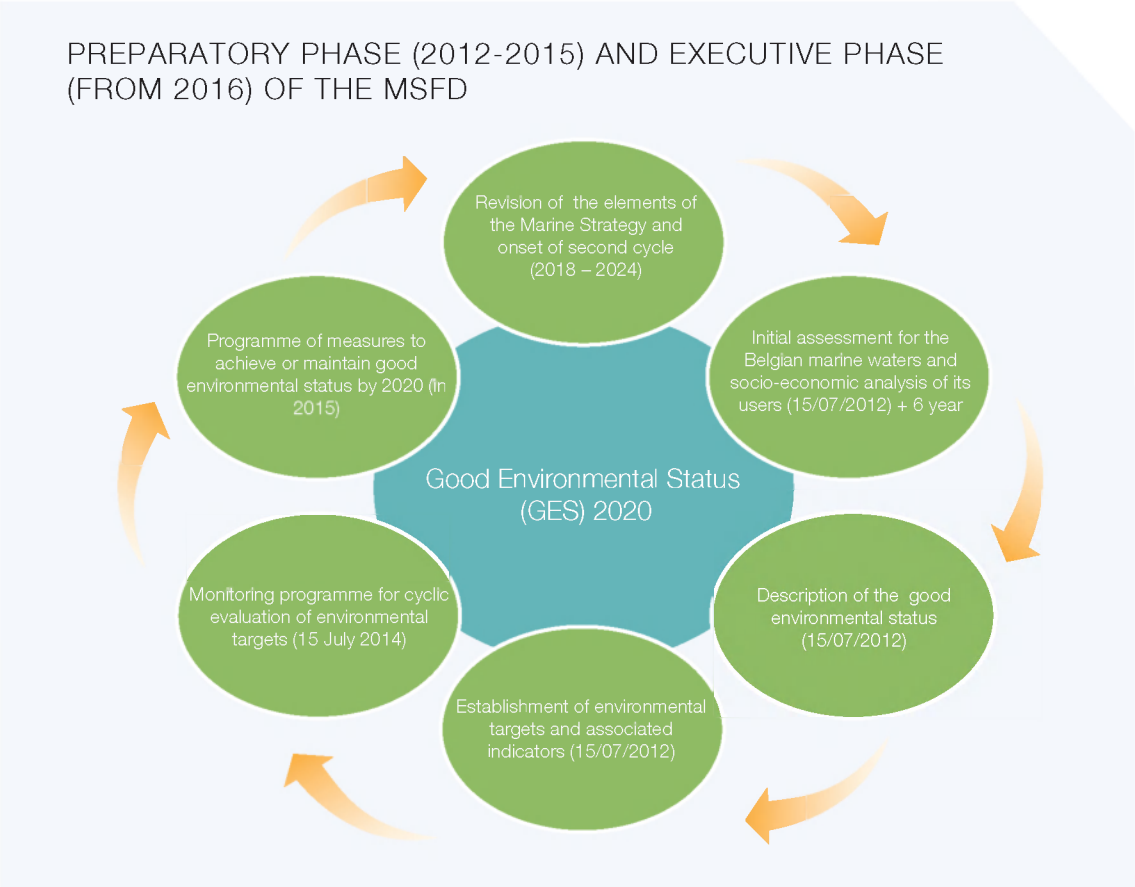

Figure 15. Preparatory phase (2012-2015) and executive phase (from 2016) of the *MSFD*.

3.2 Relation of the MSFD with other relevant legislation and instruments for the marine environment

The *MSFD* is complementary with existing regulations for the conservation of the marine environment in Belgium (see Chapter 2, theme **Nature and environment**); the most important ones are listed below:

- The Marine Protection Law (*MMM law*) aims to maintain the integrity, biodiversity and pristine nature of the marine environment through measures for protection and remediation of environmental damage and disruption. From 20 July 2012 onwards, this law also regulates the organisation and procedure for marine spatial planning and states which activities are subject to prior concession or authorisation granted by the competent minister. MSP is considered as a crucial instrument for achieving the environmental targets in the marine waters.
- The *Birds Directive* (*2009/147/EC*) (demarcation of three Special Protection Areas (SPAs), and the *Habitats Directive* (*1992/43/EEC*) (Special Area of Conservation (SAC) Flemish Banks) constitute a network of four *Natura 2000 network* areas in the BNS where a favourable conservation status must be achieved for the species and habitats defined in the annexes of the *Habitats Directive* (see Chapter 2, theme **Nature and environment**) .
- The *Water Framework Directive* (*2000/60/EC*), which applies to coastal waters less than one nautical mile (1,852 metres) offshore, states that all European 'natural' surface waters should have at least a good ecological status (GES) and good chemical status (GCS) (up to 12 nautical miles) by 2015.
- The *MSFD* also has a direct impact on the revised *Common Fisheries Policy* (*CFP*, *Regulation 2371/2002*; *COM (2011) 417*) by taking into account the environmental impacts of fisheries in line with the objectives of the *MSFD*.
- International Conventions and Treaties (*RAMSAR Convention*, *OSPAR Convention*, *IMO*, etc.) and national legislation take measures to reduce the impact of land-based sources on the marine environment.

In those areas where specific regulations and conservation measures are in force, integration and coordination are necessary for the effective implementation of the *MSFD* objectives. MSP is a powerful tool in this regard.

3.3 The MSFD in practice

The *Marine Environment Department* (FPS Health, Food Chain Safety and Environment) is the competent authority for coordination and implementation of the *MSFD*. In the preparatory phase of the *MSFD*, this authority organised the consultation of stakeholders, policy makers, scientists and researchers (September and December 2011). For the coordination, in-depth consultation with other competent federal departments and the Regions was required. This was organised primarily in the context of the 'North Sea and Oceans' steering group of the Coordinating Committee for International Environmental Policy (*CCIM*) of DG Environment. The initial assessment and socio-economic analysis resulted from collaboration with competent government agencies, the private sector and other stakeholders *(Belgian State 2012* [228707]). Subsequent to a public consultation (April – May 2012), the final results were submitted to the permanent representation to the EC in July 2012.

Policy makers and researchers collaborated intensively for the description of the GMT and the establishment of environmental targets and associated indicators of the BNS. The collaboration occurred in particular within the scope of the descriptors biological diversity (D1), elements of marine food webs (D4) and sea floor integrity (D6) during working meetings in January 2012, and was complemented by a targeted consultation for commercial fisheries (D3). By doing so, the current marine scientific knowledge and knowhow were included during policy preparation and policy support.

For each descriptor (table 9), the utility of the 29 underlying criteria and 56 indicators of the Commission Decision (*2010/477/EU*) was evaluated. In the first version (2012), the Belgian GES and environmental targets were determined at the level of the BNS, except for descriptor 3 (commercially exploited fish and shellfish) which is evaluated at the regional level. Due to the overlap and the strong relationship between descriptors D1, D4 and D6, it was decided to treat them together in this methodology

The conclusions of this consultation phase were *inter alia*:

- The current scientific knowledge and insights are often limited by a lack of data. Additional efforts should be made to collect data and to make them available to allow a more accurate assessment of the state of the marine environment. Those efforts would allow a higher measurement precision during the next management cycle for the socio-economic analysis and the assessment of costs associated with the degradation of the marine environment.
- The interaction between policy and science is needed for an effective and integrated approach in achieving GES and the environmental targets. This interaction is optimised by transparency and trust. Aspects that encourage this interaction include: transparency in government, procedures and communication, scientifically substantiated policy choices, responsibility in the scientific argumentation, and clear communication regarding uncertainties in the scientific information. The integrated approach imposed by the *MSFD* can lead to an optimisation of the interaction between policy areas that, until recently, evolved independently of each other (e.g. marine environmental policy). The research questions and knowledge gaps from the policy can initiate new or specific marine research by, for instance, being used as criteria for research funding from the Belgian Federal Science Policy Office (BELSPO).
- There is a need for a structured monitoring programme developed in view of the environmental targets, in which the existing programmes (including in view of European reporting requirements) must be spatially and temporally aligned.

The establishment of GES and environmental targets in this first management cycle is based on existing knowledge and occurs within the constraints imposed by the costs associated with systematic monitoring and evaluation. At fixed points in time, Belgium revises the appropriateness and effectiveness of how the GES, the environmental targets and indicators, and the programme of measures were determined. Therefore, Belgium will take into account new scientific knowledge, insights and infrastructure, and the possible introduction of new national and international norms and standards.

The next environmental status assessment is scheduled in 2018 and forms the basis for the review of the evaluation methodology. The collaboration between policy makers and researchers to attain these objectives includes interaction and dialogue. This 'science-policy interface' acts as a guiding factor for the identification of indicators, thresholds and knowledge gaps in view of the *MSFD* (table 9). The 'new' research resulting from this 'research-policy' dialogue often has a strong societal and applied value based on the results of fundamental research.

Table 9. Research in support of the *MSFD* (GEST, Environmental targets and indicators) for the BNS: a selection of the existent monitoring programmes, relevant data and information sources and knowledge gaps.

