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Nature and environment

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With an average depth of 95 m, the North Sea is a rather shallow sea which is mainly located on the European continental shelf. The seabed is predominantly characterised by sandy habitats. In the North Sea, water of the North Atlantic Ocean is mixed with fresh water from rivers of the surrounding countries (Norway, Sweden, Denmark, Germany, the Netherlands, Belgium, France and the United Kingdom) (*OSPAR QSR 2010*, [website Operational Directorate Natural Environment](#), Royal Belgian Institute of Natural Sciences (RBINS)). The surface of the North Sea amounts to approximately 670,000 km² (*State of Europe's Seas 2015*), of which the Belgian part (BNS) covers 3,454 km² in the Southern Bight of the North Sea (*Belpaeme et al. 2011*). More geographical information about the BNS can be found on www.kustatlas.be and <http://odnature.naturalsciences.be/marine-atlas/>. The current text elaborates on the aspects which are characteristic for the BNS and its adjacent coastal area.

1.1 Characteristics of the marine and coastal environment

1.1.1 Sea

BATHYMETRY AND SUBSTRATE

The BNS is a shallow part of the North Sea with a seabed that gradually deepens in a north-west 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 relative to these gullies, 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*, *Mathys 2010*). 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 Quaternary sediments, there is a layer of Tertiary clay which is locally exposed in the gullies (*Lanckeus et al. 2001* (*BUDGET project BELSPO*)), *Le Bot et al. 2003* (*BELSPO*)), *Mathys 2009*, *Mathys 2010*, *TILES* (*TILES project BELSPO*)). 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*, *Van Lancker et al. 2007* (*MAREBASSE project BELSPO*)).

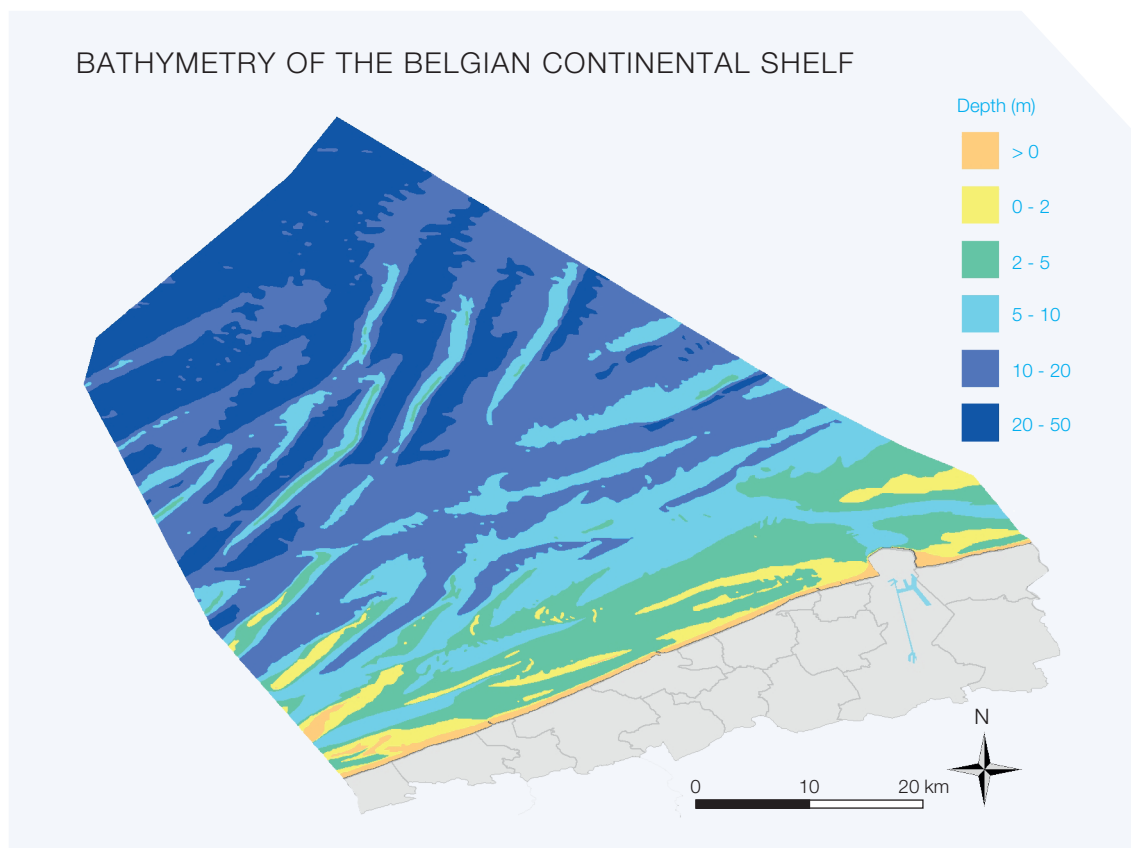


Figure 1. The bathymetry of the Belgian continental shelf (Source: agency for Maritime and Coastal Services).

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, with the tidal range decreasing 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](#), [De Moor 2006](#), [Van Lancker et al. 2012](#) (QUEST4D project BELSPO), [Baeye 2012](#)). Along the Belgian coast, a high concentration of suspended sediment occurs resulting in turbidity maximums ([Fettweis & Van den Eynde 2003](#), [Fettweis et al. 2007](#) (MOCHA project BELSPO), [Baeye 2012](#)).

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-meteorological data are available on the [website of the Operational Directorate Natural Environment \(RBINS\)](#).

SEAWATER CHARACTERISTICS

The seawater temperature in the BNS varies seasonally between 5°C and 20°C ([Flemish Banks Monitoring Network](#)). The seawater salinity 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](#)). 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](#)) (see also Integrated Carbon Observation System (ICOS)). Information about the nutrients and oxygen levels in the seawater was *inter alia* gathered in the 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 seawater characteristics in the BNS is discussed in [Van den Eynde et al. \(2011\)](#), (CLIMAR project BELSPO) (see also theme **Safety against flooding**).

A LARGE DIVERSITY OF BENTHIC LIFE

The sandbanks in the BNS are characterised by a very rich benthic life (benthos) that plays an important role in the marine food web. The benthic organisms have been intensively studied since 1970 (e.g. [Cattrijsse & Vincx 2001](#), [Van Hoey et al. 2004](#), [Degraer et al. 2006](#), [Degraer et al. 2008](#), [Merckx et al. 2010](#), [Vanaverbeke et al. 2011](#), [Van Hoey et al. 2013](#), TROPHOS project (TROPHOS project BELSPO), WESTBANKS project (WESTBANKS project BELSPO)). The benthos constitutes an important food source for fish, shrimps 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 the microbial community as well as by other small organisms (bivalves, polychaete worms, crustaceans, nematodes, etc.)) (e.g. [Braeckman et al. 2010](#), [Braeckman 2011](#)). A complete overview of the species present in the BNS is available in the Belgian Register of Marine Species ([BeRMS](#), [Vandepitte et al. 2010](#)).

