MASTERPLAN VLAAMSE WESTKUST – DUNES DE FLANDRE

LIFE+12 NAT/BE/000631 FLANDRE WVI-CPIE -INBO

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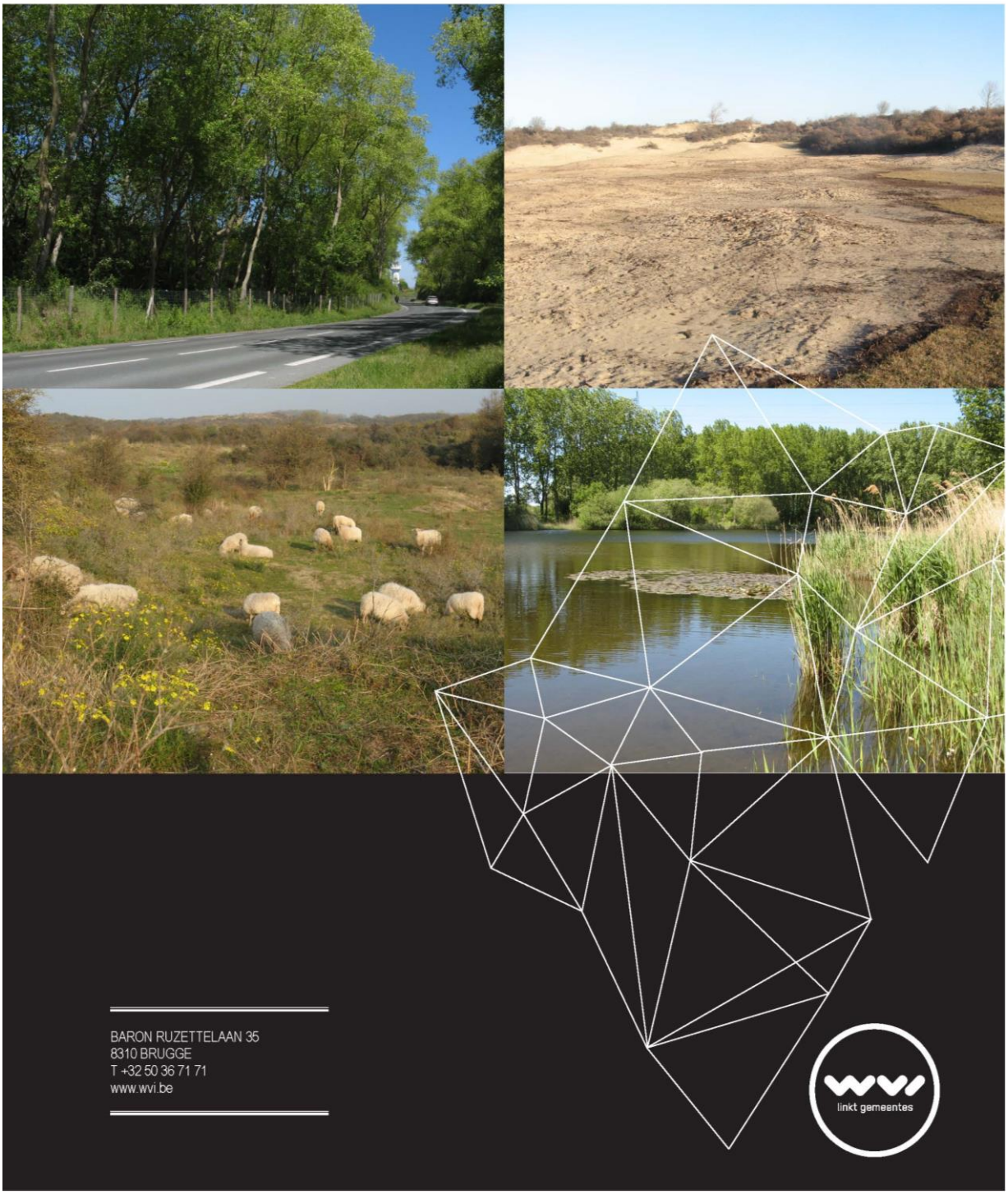
SUMMARY



Summary

This summary is based on:

Cosyns E., Bollengier B. & Provoost S. 2019. Masterplan et base juridique pour la coopération et la protection comme parc naturel transnational des dunes entre Dunkerque (France) et Westende (Belgique). Partim Masterplan. LIFE+12 NAT BE 000631 "FLANDRE": Action A.1 & A.2. Maitre d'ouvrage ANB, Conservatoire de l'espace littoral et des rivages lacustres, Departement du Nord.