DESCRIPTOR	EXISTING MONITORING	DATA AND INFORMATION SOURCES	IDENTIFIED KNOWLEDGE GAPS FOR THE MSFD
1, 4. Biological diversity and elements of marine food webs	Pelagic environment (*WFD*) Benthic environment (*WFD*, BEQI) Sea birds (OSPAR EcoQO, ESAS-INBO, EU-HR) Marine mammals (*OSPAR* EcoQO, *ASCOBANS*)	Benthos: seabed biota have been studied since 1970: e.g. *Cattrijsse & Vincx 2001* [13369], *Degraer et al. 2003* [33863], *Van Hoey et al. 2004* [59829], *Degraer et al. 2006* [100260], *Degraer et al. 2010* [221235], *TROPHOS project* (*TROPHOS project BELSPO*), *WESTBANKS project* (*WESTBANKS project BELSPO*), *Derous et al. 2007* [114316], (*BWzee project*, *BELSPO*), *Vanaverbeke & Vincx 2008* [123236], *Braeckman et al. 2010* [143590], Belgian Register of Marine Species (*BeRMS*), *Vandepitte et al. 2010* [198989], *Zintzen & Massin 2010* [197893], *Braeckman 2011* [204695], *Degraer et al. 2012* [218670] Phytoplankton: *Rousseau et al. 2002* [32970], *Daro et al. 2006* [127727], *Denayer et al. 2010* [203122], *Lancelot et al. 2009* [211949], *Muylaert et al. 2006* [99092] Pelagic: *De Blauwe 2003* [55982], *Van Hoey et al. 2004* [59829], *De Backer et al. 2010* [205884] *Van Ginderdeuren et al. 2012a* [215782], *Van Ginderdeuren et al. 2012b* [215779], *Van Ginderdeuren 2013* [226261] Sea birds: *Seys 2001* [20601], *Stienen & Kuijken 2003* [57820], *Haelters et al. 2004* [68414], *Stienen et al. 2007* [111966], *Degraer et al. 2010* [221235], *Vanermen et al. 2012* [218681], review in *Goffin et al. 2007* [114225] Marine mammals: *Degraer et al. 2010* [221235], *Haelters et al. 2011* [210068]	Pelagic: no monitoring, insufficient information Angiosperms and algae: insufficient information
6. Sea floor integrity	See also 1,4	*Fonteyne 2000a* [99836], *Fonteyne 2000b* [55982], *Lanckneus et al. 2001* [24845] (*BUDGET project BELSPO*), *Le Bot et al. 2003* [41605] (BELSPO), *Van Hoey et al. 2004* [59829], *Verfaillie et al. 2006* [107236], *Van Lancker et al. 2007* [126350], *MAREBASSE project BELSPO*, *Houziaux et al. 2007* [122159], *Houziaux et al. 2003* [140756] (*Project BELSPO*), *Du Four & Van Lancker 2008* [203866], *Polet et al. 2008* [127555], *Rabaut et al. 2008* [117452], *Depestele et al. 2008* [122687], *Verfaillie et al. 2009* [135633], *Degraer et al. 2009* [143363], *Mathys 2009* [141685], *Mathys 2010* [144601], *Polet et al. 2010* [200444], *Polet & Depestele 2010* [204067], *Degrendele et al. 2010* [205558], *Fettweis et al. 2011* [200595], *De Backer et al. 2011* [208390], *Lauwaert et al. 2011* [210179], *Roche et al. 2011* [203631], *Vanaverbeke et al. 2011* [214118], *Braeckman 2011* [204685], *Degraer et al. 2011* [225352], *Houziaux et al. 2012* [216754], *Depestele et al. 2012* [214303] (*WAKO-ll project BELSPO*), *Van Lancker et al. 2012* [213684] (*QUEST-4D project BELSPO*), *Janssens et al. 2013* [227270], MER voor Offshore Windturbineparken op zee (*website MUMM*): [226563, 227509, 227510, 226564, 225506], *De Wachter & Volckaert 2005* [78285], *GAUFRE project BELSPO*, *Van den Eynde et al. 2010* [139743], *Vernaeghe et al. 2011* [206186], *Degraer & Brabant 2009* [142930], *Degraer et al. 2010* [199194], *Degraer et al. 2011* [207257]	Further research into environmental targets regarding the intensity of aggregate extraction and dredging, and soil disturbing fishing techniques
2. Non-indigenous species		Invasive Species Environmental Impact Assessment (ISEIA) *Branquart 2009* [225606], Belgian report to the IROZ/IOC/IMO Working Group on Ballast and Other Ship Vectors (*WGBOSV*) and the Working Group on Introduction and Transfers of Marine Organisms (*WGITMO*). Review of non-indigenous species in the BNS *Kerckhof et al. 2007* [114365] en de lijst van het '*VLIZ alien species consortium*', *Vandepitte et al. 2012* [217736], *Van Ginderdeuren et al. 2012* [215782]	Impact evaluation of invasive species on the marine environment in the BNS Expansion towards planktonic species and flora and fauna >1mm

3. Population of commercially exploited fish and shellfish	ILVO Data collection programmes for the *CFP* (ILVO) ICES fish stock evaluation	ICES stock measurements (*www.ices.dk*), on species and areas *Operationeel Programma in uitvoering van het Nationaal Strategisch Plan voor de Belgische visserijsector 2007-2013* [196136], *Polet et al. 2008* [127555], *Depestele et al. 2008* [122687], *Vandendriessche et al. 2008* [126732], *Polet et al. 2010* [200444], *Polet & Depestele 2010* [204067], *Depestele et al. 2011* [204031], *Depestele et al. 2012* [214303] (*WAKO-II project BELSPO*), *Verschueren et al. 2012* [225355]. Historical references in *Lescrauwaet et al. 2013* [228661], *Gilson 1921* [27286], *Poll 1947* [5255]	Further research into the establishment of environmental target MSY for mixed fisheries Further research on the establishment of MSY for species lacking data Extent and impact of recreational fisheries in the BNS
5. Eutrophication	*OSPAR*, *WFD*	OSPAR reporting on eutrophication, *Borgens en Gypens 2010* [211190]	
7. Alteration of hydrographical conditions	Flemish Banks Monitoring Network (Flemish Hydrography - Agency for Maritime and Coastal Services) Monitoring requirements for *OSPAR* and *Water Framework Directive* (*WFD*)	*Fettweis & Van den Eynde 2003* [40787], *De Moor 2006* [99123], *Fettweis et al. 2007* [115401] (*MOCHA project BELSPO*), *Ruddick & Lacroix 2006* [127723], *Fettweis et al. 2010* [203236], *Van Lancker et al. 2012* [218318] (*QUEST4D project BELSPO*), *Baeye 2012* [215124], website *Meetnet Vlaamse Banken*: hydro-meteo measurements (tides, waves, wind, etc.) in the BNS, *Website of Direction Natural Environment (RBINS)*: Operational models of hydro-meteo data, *Lacroix et al. 2004* [66529], *Gypens et al. 2011* [211480], *AMORE* (*AMORE project BELSPO*), *AMORE II* (*AMORE II project BELSPO*) en *AMORE III* (AMORE III project *fase 1* en *fase 2* BELSPO project), *Van den Eynde et al. 2011* [212421]	Further research into adequate indicators
8. Contaminants	*OSPAR* monitoring Monitoring for *WFD* (PCBs, PAHs, heavy metals, effects of TBT, DDT, HCB, PBDEs,..) Monitoring for *Bonn Convention* (MUMM)	Usage of existing thresholds from EU legislation OSPAR reports *Francken & Ruddick 2007* [138995] and *Francken & Hafez 2009* [142543] *Missiaen & Henriet 2010* [199351], review in *Goffin et al. 2007* [114225]	Development of bio-indicators General toxicity tests (ILVO) are being developed Defining thresholds for acute toxicity
9. Contaminants in fish and seafood for human consumption	No new indicators, usage of existing levels and programmes	Review in *Goffin et al. 2007* [114225]	
10. Marine litter	OSPAR EcoQO for Northern Fulmars OSPAR Beach Litter Monitoring in marine environments (2010)	*OSPAR 2007* [123895], *OSPAR 2010* [198817], *As-MADE project BELSPO*, *Van Franeker et al. 2011* [209289], *Claessens et al. 2011* [225693], *Claessens et al. 2013* [225696], *Van Cauwenberghe et al. 2013* [226841], *Fishing for Litter*, *Waste-free Ocean*	Further research into the impact of microplastics on marine organisms and public health A need for long-term series
11. Introduction of energy, including underwater noise		*Haelters et al. 2009* [142995], *Norro et al. 2010* [193744], *Norro et al. 2011* [207277], *Verhaeghe et al. 2011* [206186], *Haelters et al. 2012* [218683], *Norro et al. 2012* [218684], *Debusschere et al. 2013* [222829]	Noise regulations for GES for the BNS Assignment of the locations for 2 independent measurement stations After the 2018 evaluation: development of a propagation model


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Annex

Annex 1: List of acronyms

A

ACOM	Adviescomité
AD	Algemene Directie
ADSEI	Algemene Directie Statistiek en Economische Informatie
AFS	Anti-Fouling System
AGERS	Administration Générale de l'Enseignement et de la Recherche Scientifique
AGIV	Agentschap voor Geografische Informatie Vlaanderen (see FGIA)
AGNAS	Afbakenen van de gebieden van de natuurlijke en agrarische structuur
AIS	Automatic Identification System
AMEPP	Allied Maritime Environmental Protection Publication
AMS	Afdeling Monitoring en Studie
ANB	Agentschap voor Natuur en Bos
AOE	Agentschap Onroerend Erfgoed
ASCOBANS	Agreement on the Conservation of Small Cetaceans of the Baltic, North East Atlantic, Irish and North Seas
ASFA	Aquatic Sciences and Fisheries Abstracts
AWI	Alfred Wegener Instituut
AWZ	Administratie Waterwegen en Zeewezen

B

BaZ	Berichten aan Zeevarenden
BBP	Bruto Binnenlands Product (see GDP)
BCP	Belgisch Continentaal Plat (see BCS)
BCS	Belgian Continental Shelf (see BCP)
BELSPO	Federaal Wetenschapsbeleid (Belgian Federal Science Policy Office)
BMB	Belgische Mariene Bibliografie
BMDC	Belgisch Marien Data Centrum
BMM	De Beheerseenheid van het Mathematisch Model van de Noordzee en het Schelde-estuarium (see MUMM)
BNIP	Bijzonder Nood- en Interventieplan
BNZ	Belgisch Deel van de Noordzee (see BNS)
BNS	Belgian part of the North Sea (see BNZ)
BOF	Bijzondere Onderzoeksfondsen
BPA	Bijzonder Plan van Aanleg
BRAIN	Belgian Research Action through Interdisciplinary Networks
BTW	Belasting over de toegevoegde waarde
BWHI	Bijzondere wet tot hervorming der instellingen
BWM	Ballast Water Management
BWZee	Biologische Waardering Zee