Just above the seabed of the North Sea, in the lowest meter of the water column, the hyperbenthos can be found which mainly consists of larvae of fish and shrimps (see *inter alia* [Mees 1994](#), [Dewicke 2002](#), [Beyst 2001](#), [Fockedey 2005](#)). Large numbers of starfish, brittle stars, crabs, lobsters, demersal fish and squids can be observed on the seabed which constitute together with less common species, the epibenthos (e.g. [Hostens 2003](#), [Calewaert et al. 2005](#)). 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, [Degraer et al. 2006](#)), nematodes and copepods (meiobenthos¹). The occurrence of these benthic organisms is not uniform and is related to the physical characteristics of the seabed. Up to 81 species of macrobenthos have been counted in sediment samples (surface of 0.1 m²), with a total of 150,000 organisms per square meter, in the 'richer' areas of the Western Coastal Banks, the Flemish Banks and the Zeeland Banks. Each species prefers a certain type of sediment which is in turn determined by the current pattern. The seabed of the BNS is characterised by (1) soft substrates (ranging from silt to fine or coarse sand) interspersed with (2) 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) ([Houziaux et al. 2008](#)) and by (3)

¹ Organisms who live on or in the seabed and measure between 1 and 0.063 mm.

biogenic reefs (e.g. shaped by *Lanice conchilega*) (Rabaut et al. 2009). 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 borealis* (– *Glycera lapidum*) community. These communities are characterised by a specific species composition, diversity and density, and occur in a specific and well-defined environment (Degraer et al. 2003, Van Hoey et al. 2004).

Recently, the increase in artificial hard substrates (e.g. offshore wind turbines) has created new possibilities for benthic organisms. The effects of hard substrates on the fauna as well as the impact on the surrounding soft substrates are monitored in detail (e.g. Degraer et al. 2013, Baeye & Fettweis 2015).

BIOLOGICAL VALIDATION MAP OF THE BNS

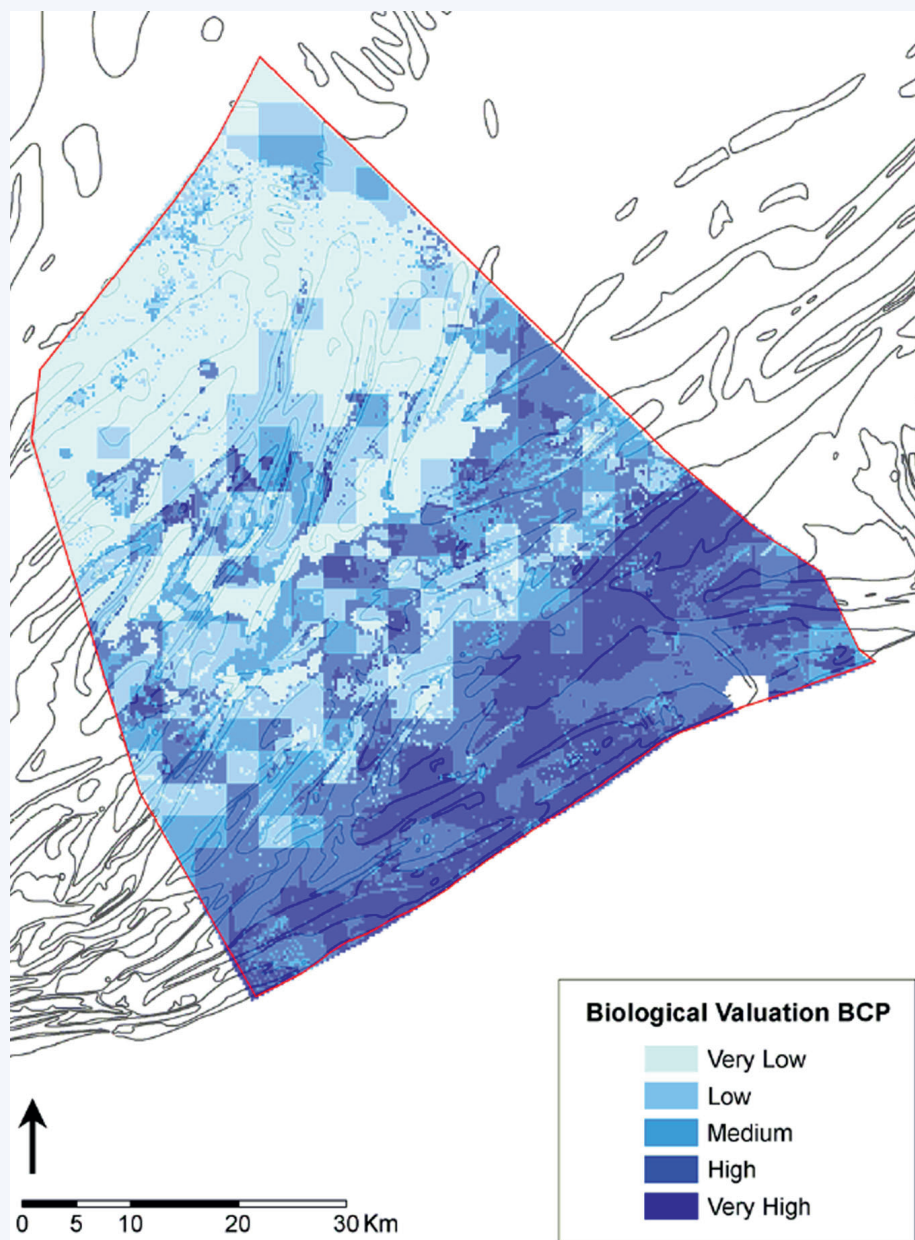


Figure 2. The biological validation map of the BNS, which combines the validation maps of the seabirds, macrobenthos, epibenthos and demersal fish (Deraus et al. 2007, BWzee project, BELSPO).