Content

Maps : available in A3-format

1. Introduction

This masterplan applies to the LIFE+ 12 NAT / BE / 000631 project Flemish And North French Dunes Restoration which is a joint nature restoration project of the Agency for nature and forests of the Flemish Government, the Conservatoire de l'Espace Littoral et des Rivages lacustres and the Département du Nord for the coastal dunes between Dunkerque (France) and Westende (Belgium), that is co-financed by the European Union.

This masterplan focuses especially on all the dunes sites included in the Natura 2000 network border between Dunkirk (France) and Westende (Belgium) which encompasses all sites of Community importance and the special protection area designated in implementation of European directives "Habitat" « FR3100474 Dunes de la Plaine Maritime Flamande », « FR3100475 Dunes flandriennes décalcifiées de Ghyvelde » and « BE2500001 Duingebieden inclusief IJzermonding en Zwin » and "bird area" « BE2500121 Westkust », but also the neighbouring areas including maritime, (sub-)urban agricultural and other "open" spaces such as some small lakes called Moëres, Mahieu, Téteghem, Armbouts-Capelle and Zwarten Hoek. Thus, the terrestrial part of the project area (Including the foreshore up to the mean low water) covers an area of 6358ha.

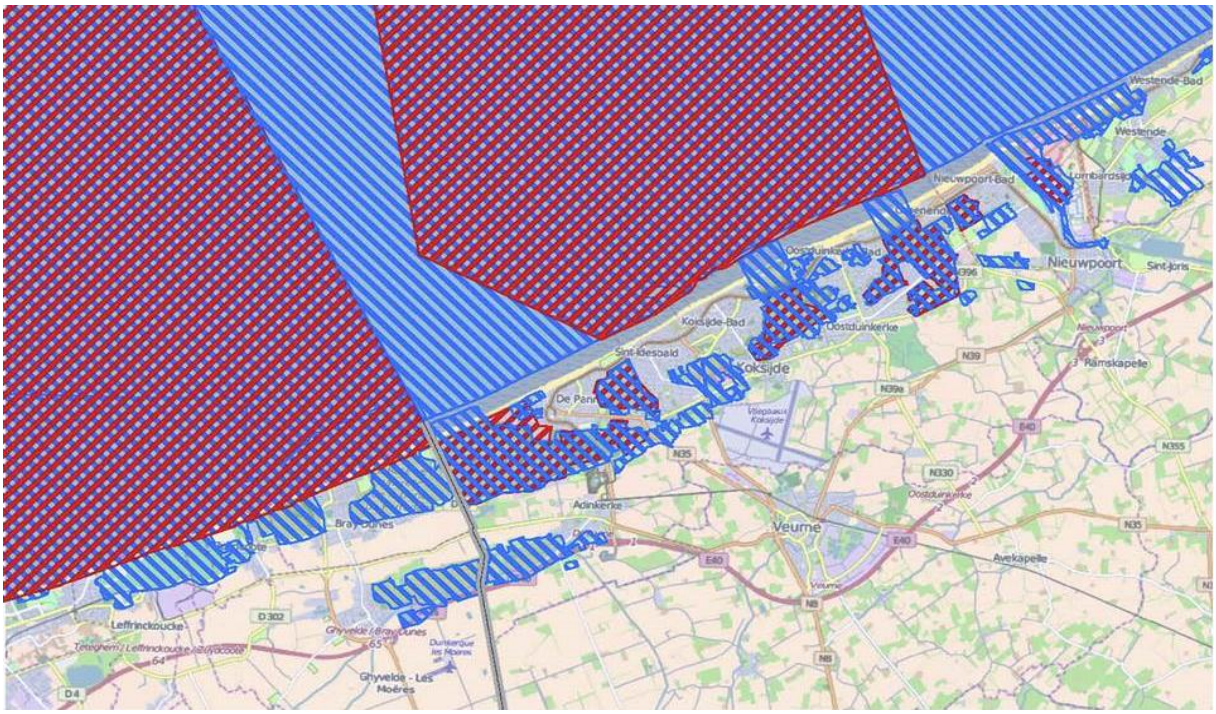
2. Aim

The aim of the project is the qualitative consolidation of the Natura 2000 network in both countries by restoring the habitat types that are characteristic of the sedimentary coasts of the Atlantic biogeographical region and the populations of species which are of Community interest through the acquisition of the coastal dunes, nature restoration work, management planning, and increasing the public awareness by a close co-operation between the Belgian and French authorities for the acquisition and management of protected areas.