C

CAP	Common Agricultural Policy (see GLB)
CBD	Convention on Biological Diversity
CBVC	Communautair Bureau voor Visserijcontrole
CCIEP	Coordination Committee for International Environmental Policy (see CCIM)
CCIM	Coördinatie Comité Internationaal Milieubeleid (see CCIEP)
CDK	Coördinatiepunt Duurzaam Kustbeheer
CFC	Chlorine fluor carbonhydrates (see CFK)
CFK	Chloorfluorkoolstofverbinding (see CFC)
CFP	Common Fisheries Policy (see GVB) / Controlled Floodplain (see GOG)
CFS	Commissie Federale Samenwerking
CEMAT	Europees Charter voor Regionale Ruimtelijke Planning
CIP	Competitiveness and Innovation Programme
CIW	Coördinatiecommissie Integraal Waterbeleid
CJSM	Cultuur, Jeugd, Sport en Media
CLC	Convention on Civil Liability for Oil Pollution Damage
CLL	International Convention on Load Lines
CNA	Common Nautical Authority (see GNA)
CNM	Common Nautical Management (see GNB)
COLREGS	Regulations for Preventing Collisions at Sea
COP	Conference of the Parties
CORDIS	Community Research and Development Information Service
COSME	Programme for Competitiveness of Enterprises and SME's
COST	European Cooperation in Science and Technology
CP	Continentaal Plat
CREG	Commissie voor de Regulering van de Elektriciteit en het Gas
CSA	Coordination and Support Actions
CWC	Chemical Weapons Convention

D

DAB	Dienst Afzonderlijk Beheer
DCF	Data Collection Framework
DCMAP	Data Collection Multi Annual Programme
DESA	Department of Economic and Social Affairs
DG	Directoraat-Generaal
DG EAC	Directoraat-Generaal Educatie en cultuur
DGENORS	Direction Générale de l'Enseignement Non Obligatoire et de la Recherche Scientifique
DG MARE	Directoraat-Generaal voor maritieme zaken en visserij
DG MOVE	Directoraat-Generaal Mobiliteit en Transport
DIV	Departement Internationaal Vlaanderen
DOALOS	Division for Ocean Affairs and the Law of the Sea
DOEB	Duurzame ontwikkeling en effectbeoordeling
DPWB	Dienst Programmatorisch Wetenschapsbeleid

DSA	Data, studie en Advies
DWTI	Dienst voor Wetenschappelijke en Technologische Informatie

E

EAFRD	European Agricultural Fund for Rural Development (see ELFPO)
EC	Europese Commissie
ECA	Emission Control Areas
ECOOM	Expertisecentrum Onderzoek en Ontwikkelingsmonitoring
EcoQO	Ecological Quality Objective (OSPAR)
ECSC	European Coal and Steel Community (see EGKS)
EEA	European Environment Agency (see EMA)
EEDI	Energy Efficiency Design Index
EEZ	Exclusieve Economische Zone
EFARO	European Fisheries and Aquaculture Research Organisation
EFF	European Fisheries Fund (see EVF)
EFMZV	Europees Fonds voor Maritieme Zaken en Visserij (see EMFF)
EFRO	Europees Fonds voor Regionale Ontwikkeling (see ERDF)
EG	Europese Gemeenschap
EGKS	Europese Gemeenschap voor Kolen en Staal (see ECSC)
EIA	Environmental Impact Assessment (see MER)
EIONet	European Environment Information and Observation Network
EIP	European Innovation Partnerships
EIT	European Institute for Innovation and Technology
ELFPO	Europees Landbouwfonds voor Plattelandsontwikkeling (see EAFRD)
EMA	Europees Agentschap voor het Milieu (see EEA)
EMFF	European Maritime and Fisheries Fund (see EFMZV)
EMODNet	European Marine Observation and Data Network
EMS	Electronic Monitoring System
EMSA	Europees agentschap voor maritieme veiligheid
EOOS	European Ocean Observation System
EOR	Europese Onderzoeksruimte (see ERA)
ERA	European Research Area (see EOR)
ERC	European Research Council
ERDF	European Regional Development Fund (see EFRO)
ERMS	European Register of Marine Species
EROP	Europees Ruimtelijk Ontwikkelingsperspectief
EVRO	European Research Vessel Organisation
ESA	European Space Agency
ESFRI	European Strategic Forum on Research Infrastructures
ETC	European Topics Center
EU	Europese Unie
EVF	Europees Visserijfonds
EWEA	European Wind Energy Association
EWI	Departement Economie, Wetenschap en Innovatie

F

FAO	Food and Agriculture Organization
FARO	Vlaams steunpunt voor cultureel erfgoed
FASFC	Federal Agency for Safety of the Food Chain (see FAVV)
FAVV	Federaal Agentschap voor de veiligheid van de voedselketen (see FASFC)
FBBF	Fonds pour la Biotechnologie
FEN	Flemish Ecological Network (see VEN)
FIVA	Financieringsinstrument voor de Vlaamse Visserij- en Aquacultuursector
FGIA	Flemish Geographical Information Agency (see AGIV)
FNRS	Fonds de la Recherche Scientifique
FOD	Federale Overheidsdienst
FP	Framework Programme (see KP)
FPS	Federal Public Service
FTE	Full-time equivalent (see VTE)
FUND	International Fund for Compensation for Oil Pollution Damage
FUST	Flanders-UNESCO Science Trust Fund

G

GBKG	Geïntegreerd Beheer van Kustgebieden (see ICZM)
GCS	Good Chemical Status (see GCT)
GCT	Goede Chemische Toestand (see GCS)
GDP	Gross Domestic Product (see BBP)
GES	Good Environmental Status (see GMT)
GET	Goede Ecologische Toestand
GEP	Goed Ecologisch Potentieel / Good Ecological Potential
GGG	Gecontroleerd Gereduceerd Getijgebied
GIS	Geografisch Informatiesysteem
GLB	Gemeenschappelijk Landbouwbeleid
GLOSS	Global Sea Level Observing System
GMB	Geïntegreerd Maritiem Beleid (see IMP)
GMES	Global Monitoring for Environment and Security
GMT	Goede Milieutoestand (see GES)
GNA	Gemeenschappelijke Nautische Autoriteit (see CNA)
GNB	Gemeenschappelijk Nautisch Beheer (see CNM)
GOG	Gecontrolleerd Overstromingsgebied (see CFP)
GOOS	Global Ocean Observing System
GRS	Gemeentelijke Ruimtelijk Structuurplan
GRUP	Gewestelijk ruimtelijk uitvoeringsplan
GSC	Groene Stroom Certificaten
GT	Gigaton
GVB	Gemeenschappelijk Visserijbeleid (see CFP)
GVS	Groot Vloot Segment
GW	Gigawatt
GWu	Gigawattuur

H

ha	Hectare
HELCOM	Helsinki Commission
HEREIN	Europese Erfgoed Netwerk
HNS	Hazardous and Noxious Substances
HRL	Habitatrichtlijn

I

IAEA	International Atomic Energy Agency
IAMSLIC	International Association of Aquatic and Marine Science Libraries and Information Centers
IAP	Instituut voor het Archeologisch Patrimonium
IAP	Interuniversitaire Aantrekkingspolen
ICAM	Integrated Coastal Area Management
ICES	International Council for the Exploration of the Sea (see IROZ)
ICM	Integrated Coastal Management
ICOMOS	Internationale Raad voor Monumenten en Landschappen
ICOS	Integrated Carbon Observation System
ICSU	International Council for Science
ICUCH	International Committee on the Underwater Cultural Heritage
ICZM	Integrated Coastal Zone Management (see GBKG)
IFREMER	Institut Français pour l'Exploitation de la Mer
IFS	International Foundation for Science
IHD	Instandhoudingsdoelstelling
ILVO	Instituut voor Landbouw- en Visserijonderzoek
ILO	International Labour Organisation
IMCWB	Interministeriële Conferentie voor Wetenschapsbeleid
IMIS	Integrated Marine Information System
IMO	International Maritime Organisation
IMP	Integrated Maritime Policy (see GMB)
IMTA	Geïntegreerde Multi-trofische Aquacultuur
INBO	Instituut voor Natuur- en Bosonderzoek
IOC	Intergovernmental Oceanographic Commission
IODE	International Oceanographic Data and Information Exchange
IODP	Intergrated Ocean Drilling Program
IOF	Industrieel Onderzoeksfonds
IOO-visserij	Illegale, Ongemelde en Ongereglementeerde visserij (see IUU-fisheries)
IPCC	Intergovernmental Panel on Climate Change
IROZ	Internationale Raad voor het Onderzoek van de Zee (see ICES)
ISBA	International Seabed Authority
ISC	Internationale Scheldecommissie
ISEIA	Invasive Species Environmental Impact Assessment
IUU-fisheries	Illegal, unreported and unregulated fisheries (see IOO-visserij)
IV	Internationaal Vlaanderen
IWC	International Whaling Commission
IWT	Agentschap voor Innovatie door Wetenschap en Technologie
IZWO	Instituut voor Zeewetenschappelijk Onderzoek

J

JAMP	Joint Assessment and Monitoring Program (OSPAR)
JCOMM	Joint Technical Commission for Oceanography and Marine Meteorology
JPI	Joint Programming Initiatives
JRC	Joint Research Center
JTI	Joint Technology Initiatives