THE PELAGIC ECOSYSTEM

The pelagic ecosystem constitutes the largest habitat in the world. Unlike the benthic ecosystem, the pelagic ecosystem has been investigated or monitored very little in Belgian waters. The zooplankton² community of the BNS mainly has a coastal nature but is occasionally influenced by species from the inflow of Atlantic water ([Van Ginderdeuren 2013](#)). The crustaceans or more specifically the calanoid copepods (holoplankton³, 66%), dominate the zooplankton with species such as *Temora longicornis*, *Acartia clausi*, *Paracalanus parvus*, *Centropages typicus* and *Centropages hamatus* ([Van Ginderdeuren et al. 2012a](#)). Also, meroplanktonic⁴ larvae of polychaetes, echinoderms, fish and barnacles are abundant in the BNS. In 2014, a total of 137 zooplankton taxa was listed for the BNS, consisting of 46 holo-, 50 mero- and 41 tycho planktonic⁵ species ([Van Ginderdeuren et al. 2014a](#)). May and June are the months with the highest mean densities, followed by a smaller autumn peak in September. Zooplankton densities vary between 150 and 15,000 ind.m⁻³ and are highest a few kilometers off the coast, in the transition zone from coastal to offshore waters. Other elements of the ecosystem (demersal fish, epibenthos, macrobenthos) also exhibit high densities and a high diversity in the zone a few kilometers off the coast ([Van Hoey et al. 2004](#), [De Backer et al. 2010](#)). Phytoplankton is the most important food source for zooplankton and modifications in the dynamics of this phytoplankton may strongly influence the zooplankton. Hence, it is important to monitor the problems related to the annual seasonal changes in the phytoplankton composition (e.g. *Phaeocystis* blooms) caused by eutrophication (see also theme **Agriculture**).

Since 2012, special attention has been paid to jellyfish, especially because of the presence of the non-indigenous species *Mnemiopsis leidyi* that has populated the entire Belgian coastal zone since 2007 ([Van Ginderdeuren et al. 2012b](#)). Similar to zooplankton s.s., the diversity of gelatinous zooplankton is rather high (33 taxa), with hydromedusa as the most diverse and abundant group ([Vansteenberghe et al. 2015a](#)). The highest densities of jellyfish are observed during summer and autumn. At present, the occurrence of *Mnemiopsis leidyi* seems limited to the nearshore zone, including ports and Western Scheldt Estuary ([Vansteenberghe et al. 2015b](#)).

Zooplankton is used as a major food source by several organisms, including most of the fish species. Furthermore, pelagic fish constitute an important food source for higher trophic levels like seabirds, commercial fish species and marine mammals. However, research on pelagic fish in the BNS is limited. [Van Ginderdeuren et al. \(2014b\)](#) revealed that herring and sprat are common in the BNS. It mainly concerns immature individuals (0-, 1-year class) in coastal waters. Adult herring *Clupea harengus* is only observed in autumn when the fish are migrating to the spawning areas in the Channel. In summer, two other pelagic species appear, namely mackerel *Scomber scombrus* and horse mackerel *Trachurus trachurus*. Young horse mackerel is present in the offshore pelagic fish community ([Van Ginderdeuren et al. 2012a](#)).

Zooplankton is generally considered as one of the better bio-indicators to demonstrate alterations in the environment. New developments (a zooplankton biodiversity index for the southern part of the North Sea), sampling technology (*Zooscan*, plankton video recorder) and intensive monitoring efforts are of great importance to monitor the marine environment, *inter alia* in the context of the Marine Strategy Framework Directive (MSFD) ([Van Ginderdeuren 2013](#)). For the research on pelagic fish (but also on plankton) the use of sonar devices (e.g. fish finder) is indispensable.

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](#), [Stienen & Kuijken 2003](#), [Haelters et al. 2004](#), [Stienen et al. 2007](#), [Degraer et al. 2010](#)). 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 have both been included in appendix 1 of the Birds Directive (see **Policy instruments**).

The beaches, groins and piers along the coast constitute resting places for internationally significant numbers of the European herring gull *Larus argentatus* and the ruddy turnstone *Arenaria interpres* ([Adriaens & Ameeuw 2008](#)). In spring and summer, the coastal zone is an important foraging area for terns that mainly breed in the harbour of

² Generic term for floating or drifting heterotrophic organisms in water.

³ Organisms that are planktonic during their entire life.

⁴ Organisms that are planktonic in a certain stage of their life.

⁵ Organisms that end up in the plankton due to a disturbance of their benthic habitat.

Zeebrugge. Three tern species regularly 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).

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).

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 the harbour porpoise *Phocoena phocoena* and the harbour seal *Phoca vitulina* (Degraer et al. 2010). In the period February – April, the numbers of harbour porpoise in the BNS can increase to more than 1% of the estimated North Sea population (Haelters et al. 2011).

1.1.2 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 Belgian coast are generally characterised by a microrelief: 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 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).

The beach is a unique habitat where large numbers of organisms are present. In Speybroeck et al. (2005) and Speybroeck et al. (2008), an overview is given of the principal 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 dispersed 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*). Microphytobenthos⁶, especially diatoms, constitutes an important primary producer at the Belgian coast. The meio-⁷ and macrobenthos on the beach include specific communities such as the *Scolecopsis squamata*–*Eurydice pulchra* community. The geomorphology of beaches, including their grain size and slope, determines to a significant extent the distribution of the (marine) benthic life on beaches. Beaches with gentle slopes and fine grains are generally richer than steep-slope beaches with coarse sand particles (Degraer et al. 2003, Vanden Eede et al. 2014a). 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*. 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*).

On the basis of the available biological information about macro-, epi- and hyperbenthos and birds, biological validation maps have been created in Vanden Eede et al. (2014b) for a number of beaches along the Belgian coast.

1.1.3 Dunes – Sand dynamics, water, biota

The dune area of the Belgian coast covers an area of approximately 75 km². Pedologically, this zone is characterised by the presence of sand that has been deposited by the wind. These deposits may 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 supposedly originated 5,000 years ago and have continuously evolved since then (De Ceunynck 1992, De Clercq & De Moor 1996 – *Ecosysteemvisie Vlaamse Kust - Geomorfologie*). At this moment, most of the coastal dynamics are limited to the dunes bordering the beach. However, one decade ago significant aeolian sand transport occurred in the Westhoek area and Ter Yde.

The age of the dunes determines the degree of decalcification of the sand, which is an important ecological determinant (Ampe 1999). Quantitatively, however, the ecological diversity is mainly determined by the soil moisture, which is in turn

⁶ Microscopic small plants that live on and in the uppermost centimeters of the soil.

⁷ Organisms that live on or in the soil and have a size between 1 and 0.063 mm.