The masterplan aims to develop a transnational strategic vision encompassing a period of 15 years from the viewpoint of nature conservation for the cross-border dune zone. This strategic management vision mainly includes:

- A description of the significance of the coastal ecosystem on an European level;
- An analysis of former initiatives for coastal dune manegment;
- An analysis of potentialities, obstacles and opportunities for restoration, strengthening and maintaining a favourable conservation status of certain types of natural habitats, populations of species, natural processes and ecological connectivity;
- Development of operational objectives and an action plan based on potentialities and opportunities.

Fig. 1. Delimitation of the study area, encompassing the coastal dune belts between Dunkirk (France) and Westende (Belgium) which mainly consists of European Natura 2000 protected area. This area includes the sites of Community importance and Special Protection Area designated in implementation of European directives "Habitat" and "Birds" (SPA-H: blue hatched areas / SPA-O: red hatched areas). In the development of vision Sea area and its sandbanks adjoining the foreshore and dunes and ponds between the dune and the E40-A18 are also considered.



3. Brief description of the main characteristics of the coastal dune system

3.1. Landscape characteristics

The coastal dunes between the French Dunkerque and the Belgian Westende is one of the most famous dune areas of continental Europe. The coastal landscape is characterized by wide sandy beaches, carved sea ridge dunes, mega-parabolic dunes embracing large humid dune slacks, and low, gently undulating ' fossil ' dunes that arose between 3,000 BC and 800 AD. The dune soils have a high lime content, except those of the ' fossil dunes ', that are deeply decalcified.

This landscape is the result of the combination of basic elements (geomorphology and climate of the territory) and changes caused by human activities that are developed there over the past three millennia (e.g. archeological findings dating back to the Iron Age in the dunes of the "Westhoek" in de Panne)

Within the boundaries of the project area one can find a huge variety of macromorphological units and related landscapes. It comprises almost all types of coastal habitats: strandline, foredune, white dunes, parabolic dunes etc. All are part of a belt of mainly recently established dunes and are characterised by a calcareous, sandy soil. The floristic richness and diversity of habitats results from the complexity of the underlying, often small scaled, variety in abiotic patterns and processes, which can be summarised as follows:

- the variation in topography;
- the variation in soil conditions (sand-clay, lime content…);

- and as consequence the variation in hydrological conditions;
- the very local influence of salt water.

Biotic factors are superimposed on the abiotic conditions. Moreover, the human influence has been substantial and has undoubtedly contributed to both the establishment and the disappearance of species and also the development and degradation of habitats.

During the 20th Century, the dunes on both sides of the border got strongly spatially fragmented and degraded by urbanization, water extraction, recreation, fixation of sand drift, invasion by exotic species, intensification of agriculture in the transition zones between dunes and polders and the extinction of traditional agro pastoral use of the remaining dune areas that resulted in overgrowth of the dune landscape by scrub. The largest part of the remaining dune areas in both Member States of the European Union is included in the Natura 2000 network.

3.2. Specific coastal biodiversity

The habitat types (incl. covering area of well developed habitat) and species of which the project wants to improve the conservation status are (Table 3.1.):

2110 Embryonic walking dunes (6ha)
2120 walking Dunes on the shoreline with Ammophila arenaria (white dunes, 390ha)
2130 * Fixed dunes with herbaceous vegetation (grey dunes, incl. 2150: 712ha)
Eu-2150 * Atlantic decalcified fixed dunes (Calluno-Ulicetea)
2160 dunes with Hippophaë rhamnoides (955ha)
2170 dunes with Salix repens SSP. Argentea (Salicion arenariae, 86 ha)
2180 Wooded dunes of the Atlantic, Continental and Boreal coastal area (376ha)
2190 Humid dune slacks (77ha)
1014 Narrow mouthed whorl snail (Vertigo angustior)
1166 Great crested Newt (Triturus cristatus)
1614 Creeping Marshwort (Apium repens)
1903 Fen Orchid (Liparis loeselii)
1202 Natterjack Toad (Bufo calamita)

3.2.1. Important habitats of the project area

Strandline and embryonic dunes (partim Eu-habitat 2110)
Here sand is trapped by beach debris and specialized grasses. This includes vegetation along the high tide line. It is usually ephemeral, salt tolerant and composed of a limited number of species e.g. *Cakile maritime*, *Salsola kali* ssp. *Kali, Honkenya peploides* and *Atriplex glabriuscula*.