K

KB	Koninklijk Besluit (see RD)
KBIN	Koninklijk Belgisch Instituut voor Natuurwetenschappen (see RBINS)
KIM	Kwaliteit Indexmethode
KiTS	Kust-Indicatoren-Toeristisch-Statistisch
KMMA	Koninklijk Museum voor Midden-Afrika (see RMCA)
KMO	Kleine of middelgrote onderneming
KP	Kaderprogramma (see FP)
KRMS	Kaderrichtlijn Mariene Strategie (see MSFD)
KRW	Kaderrichtlijn Water (see WFD)
KU Leuven	Katholieke Universiteit Leuven
kV	Kilovolt
KVAB	Koninklijk Vlaamse Academie van België voor Wetenschap en Kunst
KVS	Klein Vloot Segment
kW	Kilowatt

L

LARA	Landbouwrapportage
LNE	Leefmilieu, Natuur en Energie
LNG	Liquefied Natural Gas
LTV	Lange Termijn Visie
LV	Landbouw en Visserij

M

MAP	Mestactieplan
MarBEF	Marine Biodiversity and Ecosystem Functioning
MARPOL	International Convention for the Prevention of Pollution from Ships
MARS	European Network of Marine Research Institutes and Stations

MAS Museum aan de Stroom
MAST Marine Science and Technology Program
MB Ministrieel Besluit
MBG Mariene Beschermde Gebieden (see MPA)
MD&K Maritieme Dienstverlening en Kust
MDO Maximale duurzame opbrengst (see MSY)
MEA Millennium Ecosystem Assessment
MEA Multilateral Environmental Agreements
MEB Milieueffectenbeoordeling
MEPC Marine Environment Protection Committee
MER Milieueffectenrapport (see EIA)
MGE Marine Genomics Europe
MIK Maritiem Informatie Kruispunt
Minaraad Milieu- en Natuurraad van Vlaanderen
MIRA Milieurapport
MKBA Maatschappelijke Kosten-Batenanalyse
MMA Multilaterale Milieuakkoorden (see MEA)
MMM-wet Wet ter bescherming van het mariene milieu en ter organisatie van de mariene ruimtelijke planning in de zeegebieden onder de rechtsbevoegdheid van België
MMO Marine Management Organisation
MOG Mariene Onderzoeksgroep (see MRG)
MoU Memorandum of Understanding (see MvO)
MOW Mobiliteit en Openbare Werken
MPA Marine Protected Area (see MBG)
MRCC Maritiem Redding- en Coördinatiecentrum
MRG Marine Research Group (see MOG)
MRO Maritieme Ruimtelijke Ordening
MRP Maritieme Ruimtelijke Planning (see MSP)
MSFD Marine Strategy Framework Directive (see KRMS)
MSP Maritime Spatial Planning (MRP)
MSY Maximum Sustainable Yield (see MDO)
MUMM Management Unit of the North Sea Mathematical Models and the Scheldt estuary (see BMM)
MvO Memorandum van Overeenstemming (see MOU)
MW Megawatt
MWu Megawattuur

N

NAVIGO Nationaal Visserijmuseum Oostduinkerke
NAVO Noord-Atlantische Verdragsorganisatie(see NATO)
NATO North Atlantic Treaty Organization (see NAVO)
NBB Nationale Bank van België
NGO Niet-Gouvernementele Organisatie
NIS Nationaal Instituut voor de Statistiek
NM Nautische Mijl (1852 m)
NMCM Naval Mine Counter Measures
NOC-Southampton National Oceanographic Center Southampton
NRP Natuurrichtplannen
NSN North Sea Network of Prosecutors and Investigators

O

O&M Onderzoek en Monitoring (see R&M)
O&O Onderzoek en Ontwikkeling (see R&D)
OBIS Ocean Biogeographic Information System
OECD Organisation for Economic Co-operation and Development (see OESO)
OMA Office for Metropolitan Architecture
OESO Organisatie voor Economische Samenwerking en Ontwikkeling (see OECD)
OPRC Oil Pollution Preparedness, Response and Co-operation
OVAM Openbare Vlaamse Afvalstoffenmaatschappij

P

PBDE Polygebromeerde Difenyl Ethers
PCB Polychloorbifenyl
POD Programmatorische Overheidsdienst
POGO Partnership for Observation of the Global Oceans
POM Provinciale Ontwikkelingsmaatschappij
POP Persistent Organic Pollutant
PRS Provinciaal Ruimtelijk Structuurplan
PRS-WV Provinciaal Ruimtelijk Structuurplan West-Vlaanderen
PSC Port State Control

Q

QSR Quality Status Report (OSPAR)

R

R&D Research and Development (see O&O)
R&M Research and Monitoring (see O&M)
RAC Regional Advisory Council (see RAR)
RAR Regionale adviesraad (see RAC)
RBINS Royal Belgian Institute of Natural Sciences (see KBIN)
RD Royal Decree (see KB)
REA Research Executive Agency
RESOC Regionaal Sociaal-economisch Overlegcomité
RMCA Royal Museum for Central Africa (see KMMA)
RMT Regie voor Maritiem Transport
RSV Ruimtelijk Structuurplan Vlaanderen
RSVZ Rijksinstituut voor de Sociale Verzekeringen der Zelfstandigen
RSZ Rijksdienst voor Sociale Zekerheid
RUP Ruimtelijk Uitvoeringsplan
RV Research Vessel
RVA Rijksdienst voor arbeidsvoorseening
RVR Ruimtelijk veiligheidsrapporten
RWO Ruimtelijke Ordening, Woonbeleid en Onroerend Erfgoed

S

SALV	Strategische Adviesraad voor Landbouw en Visserij
SAR	Search and Rescue
SBO	Strategisch Basis-Onderzoek
SBZ	Speciale Beschermingszone
SCOT	Schéma de cohérence territoriale
SDVO	Stichting Duurzame Visserijontwikkeling
SEA	Strategic Environmental Assessment (see SMB)
SERV	Sociaal-Economische Raad van Vlaanderen
SHIP	Strategisch Haven Infrastructuur Project
SMB	Strategische Milieubeoordeling (see SEA)
S.M.E.	Small and Medium Enterprises
SMEBD	Society for the Management of Electronic Biodiversity Data
SOC	Strategische Onderzoekscentra
SOLAS	Safety of Life at Sea
SSD	Programma rond Wetenschap voor Duurzame Ontwikkeling
SSS	Short Seashipping
STECF	Scientific, Techincal and Economic Comittee for Fisheries (see WTECV)
STWC	Standards of Training, Certification and Watchkeeping for Seafarers
SVI	Staat van Instandhouding

T

TAW	Tweede Algemene Waterpassing
TAC	Total Allowable Catch (see TTV)
TBT	Tributyltin
TEEB	The Economics of Ecosystems and Biodiversity
TEN	Trans-European Network
TETRA-fonds	Technologietransfer door instellingen van hoger onderwijs
TSC	Technische Scheldecommissie
TTV	Totale toegestane vangsthoeveelheid (see TAC)
TWu	Terawattuur

U

UA	Universiteit Antwerpen
UAV	Unmanned aerial vehicle
UCL	Université Catholique de Louvain
UGent	Universiteit Gent
UHasselt	Universiteit Hasselt
ULB	Université Libre de Bruxelles
ULg	Université de Liège
UMons	Université de Mons
UN	United Nations (see VN)
UNamur	Université de Namur
UNCLOS	United Nations Covention on the Law of the Sea
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNIDO	United Nations Industrial Development Organization

V

VABB	Vlaams Academisch Bibliografisch Bestand
VDAB	Vlaamse Dienst voor Arbeidsbemiddeling en Beroepsopleiding
VDR	Voyage Data Recorder
VEA	Vlaams Energie Agentschap
VEN	Vlaams Ecologisch Netwerk (see FEN)
VHC	Vlaamse Havencommissie
VIN	Vlaams Innovatie Netwerk
VIOE	Vlaams Instituut voor het Onroerend Erfgoed
VIRA	Visserijrapport
VITO	Vlaamse Instelling voor Technologisch Onderzoek
VLAM	Vlaams Centrum voor Agro- en Visserijmarketing
VLAREA	Vlaams reglement inzake afvalvoorkoming en beheer
VLHORA	Vlaamse Hogescholen Raad
VLIR	Vlaamse Interuniversitaire Raad
VLIZ	Vlaams Instituut voor de Zee
VLM	Vlaamse Landmaatschappij
VLUHR	Vlaamse Universiteiten en Hogescholen Raad
VMDC	Vlaams Marien Data Centrum
VMM	Vlaamse Milieumaatschappij
VMS	Vessel Monitoring System
VN	Verenigde Naties
VNSC	Vlaams-Nederlandse Schelde Commissie
VREG	Vlaamse Regulator van de Elektriciteits- en Gasmarkt
VRL	Vogelrichtlijn
VRWI	Vlaamse Raad voor Wetenschap en Innovatie
VTE	Voltijds Equivaltent (see FTE)
VTS	Vessel Traffic Services
VUB	Vrije Universiteit Brussel
VWP	Visserij Wetenschap Partnerships

W

WAMS	World Association of Marine Stations
WB	Wereldbank / World Bank
WFD	Water Framework Directive (see KRW)
WGBOSV	Working Group on Ballast and Other Ship Vectors
WGEXT	Working Group on the Effects of Extraction of Marine Sediments on the Marine Ecosystem
WGITMO	Working Group on Introduction and transfers of Marine Organisms
WGMASC	Working Group on Marine Shellfish Culture

WGMIXFISH Working Group on Mixed Fisheries Advice for the North Sea
WMO World Meteorological Organization
WoRMS World Register of Marine Species
WSSD World Summit on Sustainable Development
WTECV Wetenschappelijk, Technisch en Economisch Comité voor de visserij (see STECF)
WTO World Trade Organisation
W&Z Waterwegen en Zeekanaal NV

X

Y

Z

ZWI Zeewetenschappelijk Instituut

Annex 2: Overview of the marine research groups

Katholieke Universiteit Leuven

1 Laboratory Aquatic Biology
2 Laboratory of Biodiversity and Evolutionary Genomics
3 Section ESAT - Electrical Energy and Computer Architecture
4 Division of Geology
5 Hydraulics Laboratory
6 Public Management Institute
7 Laboratory for Toxicology and Food Chemistry