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 (*Rappé 1996 – Ecosysteemvisie Vlaamse Kust - Biologie, Provoost et al. 2004*). In terms of the European Habitats Directive (see **Policy instruments**), it is possible to distinguish 14 more or less natural coastal ecotypes (*Decler 2007*) (see also <https://www.natura2000.vlaanderen.be/gebied/duingebieden> for more information). 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*). In the context of the European Habitat and Birds Directive (see **Policy instruments**) the following species deserve special attention (see also <https://www.natura2000.vlaanderen.be/gebied/duingebieden>):

- Plant species in appendix II: creeping marshwort *Apium repens* and fen orchid *Liparis loeselii* (extinct at the Belgian coast);
- Bats in appendix IV: whiskered bat *Myotis mystacinus* and brown long-eared bat *Plecotus auritus*, Brandt's bat *Myotis brandtii* (hibernator), Daubenton's bat *Myotis daubentonii* (hibernator), grey long-eared bat *Plecotus austriacus* (hibernator), common pipistrelle *Pipistrellus pipistrellus* (during summer), Nathusius's pipistrelle *Pipistrellus nathusii* (during summer), serotine bat *Eptesicus serotinus* (during summer) and common noctule *Nyctalus noctula* (during summer) (De Maeyer & Velter 2004 in *Provoost & Bonte 2004*);
- 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 human influence 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 in the landscape. The shifting dynamics of dunes have largely stopped, and thicket and forest development have greatly altered the vegetation structure. Over the past decades, several invasive non-indigenous plant species have proliferated as well, causing a potential threat to indigenous fauna and flora (*Provoost et al. 2004*).

1.1.4 Estuaries, mudflats and marshes

Along the Belgian coast mudflats and salt marshes occur in three areas: the Estuary of the Yser, the Bay of Heist and Zwin. Only in the Estuary of the Yser, truly estuarine nature is present. The bibliography of these areas can be searched thematically in the *catalogue* of the VLIZ-library.

Zwin used to belong to an estuary reaching Bruges (see *inter alia* *Claeys 1981, Termote 2012*). Nowadays, Zwin is a cross-border nature reserve (Belgium-the Netherlands) consisting of an interrupted dune belt with mudflats and salt marshes behind it. The North Sea can enter the area through a gully, creating a system of creeks. The protection of the types of habitats and species occurring in Zwin, by means of the European Habitats Directive is discussed in *Bot (2007a)*. The intertidal area serves as an important place to rest, feed, moult, breed and migrate for several birds, including different species which are protected by the European Birds Directive (see *Bot 2007b*). Due to the siltation of Zwin, measures have been taken in the context of the Development Sketch 2010 for the Scheldt Estuary

(*Ontwikkelingsschets 2010 Schelde-estuarium*) (see theme **Scheldt Estuary**) to restore the mudflats and salt marshes and expand the nature reserve ([Verhaegen et al. 2010](#)).

On the right bank of the Yser, between its mouth in the North Sea and the Ganzenpoot sluice complex, there is an area that is still under tidal influence. This area is part of the Flemish nature reserve of the Estuary of the Yser ([Hoffman 2006](#)). As a result of a nature restoration project, the natural transitions of the different components of the coastal ecosystem (including mudflats and salt marshes) have been restored ([Hoffman et al. 2006](#)). The protection of nature in the Estuary of the Yser by the European Birds and Habitats Directive is elaborated in [Spanoghe et al. \(2003\)](#).

The Bay of Heist constitutes an ecological beach where estuarine vegetation has developed in a central depression ([Cosyns et al. 2002](#)).

1.1.5 Polders and polder complex

'The polders' is the name of a former marine intertidal area that was reclaimed during the Middle Ages. It is a flat, rural zone characterised by a flat and low-lying landscape with inversion relief, caused by the consolidation of clay layers and the subsidence of peat ([Provoost & Hoffman 1996](#), [Baeteman 2007](#)). It is also the name of the habitats directive area in the coastal zone (ministerial decree of 24 May 2002) which overlaps with the birds directive area 'poldercomplex' (ministerial decree of 17 July 2000) (see **Policy instruments**) (More information about the Polders in the context of Natura 2000 can be found on <https://www.natura2000.vlaanderen.be/gebied/polders>).

These special protection areas have been designated for 6 European protected habitat types and 21 European protected animal species ([Paelinckx et al. 2009](#)). The habitat types include 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 in the polders 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-throated 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* ([Courtenis & Kuijken 2004](#)). The poldercomplex has also been established because significant numbers of geese stay in this area during winter months. The pink-footed goose *Anser brachyrhynchus* and the greater white-fronted goose *Anser albifrons* annually exceed the 1%-limit ([Wetlands International 2006 – Waterbird Population Estimates](#)).

The polders are also characterised by the presence of valuable historically permanent grasslands (*historisch permanente graslanden*). Their location was mapped by [De Saeger et al. \(2013\)](#).

1.2 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. \(1997\)](#) to be 252 and 4,052 dollars per hectare per year respectively. According to a study by WWF ([Hoegh-Guldberg et al. 2015](#)), the overall value of ocean 'gross marine product' amounts to US\$ 24 trillion. The demarcation of marine protected areas in 20 to 30% of all seas would create 1 million jobs worldwide ([Balmford et al. 2004](#)). This equals an estimated yield of 294 billion euros (compared to a cost of up to 15 billion euros in protection measures) ([Seys 2006](#), [Slabbinck et al. 2008](#)).

The [BEES project](#) aims 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. The new version of the nature report for Flanders ([NARA, 2014-2018](#)) has been drafted as an ecosystem assessment in which 16 ecosystem services have been further elaborated ([Stevens 2014](#)). An entire chapter is dedicated to coastal protection ([Provoost et al. 2014](#)).

Furthermore, nature valuation studies are available on the [LNE website](#) and in [Hutsebaut et al. \(2007\)](#). 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. 2013](#)).

Only a few studies on the topic of ecosystem goods and services which specifically address the BNS are currently available. However, in the new ecosystem vision for the coast (in progress) the ecosystem services will be tackled as well. A preliminary overview of the types of goods and services delivered by marine biodiversity can be found in [Beaumont et al. 2007](#). In addition, the [socio-economic analysis of the users of the BNS \(2012\)](#) has been elaborated in the framework of the Marine Strategy Framework Directive (MSFD).