White dunes (Eu-habitat 2120) occur mainly on the seaward side of the dune system. The first stage in sand deposition occurs here, normally above direct tidal influence. The vegetation is limited in species diversity, dependent on its ability to withstand the influence of salt spray and trap moving sand. The most characteristic being couch grasses *(Elytrigia spp.)* and marram grass *(Ammophila arenaria)*. Where the rate of sand deposition is less but the surface is still mostly bare sand a greater variety of plants can survive e.g. *Carex arenaria* and *Festuca arenaria*.

Fixed dunes dominated by species of grass and herbs (**grey dunes** – Eu-habitat 2130) occur further inland where sand deposition is no longer significant. Many plant species exist here and help to stabilize the dune surface and create a thin layer of humus. This type of vegetation usually develops under the influence of grazing. Apart from species-rich communities of *Koelerion albescentis* (class of sandy dry grasslands), *Corynephorion* (grey hair-grass sward) and the *Thero-Airion* alliance (ephemeral-rich *Aira* swards), Habitat type 2130 is also characterised by cryptogam-richness (patchy moss and lichen carpets). The lime content of these moss dunes varies depending on the parent substrate and the process of increasing decalcification promoting the gradual transition of the species composition. Where ground may be heterogeneous, with open areas remaining, often through cattle and horse action, dune mosses such as *Tortula ruraliformis* (acrocarpous) and *Brachythecium albicans* (pleurocarpous) may be important (*Phleo-Tortuletum ruraliformis* communities). In the initial stages of leaching, ground lichens of the genus *Cladonia* may be frequent to abundant and, mostly being grey, form 'Grey dune'. The sparsely covering herb layer exists of several winter annuals such as *Phleum arenarium* on lime containing soils.

The **Grey dunes** (Eu-habitat 2130) of the project area dunes mainly exist from *Polygalo-Koelerion* related grassland. The presence of such species as *Helianthemum nummularia, Thymus pulegioides, Silene nutans and Polygala vulgaris* indicates affinity with the *Anthyllido-Thesietum humifusi* and the *Anthyllido-Silenetum* community which all are typical for lime containing sandy soils. The best examples of this vegetation type can be found in the northern part of 'de Doornpanne' and in the "Oostvoorduinen". In addition to the already mentioned species locally one can find also some special species like *Briza media, Euphrasia stricta s.l., Linum catharticum* and *Ononis repens. Festuco-Galietum veri* related grasslands can be found in 'Oostvoorduinen' and are characterised by the dominance of graminoids e.g. *Antoxanthum odoratum, Agrostis capillaris and Holcus lanatus.* Another characteristic of this community is the co-occurrence of species with affinity to decalcified soils (*Rumex acetosella*) and of those species that are more related to lime rich soils e.g. *Galium verum*. At several places the semi natural grassland communities are degraded as a consequence of coarse grass *(Calamagrostis epigejos* and *Arrhenaterum elatius)* invasion. These grass species dominate several places that consist of monospecific grassland. When grazed or mown the dominance of these grass species will rapidly decline and a more species rich grassland soon will develop.

Dune slacks (EU-habitat 2190 - 2170)
Humid dune slacks are a component of most large, dynamic or previously dynamic, dune systems. They are damp or wet hollows left between dunes where the groundwater reaches or approaches the surface of the sand. Their most distinguishing feature is a seasonally fluctuating water table which usually reaches a maximum in winter and spring and drops in summer. Secondary dune slacks result from a blowout, where erosion down to the water table has occurred. If the erosion is extensive, a large flat area of wet sand is exposed. Most of the dune slacks in the project area are secondary dune slacks. The wet sand is colonised by plants and a succession occurs. Microbial mats can be important at the pioneer stage and, by fixing nitrogen, may facilitate colonisation by higher plants A range of wetland plants are important and early vegetation can be extremely species-rich with plants such as *Carex trinervis, C. viridula* and *C. flacca* and *Juncus articulatus.* Young dune slacks now are present in 'Schipgatduinen', 'Doornpanne south-east', Ter Yde, Simliduinen and Sint-Laureinsduinen, however this type of habitat is very scarce.
The shift from pioneer stage to more mature stages mostly occurs within 5-10 years. *Salix* spp. (e.g. *Salix repens*) usually colonise early in the succession but at this stage do not dominate. A species-rich phase of typical dune slack species including *Parnassia palustris*, *Blackstonia perfoliata, Dactylorhiza incarnata* and *Epipactis palustris* develops, often rapidly.
Without the disturbance of grazing, mowing or damage caused by anaerobic conditions in very wet slacks, the biomass increases, organic matter accumulates and the nutrient status (particularly