University of Antwerp

8 Ecosystem Management research group
9 Research group Functional Morphology
10 Institute of Transport and Maritime Management
11 Micro- and Trace Analysis Centre; Research group Environmental Analysis
12 Centre for Urban History
13 Research group Systemic Physiological and Ecotoxicological Research
14 Toxicological Centre
15 Department Transport and Regional Economy

Ghent University

16 Agro-food Marketing and Consumer Behavior
17 Phycology Research group
18 Laboratory of Analytical Chemistry and Applied Ecochemistry
19 Laboratory of Aquaculture and Artemia Reference Center
20 Laboratory for Chemical Analysis
21 Research group Economy, Ecology and Demography
22 Research group Evolutionary Morphology of Vertebrates
23 Geomatics
24 Hydraulics Laboratory
25 Laboratory for Food Microbiology and Food Preservation
26 Marine Biology Research group
27 Maritime Institute
28 Maritime Technology Division
29 Laboratory for Microbial Ecology and Technology
30 Laboratory of Microbiology
31 Laboratory of Environmental Toxicology and Aquatic Ecology
32 Center for Mobility and Spatial Planning
33 Department of Morphology
34 Research group Nutrition and Food Safety
35 Research unit Palaeontology
36 Laboratory of Protistology and Aquatic Ecology
37 Renard Centre of Marine Geology
38 Terrestrial Ecology Research group
39 Laboratory for Applied Geology and Hydrogeology
40 Coastal Engineering, Bridges and Roads; Coastal Engineering Research group

Hasselt University

41 Research group Zoology: Biodiversity and Toxicology

Vrije Universiteit Brussel

42 Plant Biology and Nature Management Laboratory
43 Research group Analytical and Environmental Chemistry
44 Research group Physical Geography
45 Department of Hydrology and Hydraulic Engineering
46 Centre for International Law
47 Department of Art Sciences and Archaeology
48 Research group Marine Biology

Flemish scientific institutes

49 Flanders Heritage Agency
50 Institute for Agricultural and Fisheries Research (ILVO)
51 Research Institute for Nature and Forest (INBO)
52 Flemish Institute for Technological Research (VITO)
53 Flanders Marine Institute (VLIZ)
54 Flanders Hydraulics Research

Université Catholique de Louvain

55 Marine Biology Laboratory
56 Lemaître Centre for Earth and Climate Research
57 Applied Mechanics Unit
58 Institute of Life Sciences
59 Research pole Environmental Sciences

Université Libre de Bruxelles

60 Acoustics and Environmental Hydroacoustic Lab
61 Biogeochemistry and Earth System Modelling group
62 Research group Marine Biology
63 Laboratory of Ecology of Aquatic System
64 Laboratory of Systems Ecology and Resource Management
65 Laboratoire de Glaciologie

66 Laboratory G-Time (Geochemistry: Tracing with Isotopes, Minerals and Elements)

University of Liège

67 Naval Architecture, Maritime Engineering, Inland and Sea Shipping and Transport System Analysis
68 Research unit Clays, Sedimentary Geochemistry and Environments
69 Animal Ecology and Ecotoxicology Laboratory; Marine Ecology Unit
70 GeoHydrodynamics and Environment Research
71 Mathematical Modelling and Methods
72 Department of Morphology and Pathology
73 Functional and Evolutionary Morphology Laboratory
74 Chemical Oceanography Unit
75 Laboratory of Oceanology
76 Palaeobiogeology, Palaeobotany and Palaeopalynology Laboratory
77 Sedimentary Petrology Laboratory

University of Mons

78 Laboratory of Biology of Marine Organisms and Biomimetics
79 Numerical Ecology of Aquatic Systems group

University of Namur

80 Research unit in Environmental and Evolutionary Biology

Federal scientific institutes

81 Royal Belgian Institute of Natural Sciences (RBINS)
82 Royal Museum for Central Africa (RMCA)

Annex 3: Overview marine / maritime policy and legal instruments (Chapter 3)

Nature and environment

International agreements, conventions, etc.	
International Convention for the Regulation of Whaling	1946
Convention on Wetlands of International Importance especially as Waterfowl Habitat (RAMSAR)	1971
The Bern Convention on the Conservation of European Wildlife and Natural Habitats	1979
Conservation of migratory species - Bonn Convention	1979
ASCOBANS - Agreement on the Conservation of Small Cetaceans of the Baltic, North East Atlantic, Irish and North Seas	1992
The Convention on Biological Diversity	1992
European legislation	
Directives	
Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora	1992
Directive 2006/7/EC of the European Parliament and of the Council of 15 February 2006 concerning the management of bathing water quality and repealing Directive 76/160/EEC	2006
Directive 2006/11/EC of the European Parliament and of the Council of 15 February 2006 on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community	2006
Directive 2008/105/EC of the European Parliament and of the Council of 16 December 2008 on environmental quality standards in the field of water policy, amending and subsequently repealing Council Directives 82/176/EEC, 83/513/EEC, 84/156/EEC, 84/491/EEC, 86/280/EEC and amending Directive 2000/60/EC of the European Parliament and of the Council	2008
Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds	2009
Belgian and Flemish legislation	
Laws	
Wet van 12 juli 1973 op het natuurbehoud (hoofdstuk 9 specifieke bepalingen voor de maritieme duinstreek)	1973
Wet van 9 juli 2004 betreffende de toetreding van België : - tot het Internationaal Verdrag tot regeling van de walvisvangst en tot het Reglement, gedaan te Washington op 2 december 1946; - tot het Protocol, gedaan te Washington op 19 november 1956, bij het Internationaal Verdrag tot regeling van de walvisvangst, gedaan te Washington op 2 december 1946	2004
Decrees	
Decreet van 14 juli 1993 houdende maatregelen tot bescherming van kustduinen	1993

Maritime transport, shipping and ports

International agreements, conventions, etc.	
Verdrag van 20 juni 1960 tussen het Koninkrijk België en het Koninkrijk der Nederlanden betreffende de verbetering van het kanaal van Terneuzen naar Gent en de regeling van enige daarmede verband houdende aangelegenheden & Protocol van 5 februari 1988 Kanaal Gent-Terneuzen	1960
Verdrag van 13 mei 1963 tussen het Koninkrijk der Nederlanden en het Koninkrijk België betreffende de verbinding tussen de Schelde en de Rijn	1963
Convention of Facilitation of International Maritime Traffic	1965
LOAD LINES 66 - International Convention on Load Lines	1966
CLC-Convention - International Convention on Civil Liability for Oil Pollution Damage	1969
TONNAGE 69 - International Convention on Tonnage Measurement of Ships	1969
International Convention relating to intervention on the high seas in cases of oil pollution casualties	1969
Overeenkomst van 13 juli 1970 tussen de Regering van het Koninkrijk België en de Regering van het Koninkrijk der Nederlanden betreffende de verbetering van de vaarweg voor de Westerschelde nabij Walsoorden	1970
FUND-Convention - International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage	1971
Special Trade Passenger Ships Agreement	1971
Convention relating to Civil Liability in the Field of Maritime Carriage of Nuclear Material (NUCLEAR)	1971
COLREG-Convention - Convention on the International Regulations for Preventing Collisions at Sea	1972
CSC-Convention - International Convention for Safe Containers	1972
London Convention - Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter	1972
MARPOL-Convention: International Convention for the prevention of pollution from ships, as modified by the Protocol of 1978 relating thereto	1973
SOLAS-Convention - International Convention for the Safety of Life at Sea	1974
Athens Convention relating to the Carriage of Passengers and their Luggage by Sea	1974
Convention concerning minimum standards in merchant ships	1976
Convention on the International Maritime Satellite Organization (IMSO C)	1976
LLMC-Convention - Convention on Limitation of Liability for Maritime Claims	1976