1.3 Impact on the marine and coastal environment

The marine and coastal environment, described above, is a region where various human activities take place 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. \(2004\)](#) (*MARE-DASM project BELSPO*), [Maes et al. \(2005\)](#) (*GAUFRE-BELSPO*), [Goffin et al. \(2007\)](#), [André et al. \(2010\)](#), *Initiële beoordeling van de staat van het mariene milieu (Belgische Staat 2012a)*, but also *OSPAR QSR (2010)* and *State of Europe's Seas (2015)* on a larger geographical scale. 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; Fisheries; Sand and gravel extraction
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

1.4 Protection of the marine environment

1.4.1 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 signalling new points of interest.

On the European level, the Directorate-General for the Environment (*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 anyone involved or interested in environmental policy. In the *OSPAR commission*, 15 countries from Western Europe (including Belgium) collaborate 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 statement (2014)* of the state secretary which is *inter alia* competent for the North Sea stipulates the current North Sea policy.

All aspects of the environmental policy with regard to the coast (landward of the baseline) are an exclusive competence of Flanders (*Policy note environment 2014-2019*). The Environment, Nature and Energy department (*LNE*) plays a coordinating role in the Flemish environmental administration. The department is responsible for the preparation, steering and monitoring of the execution and evaluation of the Flemish environmental policy. The LNE department is also responsible for operational matters such as environmental enforcement, environmental permits and approvals, environmental impact and safety reports, environmental and nature education, and nature conservation and development. 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*).

The *Province of West Flanders* acts as an intermediary 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, the management of the provincial domains and green axes, and nature and environmental education.

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

1.4.2 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 (see *Verleye et al. 2014*). These mostly sectoral legislations and regulations are discussed in the theme texts of the relevant user functions in the sections 'Policy context' and 'Sustainable use'. Hence, important policy instruments such as the MARPOL Convention will not be treated here, but in the theme about **Maritime transport, shipping and ports**. A selection of the most relevant policy instruments related to nature and environment for the BNS and the coastal zone is given below.

UNITED NATIONS CONVENTION ON THE LAW OF THE SEA (1982)

The United Nations Convention on the Law of the Sea ([UNCLOS](#), 1982) can be considered as the first intergovernmental convention that creates an integrated legal framework for the use of the oceans. Notwithstanding the broad scope of this convention, part XII of UNCLOS specifically addresses the protection and preservation of the marine environment.

RAMSAR CONVENTION

The [Ramsar Convention](#) (Ramsar, Iran, 1971) is an intergovernmental treaty aimed at the protection and sustainable management of wetlands with special attention to the conservation of habitats for water birds ([Goffin et al. 2007](#)). The convention attempts to achieve the protection and 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](#)) and the protection and preservation of the ecosystems and biological diversity are part of the OSPAR Convention ([Goffin et al. 2007](#)).

MARINE STRATEGY FRAMEWORK DIRECTIVE

The European Marine Strategy Framework Directive (MSFD) (directive 2008/56/EC) 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 on 11 descriptors (see table 2). The member states need to define indicators and associated target values for each of these descriptors ([DG Leefmilieu 2012](#)). The EU supports the member states by developing methodologies for these indicators and by giving scientific advice for every descriptor (see table 2). Based on these scientific advices, a decision (2010/477/EU) has been published which further elaborates on the criteria and methodological standards for the implementation of the MSFD and the determination of the GES of the marine waters.

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

DESCRIPTORS MSFD		
1	Biological diversity	Cochrane et al. (2010)
2	Non-indigenous species	Olenin et al. (2010)
3	Commercially exploited fish and shellfish	Piet et al. (2010)
4	Food webs	Rogers et al. (2010)
5	Eutrophication	Ferreira et al. (2010)
6	Seafloor integrity	Rice et al. (2010)
7	Hydrographical features	
8	Contaminants and pollution effects	Law et al. (2010)
9	Contaminants in fish and other seafood	Swartenbroux et al. (2010)
10	Marine litter	Galgani et al. (2010)
11	Underwater noise and other forms of energy	Tasker et al. (2010)

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* (Belgische Staat 2012a), including a socio-economic analysis of the users of the BNS (*socio-economische analyse van de gebruikers van het BNZ* (Belgische Staat 2012b)). Furthermore, a report with the description of the GES and the environmental targets for the BNS was published (*Omschrijving van de Goede Milieutoestand & vaststelling van Milieudoelen* (Belgische Staat 2012c)). Based on this document, MUMM has developed a monitoring programme (*monitoringsprogramma* (2014)) in order to monitor the evolution and condition of the environment. Subsequently, the Marine Environment department coordinates the development of a programme of measures. Every six years (2018, 2024, etc.), a revision should be conducted based on the results of the monitoring programme and the programme of measures (DG Leefmilieu 2012).

WATER FRAMEWORK DIRECTIVE

The European Water Framework Directive (WFD) (directive 2000/60/EC) 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 bodies⁸, 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* (river basin management plan 2016-2021, in preparation), *FOD Volksgezondheid, Veiligheid van de Voedselketen en Leefmilieu 2009*).

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* and *website Coördinatiecommissie Integraal Waterbeleid*). 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*) (river basin management plan 2016-2021, in preparation) and a river basin management plan for the Belgian coastal waters (*FOD Volksgezondheid, Veiligheid van de Voedselketen en Leefmilieu 2009*). 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 WFD is supplemented by directive 2006/118/EC (on the protection of groundwater against pollution and deterioration) and directive 2008/105/EC (on environmental quality standards in the field of water policy). Furthermore, the WFD is closely related to a number of directives which are discussed in more detail in other theme texts of the Compendium for Coast and Sea. It *inter alia* concerns the Urban Waste Water Directive (91/271/EC), Nitrates Directive (91/676/EC) (theme **Agriculture**), Bathing Water Directive (2006/7/EC) (theme **Tourism and recreation**) and the Floods Directive (theme **Safety against flooding**).

The WFD has been implemented by the royal decree of 23 June 2010 with regard to 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 restore the threatened European natural habitats and wild fauna and flora. The member states need to designate special protection areas (habitats directive areas) for certain habitats and species of European importance which are listed in the annexes I and II of the directive. Together with the birds directive areas, these habitats directive areas constitute 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 (see also *Bot 2007* and *T'Jollyn et al. 2009*).

⁸ 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.

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 policy pursued. The conservation objectives of the marine natura 2000 areas have not yet been determined ([DG Leefmilieu 2010](#), [Raeymaekers 2011](#)). A proposal for the objectives for the protected species and habitats of the BNS has been elaborated by [Degraer et al. \(2010\)](#). For the landward side, the conservation status of the species and habitats of European importance was reported by [Louette et al. \(2013\)](#) for the period 2007-2012.