nitrogen and phosphorus) of the soil increases. This results in increasing dominance of tall grasses and shrubs. At most occasions these communities are degraded with Salix spp. and only *Salix repens* as a remnant of a passed botanical glory.

Scrub (Eu-habitat 2160)
A few shrubby species are capable of invading sand dunes to form scrub. Sea Buckthorn (*Hippophae rhamnoides*) is omnipresent and is the most dominant species. Along with *Crataegus monogyna*, *Sambucus nigra*, wild roses (*Rosa* spp.) and brambles (*Rubus* spp.), it can form dense, impenetrable thickets. The non-spiny species, *Ligustrum vulgare*, is abundant at some well-located places but almost absent from others.
Succession from scrub to woodland can be expected, with trees such as *Quercus robur*, *Betula spp, Fraxinus excelsior* and *Acer pseudoplatanus* which are able to colonise dune scrub. However, the landward margins of the dune system was typically highly managed and most forest were often planted.

Forest (Eu-habitat 2180)
Almost without exception all forests are of anthropogenic origin. Poplars (*Populus x Canadensis, P. alba and P. albescens)*, pine (*Pinus nigra)* and *Ulmus minor* are the most frequent planted species. In general, the ground flora consists of ruderal annuals, such as Claytonia perfoliata, Anthriscus caucalis, Stellaria media and of perennial species, like Urtica dioica, Glechoma hederacea, Galium aparine and Poa trivialis. Certainly, the lime-rich woods are interesting for other groups of organisms such as fungi and snails. It is especially under the trees with little dense foliage such as poplar or common ash that special species of snails were found e.g. the common Jersey, reverse vertigo, *Vertigo angustior* etc. *Vertigo angustior* deserves special attention as a species to Appendix II of the habitat directive. In the lowlands, this species is limited to the coastal dunes, but displays in this area relatively broad ecological amplitude.

Open water (Eu-habitat 3140)
Ponds rich in limestone and poor in food are an excellent site for macroalgae. In addition, one also find different vascular plant species such as opposite-leaf pondweed (*Groenlandia densa*) and alkaline bog pondweed, rare at the international level. Creation of new ponds also has positive consequences for amphibians and dragonflies. Both the crested Newt and natterjack toads in recent years deployed on the coast and the number of species of dragonflies and damselflies observed (including travellers) also is well increased.

Other Eu-habitats occurring in but covering only a small part of the project area:

• halophile vegetations
1310 - Salicornia and other annuals colonizing mud and sand.
1320 - Spartina swards (*Spartinion maritimae*)
1330 - Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)

6510 - Prairie mesophilic prairies with *Alopecurus pratensis* and *Sanguisorba officinalis*
6430 - Wet and nitrophilous tall herb edge communities, along water courses and woodland borders belonging to the Glechometalia hederaceae and the Convolvuletalia sepium orders

3.2.2. Target species and species groups of the project area

Birds

The project area is inhabited by a wide array of wildlife among them important numbers of breeding bird species. Birds were well studied in the project area during past years. During last decenium a lot of bird species were recorded including several species that are mentioned on the Red list of Flemish Birds e.g. Nightingale (*Luscinia megarhynchos*), Turtur dove (*Streptopelia turtur*)

The forest support a wide variety of bird species including 3 species of woodpecker i.e. Green, Great and Lesser spotted woodpecker and at least 3 species of diurnal raptors and the Long-eared Owl (*Asio otus*). Perhaps the most important bird habitat is provided by the open area covered with grey dune vegetation and scattered with solitary trees. This is the core habitat of the Tree pipit (*Anthus trivialis).* The water side vegetation, including small reed beds, holds rarities like the Sedge warbler (*Acrocephalus schoenoboanus*) and the Blue throat (*Luscinia svecica*), a species proteced by the Annex-I of the European Bird directive.