STCW-Convention - International Convention on Standards of Training, Certification and Watchkeeping for Seafarers	1978
SAR-Convention - International Convention on Maritime Search and Rescue	1979
Paris Memorandum of Understanding on Port State Control	1982
Bonn Agreement - Agreement for cooperation in dealing with pollution of the North Sea by oil and other harmful substances	1983
Convention for the Suppression of Unlawful Acts Against the Safety of Maritime Navigation (SUA), 1988, and Protocol for the Suppression of Unlawful Acts Against the Safety of Fixed Platforms located on the Continental Shelf	1988
International Convention on Salvage	1989
OPRC-Convention: International Convention on Oil Pollution Preparedness, Response and Co-operation	1990
Verdrag tussen het Vlaams Gewest en het Koninkrijk der Nederlanden inzake de verruiming van de vaarweg in de Westerschelde	1995
HNS-Convention - International Convention on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances by Sea	1996
Convention concerning seafarers' hours of work and the manning of ships	1996
AFS-Convention - International Convention on the Control of Harmful Anti-fouling Systems on Ships	2001
International Convention on Civil Liability for Bunker Oil Pollution Damage	2001
BWM-Convention - International Convention for the Control and Management of Ships' Ballast Water and Sediments	2004
Verdrag tussen het Vlaams Gewest en het Koninkrijk der Nederlanden inzake de beëindiging van de onderlinge koppeling van de loodsgeldtarieven	2005
Verdrag tussen het Vlaams Gewest en het Koninkrijk der Nederlanden inzake het gemeenschappelijk nautisch beheer in het Scheldegebied	2005
Nairobi International Convention on the removal of wrecks	2007
The Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships	2009
European legislation	
Directives	
Council Directive 79/115/EEC of 21 December 1978 concerning pilotage of vessels by deep-sea pilots in the North Sea and English Channel	1979
Council Directive 1999/32/EC of 26 April 1999 relating to a reduction in the sulphur content of certain liquid fuels and amending Directive 93/12/EEC	1999
Directive 1999/95/EC of the European Parliament and of the Council of 13 December 1999 concerning the enforcement of provisions in respect of seafarers' hours of work on board ships calling at Community ports	1999
Directive 2000/59/EC of the European Parliament and of the Council of 27 November 2000 on port reception facilities for ship-generated waste and cargo residues	2000
Directive 2001/96/EC of the European Parliament and of the Council of 4 December 2001 establishing harmonised requirements and procedures for the safe loading and unloading of bulk carriers	2001
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	2002
Directive 2002/84/EC of the European Parliament and of the Council of 5 November 2002 amending the Directives on maritime safety and the prevention of pollution from ships	2002
Directive 2003/25/EC of the European Parliament and of the Council of 14 April 2003 on specific stability requirements for ro-ro passenger ships	2003
Directive 2005/35/EC of the European Parliament and of the Council of 7 September 2005 on ship-source pollution and on the introduction of penalties for infringements	2005
Directive 2005/45/EC of the European Parliament and of the Council of 7 September 2005 on the mutual recognition of seafarers' certificates issued by the Member States and amending Directive 2001/25/EC	2005
Directive 2005/65/EC of the European Parliament and of the Council of 26 October 2005 on enhancing port security	2005
Directive 2008/106/EC of the European Parliament and of the Council of 19 November 2008 on the minimum level of training of seafarers	2008
Directive 2009/15/EC of the European Parliament and of the Council of 23 April 2009 on common rules and standards for ship inspection and survey organisations and for the relevant activities of maritime administrations	2009
Directive 2009/16/EC of the European Parliament and of the Council of 23 April 2009 on port State control	2009
Directive 2009/18/EC of the European Parliament and of the Council of 23 April 2009 establishing the fundamental principles governing the investigation of accidents in the maritime transport sector and amending Council Directive 1999/35/EC and Directive 2002/59/EC of the European Parliament and of the Council	2009
Directive 2009/21/EC of the European Parliament and of the Council of 23 April 2009 on compliance with flag State requirements	2009
Directive 2009/42/EC of the European Parliament and of the Council of 6 May 2009 on statistical returns in respect of carriage of goods and passengers by sea	2009
Directive 2009/45/EC of the European Parliament and of the Council of 6 May 2009 on safety rules and standards for passenger ships	2009
Directive 2010/65/EU of the European Parliament and of the Council of 20 October 2010 on reporting formalities for ships arriving in and/or departing from ports of the Member States and repealing Directive 2002/6/EC	2010
Regulations	
Regulation (EC) No 2099/2002 of the European Parliament and of the Council of 5 November 2002 establishing a Committee on Safe Seas and the Prevention of Pollution from Ships (COSS) and amending the Regulations on maritime safety and the prevention of pollution from ships	2002
Regulation (EC) No 725/2004 of the European Parliament and of the Council of 31 March 2004 on enhancing ship and port facility security	2004

Regulation (EC) No 1692/2006 of the European Parliament and of the Council of 24 October 2006 establishing the second Marco Polo programme for the granting of Community financial assistance to improve the environmental performance of the freight transport system (Marco Polo II) and repealing Regulation (EC) No 1382/2003	2006
Regulation (EC) No 336/2006 of the European Parliament and of the Council of 15 February 2006 on the implementation of the International Safety Management Code within the Community and repealing Council Regulation (EC) No 3051/95	2006
Commission Regulation (EC) No 324/2008 of 9 April 2008 laying down revised procedures for conducting Commission inspections in the field of maritime security	2008
Regulation (EC) No 391/2009 of the European Parliament and of the Council of 23 April 2009 on common rules and standards for ship inspection and survey organisations	2009
Regulation (EU) No 530/2012 of the European Parliament and of the Council of 13 June 2012 on the accelerated phasing-in of double-hull or equivalent design requirements for single-hull oil tankers	2012
Other	
COM (2000) 142 - Communication from the commission to the European Parliament and the Council on the safety of the seaborne oil trade	2000
COM (2000) 802 - Communication from the commission to the European Parliament and the Council on a second set of community measures on maritime safety following the sinking of the oil tanker Erika	2000
COM (2003) 229 - Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions on enhancing maritime transport security	2003
COM (2005) 585 - Communication from the Commission: Third package of legislative measures on maritime safety in the European Union	2005
COM (2007) 616 - Communication from the Commission - Communication on a European Ports Policy {SEC(2007)1339} {SEC(2007)1340}	2007
COM (2009) 8 - Communication from the Commission: Strategic goals and recommendations for the EU's maritime transport policy until 2018	2009
COM (2009) 10 - Communication from the Commission: Communication and action plan with a view to establishing a European maritime transport space without barriers	2009
Belgian and Flemish legislation	
Laws	
Wet van 17 maart 1965 houdende goedkeuring van het Verdrag tussen het Koninkrijk België en het Koninkrijk der Nederlanden betreffende de verbinding tussen de Schelde en de Rijn, en van de bijlagen I, II en III	1965
Wet van 24 november 1975 houdende goedkeuring en uitvoering van het Verdrag inzake de internationale bepalingen ter voorkoming van aanvaringen op zee, 1972, bijgevoegd Reglement en zijn Bijlagen, opgemaakt te Londen op 20 oktober 1972	1975
Wet van 20 juli 1976 houdende goedkeuring en uitvoering van het Internationaal Verdrag inzake de burgerlijke aansprakelijkheid voor schade door verontreiniging door olie, en van de Bijlage, opgemaakt te Brussel op 29 november 1969	1976
Wet van 6 augustus 1982 houdende goedkeuring van het Protocol van 1973 betreffende de maatregelen in volle zee in geval van verontreiniging door stoffen, andere dan oliën, en van de Bijlage, opgemaakt te Londen op 2 november 1973	1982
Wet van 8 juni 1983 houdende instelling van een certificaat van Noordzee-loods voor het loodsen van schepen op de Noordzee en in het Kanaal	1983
Wet van 25 januari 1984 tot bescherming van de Belgische koopvaardij	1984
Wet van 11 april 1989 houdende goedkeuring en uitvoering van diverse Internationale Akten inzake de zeevaart	1989
Wet van 16 juni 1989 houdende goedkeuring van de Overeenkomst inzake samenwerking bij het bestrijden van de verontreiniging van de Noordzee door olie en andere schadelijke stoffen, en van de Bijlage, opgemaakt te Bonn op 13 september 1983	1989
Wet van 21 december 1990 betreffende de registratie van zeeschepen	1990
Wet van 6 augustus 1993 houdende goedkeuring en uitvoering van het Internationaal Verdrag ter oprichting van een internationaal fonds voor vergoeding van schade door verontreiniging door olie, opgemaakt te Brussel op 18 december 1971, en houdende uitvoering van de Protocollen bij dit Verdrag, opgemaakt te Londen op 27 november 1992 en 16 mei 2003	1993
Wet van 6 april 1995 betreffende de voorkoming van verontreiniging door schepen	1995
Wet van 10 augustus 1998 houdende instemming met het Protocol van 1992 tot wijziging van het Internationaal Verdrag inzake de burgerlijke aansprakelijkheid voor schade door verontreiniging door olie, 1969, en de Bijlage, gedaan te Londen op 27 november 1992	1998
Wet van 10 augustus 1998 houdende instemming met het Protocol van 1992 tot wijziging van het Internationaal Verdrag van 1971 ter oprichting van een Internationaal Fonds voor vergoeding van schade door verontreiniging door olie, gedaan te Londen op 27 november 1992	1998
Wet van 14 maart 2005 houdende instemming met volgende Internationale Akten : 1° Verdrag tot bestrijding van wederrechtelijke gedragingen gericht tegen de veiligheid van de zeevaart; 2° Protocol tot bestrijding van wederrechtelijke gedragingen gericht tegen de veiligheid van vaste platforms op het continentale plat, gedaan te Rome op 10 maart 1988	2005
Wet van 6 oktober 2005 houdende instemming met en uitvoering van het Protocol van 2003 bij het Internationaal Verdrag van 1992 ter oprichting van een Internationaal Fonds voor vergoeding van schade door verontreiniging door olie, opgemaakt te Londen op 16 mei 2003	2005
Wet van 5 februari 2007 betreffende de maritieme beveiliging	2007
Wet van 9 april 2007 betreffende de vondst en de bescherming van wrakken	2007
Wet van 10 september 2009 houdende instemming met het Protocol van 1996 tot wijziging van het Verdrag van 1976 inzake beperking van aansprakelijkheid voor maritieme vorderingen, gedaan te Londen op 2 mei 1996	2009
Wet van 16 februari 2009 houdende instemming met het Internationaal Verdrag van 2001 betreffende de controle op schadelijke aangroeiwerende systemen op schepen, en met de Bijlagen, gedaan te Londen op 5 oktober 2001	2009
Wet van 30 december 2009 betreffende de strijd tegen piraterij op zee	2009

Wet van 27 juli 2011 betreffende de bevoegde instantie voor de opvang van schepen die bijstand behoeven	2011
Wet van 2 juni 2012 betreffende de federale instantie voor onderzoek van scheepvaartongevallen	2012
Wet van 30 januari 2012 tot regeling van aangelegenheden als bedoeld door artikel 78 van de Grondwet inzake verzekering van scheepseigenaren tegen maritieme vorderingen	2012
Decrees	
Decreet van 4 mei 1994 betreffende het publiekrechtelijk vormgegeven extern verzelfstandigde agentschap Waterwegen en Zeekanaal, naamloze vennootschap van publiek recht	1994
Decreet van 19 april 1995 betreffende de organisatie en de werking van de loodsdienst van het Vlaamse Gewest en betreffende de brevetten van havenloods en bootman	1995
Decreet van 2 maart 1999 houdende het beleid en het beheer van de zeehavens	1999
Decreet van 16 juni 2006 betreffende de begeleiding van de scheepvaart op de maritieme toegangswegen en de organisatie van het Maritiem Reddings- en Coördinatiecentrum	2006
Decreet van 17 maart 2006 tot omzetting van Richtlijn 2001/96/EG van het Europees Parlement en de Raad van 4 december 2001 tot vaststelling van geharmoniseerde voorschriften en procedures voor het veilig laden en lossen van bulkschepen	2006
Decreet van 9 mei 2008 houdende instemming met het Internationaal Verdrag betreffende de controle van schadelijke aangroeiwerende systemen op schepen, opgemaakt in Londen op 5 oktober 2001	2008