BIRDS DIRECTIVE

The European Birds Directive (directive 2009/1147/EC) 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, migratory or winter birds. 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 policy pursued to the EC. The most recent reporting in the framework of the Birds Directive covers the period 2007-2012 (see [Anselin et al. 2013](#)). 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. \(2009\)](#) and [Degraer et al. \(2010\)](#), the conservation of the bird species of the Birds Directive at the level of Flanders and the North Sea (see also [DG Leefmilieu 2010](#)) 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, the royal decree of 5 March 2006 and the royal decree of 20 March 2014. The decision of the Flemish government on 23 March 2014 led to a definitive designation of the special protection areas on the landward side of the coast ([Achterhaven Zeebrugge-Heist](#), [Duingebieden](#) and [Polders](#)) and the related conservation objectives (see www.natura2000.vlaanderen.be).

MARINE ENVIRONMENT AND MARINE SPATIAL PLANNING LAW

The law on the marine environment and marine spatial planning (law of 20 January 1999) intends to maintain the nature, the biodiversity and the integral character of the marine environment by means of protective 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](#)). Furthermore, the law stipulates which activities are subject to a permit or authorisation by the competent minister and associated environmental impact assessment. Since 20 July 2012, this law also regulates the organisation and procedure with regard to marine spatial planning.

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

Besides the aforementioned 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 of the law of 12 July 1973), additional areas have been protected, either as 'protected dune area' or as 'agricultural area important for the dune area' ([Provoost 1999](#)).

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 build a natural- and human-friendly environment. For the FEN-areas, nature policy plans (*natuurinrichtingplannen* ([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](#)).

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

1.4.3 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**). The working areas of 2 or more of the mentioned regulations often overlap. In total, more than 1,200 km² or about 36% of the BNS has been designated as a marine protected area (see table 3 and figure 3).

Table 3. An overview of the protected areas, their surface, status and associated legislation (Source: *DG Leefmilieu 2010*).

PROTECTED AREAS IN THE BNS			
Protected area	Surface	Status	Legislation
Special protection area SBZ-1 (Birds Directive)	110.01 km ²	<ul style="list-style-type: none"> Policy plan available (<i>Beleidsplan</i>) Conservation objectives to be determined (scientific advice: <i>Degraer et al. 2010</i>) Management plan to be determined 	
Special protection area SBZ-2 (Birds Directive)	144.80 km ²	<ul style="list-style-type: none"> Policy plan available (<i>Beleidsplan</i>) Conservation objectives to be determined (scientific advice: <i>Degraer et al. 2010</i>) Management plan to be determined 	royal decree of 14 October 2005 – <i>speciale beschermingszones en speciale zones voor natuurbewoud</i>
Special protection area SBZ-3 (Birds Directive)	57.71 km ²	<ul style="list-style-type: none"> Policy plan available (<i>Beleidsplan</i>) Conservation objectives to be determined (scientific advice: <i>Degraer et al. 2010</i>) Management plan to be determined 	
Special protection area H2 <i>Vlakte van de Raan</i> (Habitats Directive)	19.17 km ²	<ul style="list-style-type: none"> Designation as habitats directive area annulled in 2008 	royal decree of 14 October 2005 – <i>speciale beschermingszones en speciale zones voor natuurbewoud</i>
Special protection area 'Flemish Banks' (Habitats Directive)	1,099.939 km ²	<ul style="list-style-type: none"> Expansion of the area 'Trapegeer-Stroombank' Study of demarcation of the area: <i>Degraer et al. (2009)</i> Conservation objectives to be determined (scientific advice: <i>Degraer et al. 2010</i>) Management plan to be determined 	royal decree of 16 October 2012
Marine reserve (Bay of Heist)	6.76 km ²	<ul style="list-style-type: none"> Policy plan available (<i>Beleidsplan</i>) 	royal decree of 5 March 2006
Ramsar site Western Coastal Banks	19 km ² (<i>list Ramsar areas</i>)		

The [Marine Environment department](#) of the FPS Public Health, Safety of the Food Chain and Environment is currently working on a new royal decree on the procedures with regard to the designation and management of natura 2000 areas in the BNS. Within this royal decree, the following matters will be addressed: the designation of an area, the conservation objectives, conservation measures and management plans, the execution of an appropriate assessment and the monitoring.

The impact of activities on the protected marine areas will still be subject to an appropriate assessment and activities will only be allowed when there is no risk of negative consequences for the area. Activities that may have negative effects could be permitted when there is a compelling motive of great public interest, but only when there are no alternatives available.