During the last three decades, three major trends in the species composition can be observed:

- Birds of open dune and strandline are under high recreational pressure, and have virtually disappeared e.g. crested Lark (*Galerida cristata*) and the meadow pipit (*Anthus pratensis*);
- The diversity and density of forest species increased as a result of vegetation succession (scrub encroachment),
- The numbers of hygrophylous species reduced significantly (water stress of the dune ecosystem) however, some species have been observed around the new dune slack in Sint-Laureinsduinen e.g. the Shelduck, little Grebe and Lapwing

Table 3.2. Bird species listed in Annex I of the Birds Directive e.g.

Charadrius alexandrinus	Kentish plover
Luscinia svecica	Bluethroat
Lulla arborea	Woodlark
Circus aeruginosus	Marsh Harrier
Alcedo atthis	Common Kingfisher
Dendrocopus medius	Woodpecker
Caprimulgus europaeus	Nightjar
Pernis apivorus	Honey Buzzard
Circus cyaneus	Hen Harrier
Philomachus pugnax	Ruff
Numenius arquata	Curlew
Pluvialis apricari	Golden Plover
Larus fuscus	Black-backed Gull

Reptiles.

The viviparous lizard is the only species known in these dunes.

Amphibians

Ponds are refuge areas for many amphibians which take advantage of the food present. Great Crested Newt (*Triturus cristatus*) (annex II and IV of the Habitat Directive) were already discovered at several places in the Frnech dunes and in the western part of the Flemish (Belgian) dunes. Here also a lot of Natterjack Toad (*Bufo calamita*) were recorded. Ponds provide also valuable habitat for many different invertebrates such as Dragonflies, specialised beetles and spiders and different species of Molluscs (e.g. *Vertigo antivertigo*, table 3.3.).

Table 3.3. Presentation of amphibian and mollusc species of Community interest (Annex-II, Habitat-Dir.) which have already been observed in the project area and selected as target species to take into account for nature management.

Amphibians	
Triturus cristatus	Triton crêté
Bufo calamita	Crapaud calamite
Molluscs	
Vertigo angustior	Vertigo étroit
Vertigo moulinsiana	Vertigo de Des Moulins

Mammals

The project area is also important for mammals (table 3.4). So far, several bats species were observed, albeit usually in low numbers and with only sporadic overwintering individuals. The Pipistrelle (Pipistrellus pipistrellus) is often present. In addition, occasionally also the late Aviator, rugged Pipistrelle and whiskered bat are observed. The presence of war infrastructure in the project area may serve as a wintering habitat for several bats. Until now only very few species were recorded at such places but this will change if the vestiges could made more comfortable for bats.

Table 3.4. Presentation of mammal species of Community interest which have already been observed in the project area or neighbouring marine area and selected as target species to take into account for nature management.

Myotis dasycneme	Pond bat
Eptesicus serotinus	Serotine bat
Myotis mystacinus/brandtii	Whiskered bat and murine Brandt
Myotis daubentonii	Daubenton's bat
Nyctalus noctula	Common noctule
Pipistrellus nathusii	Nathusius' pipistrelle
Pipistrellus pipistrellus	Common pipistrelle
Plecotus auritus	grey long-eared bat
Vespertilio murinus	Parti-colored bat
Myotis nattereri	Natterer's bat
Phoca vitulina	Common seal
Halichoerus grypus	Grey seal
Phocoena phocoena	Harbour Porpoise

In addition several other species of mammals were observed in the nature reserve e.g. mustelids (stone marten, polecat), various species of rodents, Lagomorphs and Insectivores. Noteworthy is the presence of a population garden Dormouse (*Eliomys quercinus*) along the abandoned railway between Dunkirk and Bray Dune and near the Flemish nature reserve Belvedère and Oostvoorduinen. Foxes are generally prevalent in the project area.

Diurnal butterflies and grasshoppers

Several species of diurnal butterflies have been observed in the last decade. The main observations concern several rare species of gray dunes: the rare Queen of Spain Fritillary (*Issoria lathonia*), the Brown Argus (*Aricia agestis*) and grayling (*Hipparchia semele)*. In addition several species of grasshoppers were observed almost half of which is included in the red list. Especially Grey dunes support many grasshopper species including endangered species e.g. Blue-Winged Grasshopper (*Oedipoda caerulescens*).

Moths
Until now, there has not been any study that is explicit about the moths in the reserve. But some observations provide us with some information on this group of insects. From several investigations, it becomes obvious that the nature reserves also harbour tenth of species of moths. As well as other night active insects that serve as food for bats.