Dredging and dumping

International agreements, conventions, etc.	
Overeenkomst van 13 juli 1970 tussen de Regering van het Koninkrijk België en de Regering van het Koninkrijk der Nederlanden betreffende de verbetering van de vaarweg voor de Westerschelde nabij Walsoorden.	1970
London Convention - Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter	1972
Verdrag tussen het Vlaams Gewest en het Koninkrijk der Nederlanden inzake de verruiming van de vaarweg in de Westerschelde	1995
Verdrag tussen het Vlaams Gewest en het Koninkrijk der Nederlanden betreffende de uitvoering van de Ontwikkelingsschets 2010 Schelde-estuarium, en de bijlagen A, B, C, D en E, ondertekend in Middelburg op 21 december 2005	2010
Belgian and Flemish legislation	
Decree	
Decreet van 2 maart 1999 houdende het beleid en het beheer van de zeehavens	1999

Sand and gravel extraction

Belgian and Flemish legislation	
Law	
Wet van 13 juni 1969 inzake de exploratie en de exploitatie van niet -levende rijkdommen van de territoriale zee en het continentaal plat	1969

Energy (including cables and pipelines)

International agreements, conventions, etc.	
Overeenkomst tussen de Regering van het Koninkrijk België en de Regering van het Koninkrijk Noorwegen inzake het leggen van de " Norfra " gaspijpleiding op het Belgisch continentaal plat	1996
Overeenkomst tussen de regering van het Koninkrijk België en de regering van het Verenigd Koninkrijk van Groot-Brittanië en Noord-Ierland inzake het vervoer van aardgas door middel van een pijpleiding tussen het Koninkrijk België en het Vernenigd Koninkrijk van Groot-Brittannie en Noord-Ierland	1997
Belgian and Flemish legislation	
Laws	
Wet van 13 juni 1969 inzake de exploratie en de exploitatie van niet -levende rijkdommen van de territoriale zee en het continentaal plat	1969
Wet van 26 juni 2000 houdende instemming met de Overeenkomst tussen de Regering van het Koninkrijk België en de Regering van het Verenigd Koninkrijk van Groot-Brittannië en Noord-Ierland inzake het vervoer van aardgas door middel van een pijpleiding tussen het Koninkrijk België en het Verenigd Koninkrijk van Groot-Brittannië en Noord-Ierland, ondertekend te Brussel op 10 december 1997	2000
Wet van 13 mei 2003 houdende instemming met de Overeenkomst tussen de Regering van het Koninkrijk België en de Regering van het Koninkrijk Noorwegen inzake het leggen van de "Norfra" gaspijpleiding op het Belgische continentaal plat, en de Bijlagen 1, 2 en 3, ondertekend te Brussel op 20 december 1996	2003
Wet van 14 maart 2005 houdende instemming met volgende Internationale Akten : 1° Verdrag tot bestrijding van wederrechtelijke gedragingen gericht tegen de veiligheid van de zeevaart; 2° Protocol tot bestrijding van wederrechtelijke gedragingen gericht tegen de veiligheid van vaste platforms op het continentale plat, gedaan te Rome op 10 maart 1988	2005
Decree	
Decreet van 1 maart 2002 houdende instemming met de Overeenkomst tussen de Regering van het Koninkrijk België en de Regering van het Verenigd Koninkrijk van Groot-Brittannië en Noord-Ierland inzake het vervoer van aardgas door middel van een pijpleiding tussen het Koninkrijk België en het Verenigd Koninkrijk van Groot-Brittannië en Noord-Ierland, ondertekend in Brussel op 10 december 1997	2002

Fisheries

International agreements, conventions, etc.	
International Convention for the Regulation of Whaling	1946
Convention concerning accommodation on Board Fishing Vessels	1966
The Convention on Conduct of Fishing Operations in the North Atlantic	1967
Akkoord van 30 september 1975 voor de visserij op ijle haring en sprot in de Belgische en Franse territoriale zee	1975
The Torremolinos International Convention for the Safety of Fishing Vessels & protocol	1977
European legislation	
Regulations	
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	1998
Council Regulation (EC) No 2371/2002 of 20 December 2002 on the conservation and sustainable exploitation of fisheries resources under the Common Fisheries Policy	2002
Council Regulation (EC) No 1005/2008 of 29 September 2008 establishing a Community system to prevent, deter and eliminate illegal, unreported and unregulated fishing, amending Regulations (EEC) No 2847/93, (EC) No 1936/2001 and (EC) No 601/2004 and repealing Regulations (EC) No 1093/94 and (EC) No 1447/1999	2008
Council Regulation (EC) No 1342/2008 of 18 December 2008 establishing a long-term plan for cod stocks and the fisheries exploiting those stocks and repealing Regulation (EC) No 423/2004	2008
Council Regulation (EC) No 199/2008 of 25 February 2008 concerning the establishment of a Community framework for the collection, management and use of data in the fisheries sector and support for scientific advice regarding the Common Fisheries Policy	2008
Council Regulation (EC) No 1224/2009 of 20 November 2009 establishing a Community control system for ensuring compliance with the rules of the common fisheries policy, amending Regulations (EC) No 847/96, (EC) No 2371/2002, (EC) No 811/2004, (EC) No 768/2005, (EC) No 2115/2005, (EC) No 2166/2005, (EC) No 388/2006, (EC) No 509/2007, (EC) No 676/2007, (EC) No 1098/2007, (EC) No 1300/2008, (EC) No 1342/2008 and repealing Regulations (EEC) No 2847/93, (EC) No 1627/94 and (EC) No 1966/2006	2009
Other	
COM (2011) 417 - COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS Reform of the Common Fisheries Policy	2011
COM (2011) 804 - Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the European Maritime and Fisheries Fund [repealing Council Regulation (EC) No 1198/2006 and Council Regulation (EC) No 861/2006 and Council Regulation No XXX/2011 on integrated maritime policy	2011
Belgian and Flemish legislation	
Laws	
Wet van 19 augustus 1891 betreffende de zeevisserij in de territoriale zee	1891
Wet van 28 maart 1975 betreffende de handel in landbouw-, tuinbouw- en zeevisserijprodukten	1975
Wet van 10 oktober 1978 houdende vaststelling van een Belgische visserijzone	1978
Wet van 9 juli 2004 betreffende de toetreding van België : - tot het Internationaal Verdrag tot regeling van de walvisvangst en tot het Reglement, gedaan te Washington op 2 december 1946; - tot het Protocol, gedaan te Washington op 19 november 1956, bij het Internationaal Verdrag tot regeling van de walvisvangst, gedaan te Washington op 2 december 1946	2004
Decrees	
Decreet van 13 mei 1997 houdende oprichting van een Financieringsinstrument voor de Vlaamse visserij- en aquacultuursector	1997
Decreet van 19 mei 2006 betreffende de oprichting en de werking van het Fonds voor Landbouw en Visserij	2006
Decreet van 6 juli 2007 houdende de oprichting van de Strategische Adviesraad voor Landbouw en Visserij	2007

Aquaculture

European legislation	
Directives	
Directive 2006/113/EC of the European Parliament and of the Council of 12 December 2006 on the quality required of shellfish waters	2006
Council Directive 2006/88/EC of 24 October 2006 on animal health requirements for aquaculture animals and products thereof, and on the prevention and control of certain diseases in aquatic animals	2006
Regulations	
Council Regulation (EC) No 2371/2002 of 20 December 2002 on the conservation and sustainable exploitation of fisheries resources under the Common Fisheries Policy	2002
Council Regulation (EC) No 708/2007 of 11 June 2007 concerning use of alien and locally absent species in aquaculture	2007
Council Regulation (EC) No 1224/2009 of 20 November 2009 establishing a Community control system for ensuring compliance with the rules of the common fisheries policy, amending Regulations (EC) No 847/96, (EC) No 2371/2002, (EC) No 811/2004, (EC) No 768/2005, (EC) No 2115/2005, (EC) No 2166/2005, (EC) No 388/2006, (EC) No 509/2007, (EC) No 676/2007, (EC) No 1098/2007, (EC) No 1300/2008, (EC) No 1342/2008 and repealing Regulations (EEC) No 2847/93, (EC) No 1627/94 and (EC) No 1966/2006	2009
Other	
COM (2002) 511 - Communication from the Commission to the Council and the European Parliament - A strategy for the sustainable development of European aquaculture	2002

COM (2009) 162 - Communication from the Commission to the European Parliament and the Council - Building a sustainable future for aquaculture - A new impetus for the Strategy for the Sustainable Development of European Aquaculture {SEC(2009) 453} {SEC(2009) 454}	2009
COM (2011) 804 - Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the European Maritime and Fisheries Fund [repealing Council Regulation (EC) No 1198/2006 and Council Regulation (EC) No 861/2006 and Council Regulation No XXX/2011 on integrated maritime policy	2011
Belgian and Flemish legislation	
Decrees	
Decreet van 13 mei 1997 houdende oprichting van een Financieringsinstrument voor de Vlaamse visserij- en aquacultuursector	1997
Decreet van 19 mei 2006 betreffende de oprichting en de werking van het Fonds voor Landbouw en Visserij	2006
Decreet van 6 juli 2007 houdende de oprichting van de Strategische Adviesraad voor Landbouw en Visserij	2007

Agriculture

Belgian and Flemish legislation	
Laws	
Wet van 3 juni 1957 betreffende de polders	1957
Wet van 12 juli 1973 op het natuurbehoud (hoofdstuk 9 specifieke bepalingen voor de maritieme duinstreek)	1973
Decrees	
Decreet van 14 juli 1993 houdende maatregelen tot bescherming van kustduinen	1993