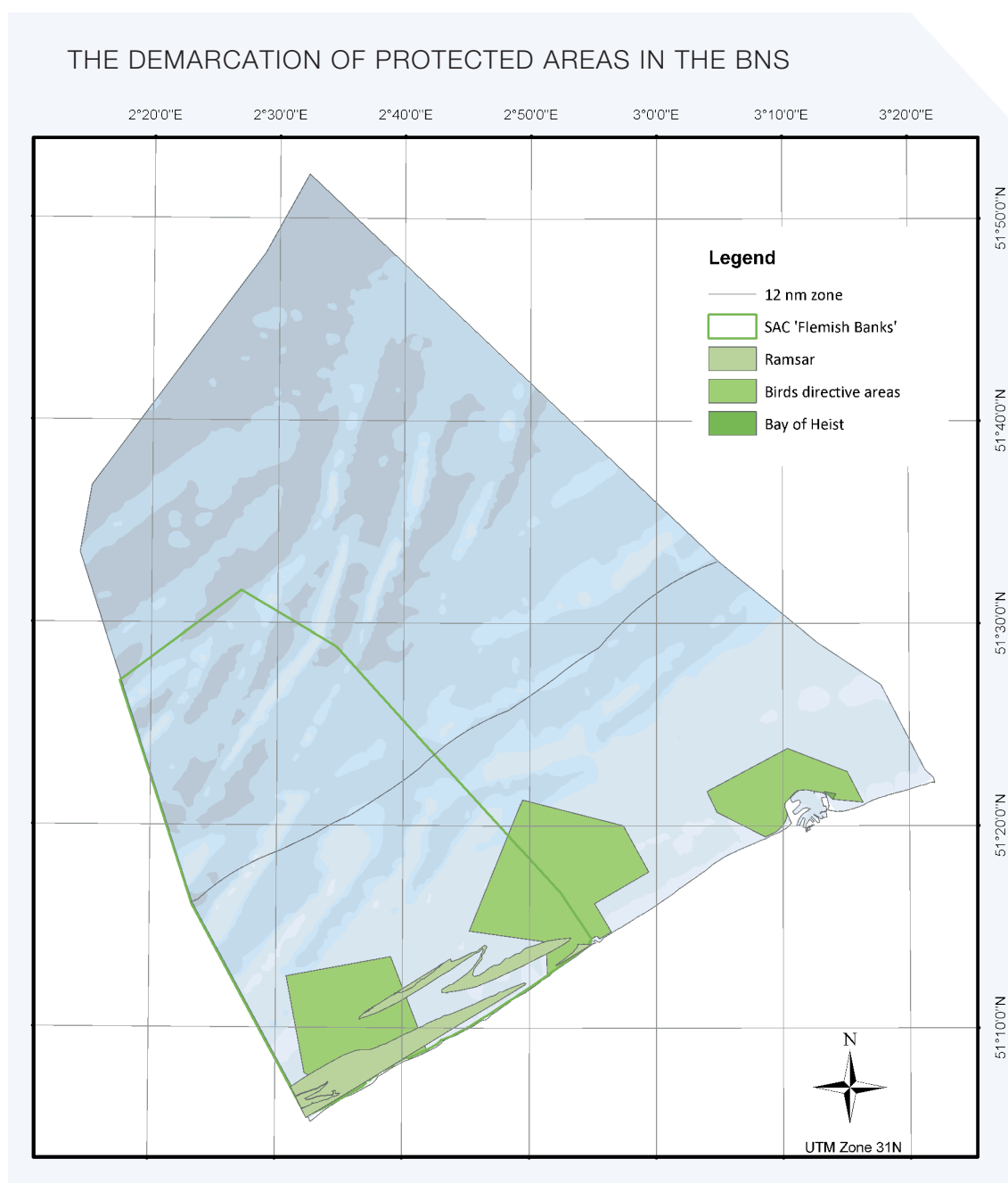


Figure 3. A map of the protected areas in the BNS (Source: IRSNB, marineatlas.be, based on the royal decree of 20 March 2014).

The marine spatial plan (MSP) (royal decree of 20 March 2014, see also [Van de Velde et al. 2014](#), <http://odnature.naturalsciences.be/marine-atlas/data>) does not add any additional protected areas. The marine spatial plan aims to streamline the activities in the existing areas with the protection of the environment.

Hence, a number of subareas have been delineated within the special protection area of the Flemish Banks. In these subareas, there are certain restrictions with regard to bottom-disturbing activities such as trawl fisheries ([Pecceu et al. 2014](#)) and sand and gravel extraction. In addition, the marine spatial plan also discusses 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 has been assigned with some kind of protection with regard to nature conservation. This share is higher compared to the hinterland ($\pm 16\%$) and Flanders ($\pm 14\%$) ([Maelfait et al. 2012](#)). The maps and surface of the natura 2000 areas in the coastal zone can be consulted on www.natura2000.vlaanderen.be.

The remaining ecologically valuable dune areas with a total surface of approximately 2,830 ha are almost entirely protected (figures 4 and 5). Only 5% of these domains do not belong to nature areas of the regional spatial plan or are not protected by 'higher' protection statutes (protected dune area, nature protocol for military domains or nature reserves). It mainly concerns inner-dune areas and areas at the edge of the dunes, e.g. at Cabour (old dunes of Adinkerke), Sandeshoved and Oude Hazegraspolder in Knokke. However, these areas have been marked as special protection areas and belong to the 'agricultural areas important for the dune area' of the Decree of the Dunes (Chapter 9 law of 12 July 1973) ([Dumortier et al. 2003](#)).

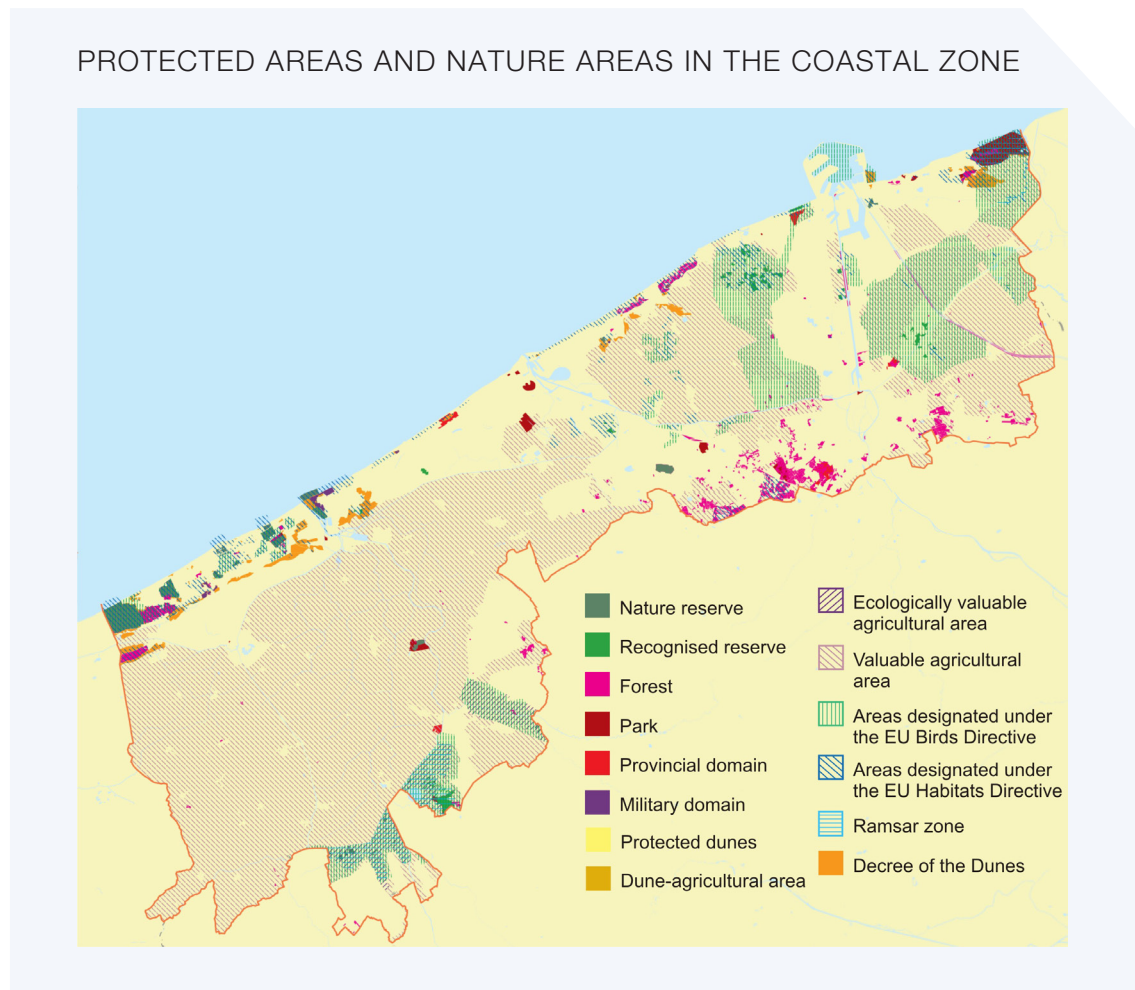


Figure 4. Protected areas and nature areas in the coastal zone (Source: [Coastal Atlas](#)).