Table 3.5. Presentation of two plant species of Community interest (Annex-II, Habitat-Dir.) which are represented in the project area and are selected as target species to take into account for nature management.

Vascular plant species	
Apium repens	creeping marshwort
Liparis Loeselii	Fen orchid or bog twayblade

4. Brief review of past nature management and policy

4.1. French dune area

The first interventions with regard to the protection of the dunes east of Dunkirk happened in the mid-1970's as the Communauté Urbaine de Dunkerque (CUD) became the owner of land in the area of "les dunes Dewulf" (34 ha) in "les dunes Marchand" (6.2 ha) and in "les dunes du Perroquet" (81.9ha and 65ha to Bray-Dunes). Between 1987 and 1989 these dune areas were sold to the Conservatoire du littoral.The Département du Nord became site manager of the areas owned by the Conservatoire du Littoral as a result of the Treaty of October 5, 1982 defining the conditions of the lawn of the land entrusted to the Department.
The areas owned by the Conservatoire du Littoral are now (2019):
- the "Dune Dewulf" (Leffrinckoucke, Ghyvelde, Zuydcoote) 231.32 hectares of a total of 275 hectares of protected dunes massif.
- the "dune Marchand" (Zuydcoote-Bray-Dunes): 108.8 ha of a total of 113 ha protected dune range.
- the "Dune du Perroquet" (Bray-Dunes): 179 ha of a total of 240 ha of protected dunes.
- the "fossil dune the Ghyvelde" (including Le Lac des Moëres: 22ha.): 224 ha.

4.2. Belgian (Flemish) dune area

The first series of acquisitions of coastal dunes for nature conservation done by the national authority (at that time: the Belgian State) took place in the years 1956-1965. These land purchases concerned the area that was designated by royal decree in 1957 as the State Nature Reserve 'De Westhoek,' at De Panne, and the following expansions, with a total surface area of 346ha. Between 1965 and 1997 the Belgian State and its legal successor after the institutional reform, the Flemish Region, purchased 'de Hoge Blekker' at Koksijde (18ha)), 'Hannecartbos' at Oostduinkerke (32ha in 1981), 'de Karthuizerduinen' at Oostduinkerke (6ha in 1983), 'de Houtsaegerduinen' (80ha, several acquisitions between 1988 and 1990), the domain of the 'Children's home Georges Theunis' at Oostduinkerke (16ha in 1994), 'de IJzermonding' at Nieuwpoort (7ha, acquisitions between 1985 and 1989) all adding up to a total of 159 ha.
In 1997 the property situation of the remaining coastal dune area (with a total superficies of 3800ha) consisted of:
522ha owned by the Flemish Region and managed by the Nature Division;
150ha owned by the Flemish Region, managed by the Forestry Division;
350ha owned by the Flemish Region, managed by the Waterways-Coast Division, competent for coastal defence;

2778ha that were property of essentially private owners and real estate firms, and to a lesser degree, also of other public owners such as the Ministry of Defence, water supply companies, municipalities etc.

In 1994 the Flemish Region was the FLANDRE-project owner 489,7ha dunes (fig. 3.1). A specific acquisition tool for coastal dunes and adjacent areas was established by the Flemish government in 1998. This decision showed very effective and crucial for the further purchase of dune area (fig. 3.1). Between 1994 and 2015 about 454 additional hectares of dune area were purchased by the Flemish Region. Some major purchase project were for example 'Ter Yde' (1999, 37ha), the 'Schipgatduinen-Doornpanne "(1999, 22ha) and" North Dunes "(2004, 45ha) in Koksijde. In addition, during the same period was also made progress in more complex purchasing projects.