Maritime and coastal heritage

International agreements, conventions, etc.	
UNESCO-Convention on the Protection of the Underwater Cultural Heritage (2 november 2001)	2001
Belgian and Flemish legislation	
Law	
Wet van 9 april 2007 betreffende de vondst en de bescherming van wrakken	2007
Decree	
Decreet van 29 maart 2002 tot bescherming van varend erfgoed	2002

Tourism and recreation

European legislation	
Directive	
Directive 2006/7/EC of the European Parliament and of the Council of 15 February 2006 concerning the management of bathing water quality and repealing Directive 76/160/EEC	2006

Safety against flooding

European legislation	
Directive	
Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks	2007
Belgian and Flemish legislation	
Laws	
Wet van 3 juni 1957 betreffende de polders	1957
Wet van 12 juli 1973 op het natuurbehoud (hoofdstuk 9 specifieke bepalingen voor de maritieme duinstreek)	1973
Decrees	
Decreet van 14 juli 1993 houdende maatregelen tot bescherming van kustduinen	1993
Decreet van 16 april 1996 betreffende de waterkeringen	1996

Scheldt Estuary

International agreements, conventions, etc.	
Verdrag van 13 mei 1963 tussen het Koninkrijk der Nederlanden en het Koninkrijk België betreffende de verbinding tussen de Schelde en de Rijn	1963
Overeenkomst van 13 juli 1970 tussen de Regering van het Koninkrijk België en de Regering van het Koninkrijk der Nederlanden betreffende de verbetering van de vaarweg voor de Westerschelde nabij Walsoorden	1970
Verdrag tussen het Vlaams Gewest en het Koninkrijk der Nederlanden inzake de verruiming van de vaarweg in de Westerschelde	1995
Scheldeverdrag van 3 december 2002	2002

Verdrag tussen de Vlaamse Gemeenschap en het Vlaams Gewest enerzijds en het Koninkrijk der Nederlanden anderzijds inzake de samenwerking op het gebied van het beleid en het beheer in het Schelde-estuarium, ondertekend in Middelburg op 21 december 2005	2005
Verdrag tussen het Vlaams Gewest en het Koninkrijk der Nederlanden inzake de beëindiging van de onderlinge koppeling van de loodsgeldtarieven, ondertekend in Middelburg op 21 december 2005	2005
Verdrag tussen het Vlaams Gewest en het Koninkrijk der Nederlanden inzake het gemeenschappelijk nautisch beheer in het Scheldegebied, ondertekend in Middelburg op 21 december 2005	2005
Verdrag tussen het Vlaams Gewest en het Koninkrijk der Nederlanden betreffende de uitvoering van de Ontwikkelingsschets 2010 Schelde-estuarium, en de bijlagen A, B, C, D en E, ondertekend in Middelburg op 21 december 2005	2010
Belgian and Flemish legislation	
Law	
Wet van 17 maart 1965 houdende goedkeuring van het Verdrag tussen het Koninkrijk Belgie en het Koninkrijk der Nederlanden betreffende de verbinding tussen de Schelde en de Rijn, en van de bijlagen I, II en III	1965
Decrees	
Decreet van 30 april 2004 houdende goedkeuring van het Scheldeverdrag, ondertekend te Gent op 3 december 2002	2004
Decreet van 9 maart 2007 houdende instemming met het verdrag tussen het Vlaams Gewest en het Koninkrijk der Nederlanden inzake de beëindiging van de onderlinge koppeling van de loodsgeldtarieven, ondertekend in Middelburg op 21 december 2005, het verdrag tussen het Vlaams Gewest en het Koninkrijk der Nederlanden betreffende de uitvoering van de Ontwikkelingsschets 2010 Schelde-estuarium, en de bijlagen A, B, C, D en E, ondertekend in Middelburg op 21 december 2005, het verdrag tussen het Vlaams Gewest en het Koninkrijk der Nederlanden inzake het gemeenschappelijk nautisch beheer in het Scheldegebied, ondertekend in Middelburg op 21 december 2005, en het verdrag tussen de Vlaamse Gemeenschap en het Vlaams Gewest enerzijds en het Koninkrijk der Nederlanden, anderzijds inzake de samenwerking op het gebied van het beleid en het beheer in het Schelde-estuarium, ondertekend in Middelburg op 21 december 2005	2007

Integrated legislation

International agreements, conventions, etc.	
UNCLOS - United Nations Convention on the law of the sea	1982
OSPAR-Convention - The Convention for the Protection of the marine Environment of the North-East Atlantic	1992
Regulation (EU) No 1255/2011 of the European Parliament and of the Council of 30 November 2011 establishing a Programme to support the further development of an Integrated Maritime Policy	2011
European legislation	
Directives	
Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy	2000
Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive)	2008
Other	
2002/413/EG - Recommendation of the European Parliament and of the Council of 30 May 2002 concerning the implementation of Integrated Coastal Zone Management in Europe	2002
COM (2007) 575 - Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions - An Integrated Maritime Policy for the European Union {COM(2007) 574 final)} {SEC(2007) 1278} {SEC(2007) 1279} {SEC(2007) 1280} {SEC(2007) 1283}	2007
COM (2008) 791 - Communication from the Commission - Roadmap for Maritime Spatial Planning: Achieving Common Principles in the EU	2008
COM (2010) 477 - 2010/477/EU: Commission Decision of 1 September 2010 on criteria and methodological standards on good environmental status of marine waters	2010
COM (2011) 782 - COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS Developing a Maritime Strategy for the Atlantic Ocean Area	2011
COM (2013) 133: Proposal for a DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL establishing a framework for maritime spatial planning and integrated coastal management	2013
Belgian and Flemish legislation	
Laws	
Wet van 29 juli 1971 houdende goedkeuring van volgende internationale akten : 1. Verdrag inzake de territoriale zee en de aansluitende zone; 2. Verdrag inzake de volle zee; 3. Verdrag inzake de visserij en de instandhouding van de levende rijkdommen van de volle zee; 4. Protocol van facultatieve ondertekening inzake de verplichte beslechting van geschillen, opgemaakt te Genève op 29 april 1958; 5. Internationaal verdrag betreffende maatregelen in volle zee in geval van een ongeval dat verontreiniging door olie tot gevolg heeft of kan hebben en bijlage, opgemaakt te Brussel op 29 november 1969	1971
Wet van 6 oktober 1987 tot bepaling van de breedte van de territoriale zee van België	1987
Wet van 17 februari 1993 houdende goedkeuring van de Overeenkomst tussen de Regering van het Koninkrijk Belgie en de Regering van het Verenigd Koninkrijk van Groot-Brittannie en Noord-Ierland inzake de afbakening van het Continentaal Plat tussen beide landen, ondertekend te Brussel op 29 mei 1991	1993
Wet van 17 februari 1993 houdende goedkeuring van volgende Internationale Akten: 1. Overeenkomst tussen de Regering van het Koninkrijk België en de Regering van de Franse Republiek inzake de afbakening van de territoriale zee, 2. Overeenkomst tussen de Regering van het Koninkrijk België en de Regering van de Franse Republiek inzake de afbakening van het continentaal plat, ondertekend te Brussel op 8 oktober 1990	1993

Wet van 10 augustus 1998 houdende instemming met het Verdrag tussen het Koninkrijk België en het Koninkrijk der Nederlanden inzake de afbakening van het continentaal plat, en Bijlage, en briefwisseling; en het Verdrag tussen het Koninkrijk België en het Koninkrijk der Nederlanden inzake de zijwaartse afbakening van de territoriale zee, ondertekend te Brussel op 18 december 1996	1998
Wet van 18 juni 1998 houdende instemming met het Verdrag van de Verenigde Naties inzake het recht van de Zee, gedaan te Montego Bay op 10 december 1982 en de Overeenkomst inzake de tenuitvoerlegging van deel XI van het Verdrag van de Verenigde Naties inzake het recht van de Zee van 10 december 1982, gedaan te New York op 28 juli 1994	1998
Wet van 20 januari 1999 ter bescherming van het mariene milieu en ter organisatie van de mariene ruimtelijke planning in de zeegebieden onder de rechtsbevoegdheid van België	1999
Wet van 22 april 1999 betreffende de exclusieve zone van België in de Noordzee	1999
Wet van 22 augustus 2006 houdende instemming met het Akkoord, gesloten door uitwisseling van brieven gedagtekend te Brussel op 21 maart 2005 en 7 juni 2005, houdende wijziging van de Overeenkomst tussen de Regering van het Koninkrijk België en de Regering van het Verenigd Koninkrijk van Groot-Brittannië en Noord-Ierland inzake de afbakening van het continentaal plat tussen beide landen, ondertekend te Brussel op 29 mei 1991	2006
Decrees	
Decreet van 14 juli 1998 houdende instemming met het Verdrag van de Verenigde Naties inzake het Recht van de Zee, en de bijlagen, ondertekend in Montego Bay op 10 december 1982, en de Overeenkomst inzake de toepassing van deel XI van het Verdrag van de Verenigde Naties inzake het Recht van de Zee van 10 december 1982, en de bijlage, ondertekend in New York op 28 juli 1994	1998
Decreet van 18 juli 2003 betreffende het integraal waterbeleid	2003

Education, research and innovation

International agreements, conventions, etc.	
Lisbon Treaty 17 december 2007	2007
European legislation	
Directive	
Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE)	2007
Other	
COM (2008) 534 - Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions - A European strategy for marine and maritime research : a coherent European research area framework in support of a sustainable use of oceans and seas	2008
COM (2010) 461 - COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL MARINE KNOWLEDGE 2020 marine data and observation for smart and sustainable growth	2010
Commission Recommendation of 16 September 2011 on the research joint programming initiative 'Healthy and Productive Seas and Oceans'	2011
Belgian and Flemish legislation	
Decree	
Decreet van 30 april 2009 betreffende de organisatie en financiering van het wetenschaps- en innovatiebeleid	2009