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

According to [De Saeger et al. 2013](#) there are approximately 12,000 acres of historic permanent grasslands in the coastal polders. The decree of 21 October 1997 stipulates a prohibition or authorisation with regard to alterations of the vegetation and specific physical properties of these grasslands. In 2015, the Flemish government decided to protect 8,000 acres of grasslands. A part will be protected by means of nature legislation, whereas another part will be covered by the European agricultural policy.

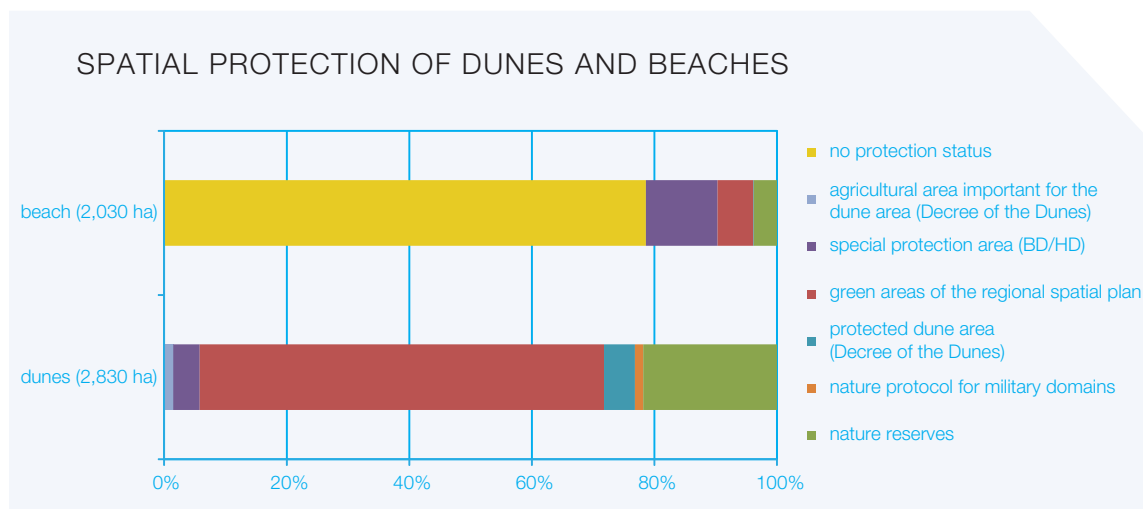


Figure 5. Spatial protection of the ecologically valuable dune ecotypes and beaches according to the different statutes for nature preservation ([Dumortier et al. 2003](#)).

Legislation reference list

Table with international agreements, conventions, etc.

INTERNATIONAL AGREEMENTS, CONVENTIONS, ...			
Abbreviations (if available)	Title	Year of conclusion	Year of entering into force
<i>Ramsar Convention</i>	Convention on Wetlands of International Importance especially as Waterfowl Habitat	1971	1975
<i>MARPOL Convention</i>	International convention for the prevention of pollution from ships, as modified by the Protocol of 1978	1973	1978
<i>UNCLOS</i>	United Nations convention on the law of the sea	1982	1997
<i>OSPAR Convention</i>	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			
	<i>Council Directive concerning urban waste-water treatment</i>	1991	271
<i>Nitrates Directive</i>	Council Directive concerning the protection of waters against pollution caused by nitrates from agricultural sources	1991	676
<i>Habitats Directive</i>	Directive on the conservation of natural habitats and of wild fauna and flora	1992	43
<i>Water Framework Directive</i>	Directive establishing a framework for Community action in the field of water policy	2000	60
	<i>Directive 2006/118/EC of the European Parliament and of the Council of 12 December 2006 on the protection of groundwater against pollution and deterioration</i>	2006	118
<i>Floods Directive</i>	Directive on the assessment and management of flood risks	2007	60
<i>Marine Strategy Framework Directive</i>	Directive establishing a framework for Community action in the field of marine environmental policy (Marine Strategy Framework Directive)	2008	56
	<i>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</i>	2008	105
<i>Birds Directive</i>	Directive on the conservation of wild birds	2009	147
Other (Decisions, Communications, White Papers, etc.)			
<i>Integrated Maritime Policy</i>	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
	<i>Commission Decision of 1 September 2010 on criteria and methodological standards on good environmental status of marine waters</i>	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	File number
Laws		
Wet van 12 juli 1973	Wet op het natuurbehoud: Vlaamse Gewest	1973-07-12/35
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	1999-01-20/33
Royal decrees		
KB van 21 december 2001	Koninklijk besluit betreffende de soortenbescherming in de zeegebieden onder de rechtsbevoegdheid van België	2001-12-21/72
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	2005-10-14/35
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.	2005-10-14/36
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	2006-03-05/48
KB van 23 juni 2010 – oppervlaktewatertoestand	Koninklijk besluit betreffende de vaststelling van een kader voor het bereiken van een goede oppervlaktewatertoestand	2010-06-23/04
KB van 23 juni 2010 – mariene strategie	Koninklijk besluit betreffende de mariene strategie voor de Belgische zeegebieden	2010-06-23/05
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.	2012-10-16/05
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	2012-11-13/07
KB van 20 maart 2014	Koninklijk besluit tot vaststelling van het marien ruimtelijk plan	2014-03-20/03
Decrees		
Decreet van 14 juli 1993	Decreet houdende maatregelen tot bescherming van kustduinen	1993-07-14/31
Decreet van 21 oktober 1997	Decreet betreffende het natuurbehoud en het natuurlijk milieu	1997-10-21/40
Decreet van 18 juli 2003	Decreet betreffende het integraal waterbeleid	2003-07-18/72
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»	2000-07-17/70
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	2002-05-24/44