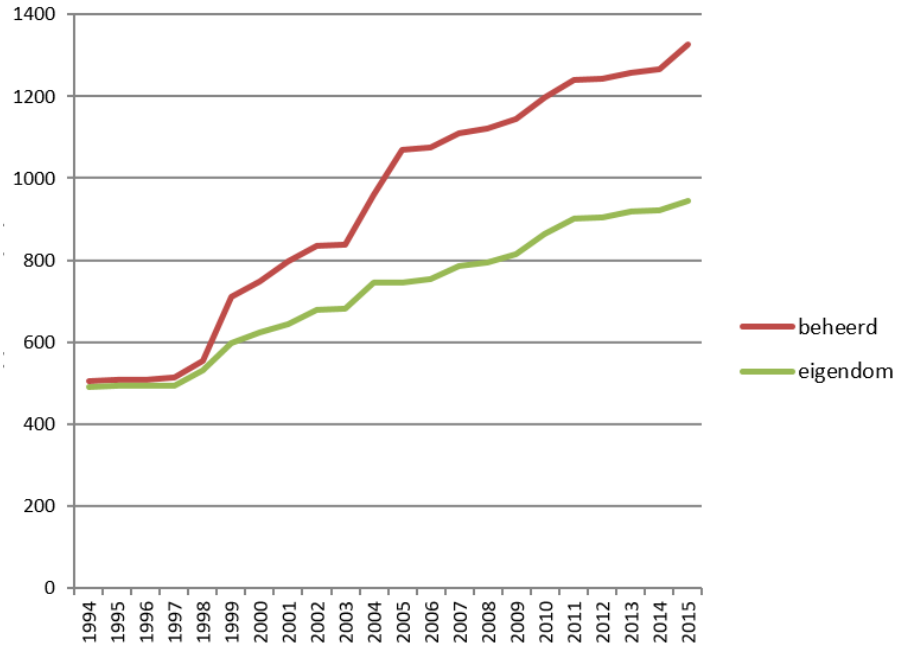


Fig. 3.1. By taking properties from other public institutions e.g. Ministry of Defence (Lombardsijde) AMDK (Ijzermonding) IWVA (Cabour, Ter Yde) municipality De Panne (Oosthoekduinen), the dune area owned and or managed by the Flemish authorities (ANB and its predecessor the former department Nature) grew from 1999 on, managed dune area run faster than property acquisition.

Table 3.2. Status of ownership and managed dune area by ANB, Conservatoire du Littoral (CDL), and Département du Nord (CD59). The total area of dunes is based on data from The Loose (1996) and the French management.

FLANDRE (2018) - ANB	Property	Managed	Sup (ha)
Duinen en Bossen van De Panne	511.9	672,02	1095.7
Noordduinen - Belvedèreduinen - Belvédère	86.74	101,35	186.7
Schipgatduinen - Doornpanne - Sint-André - Hoge Blekker	72.0	216,51	274.1
Ter Yde	193.4	234,3	399.7
Simliduinen-Groenendijk-Sandeshoved	38.3	59,7	171.9
IJzermonding – Sint-Laureinsduinen	43.1	227,3	204.6
Schuddebeurze		14,51	299.5
Overige kleine gebieden (autres petits sites)			92.6
Subtotal (ha)	**985.44**	**1511.18**	**2724.8**

France	property CDL	Managed by CD59	
Dune Dewulf	243.4	243.4	275
Dune Marchand	108.3	108.3	113
Dune du Perroquet	183.2	183.2	240
Dune fossile Ghyvelde + Lac des Moëres	210.2	210.2	240
	CD-59		
Dune fossile Ghyvelde + Lac des Moëres	1.3	1.3	
Subtotal (ha)	**746.4**	**746.4**	**868**
Total (ha)	**1731.84**	**2257.58**	**3472.8**
Total %	**49.86**	**65.01**	**100**

4.3. Brief review of nature management techniques used to restore coastal biodiversity

Scrub removal and deforestation were from the mid-1990s very important nature management measures taken in order to restore open dune habitats. In the project area more than 107 hectares of open dune were restored that way in the past quarter (Table 3.3.)
However preserving the biodiversity characteristic of e.g. dune grasslands and low dune valley vegetation is not possible without active conservation. Doing nothing leads to grass and scrub encroachment and forestation. Little competitive species such as *Parnassia*, *Polygala* or *Thymus* sp. are thereby negatively affected by light competition and litter accumulation. To reduce the excess of biomass in past decades, especially in Flanders, was often chosen for grazing as the main recurrent nature management tool. In addition for very specific circumstances mowing is by far the second most used management tool (Table 3.4 and 3.5). Indeed, grazing alone is rarely enough to achieve all the nature policy objectives. With only grazing scrub regrowth cannot be sufficiently reduced, or be kept under control.
Haying is combined with yer-round or seasonal grazing in various dune areas especially in dune valleys and hay meadows on the inner dune edge. In France, nearly all mowing run from late summer to autumn (Fauche tardive, except an early mowing or Fauche Précoce for *Colchicum* zone in the Dune du Perroquet).

Table 3.4. provides an overview of the areas where since 1992 to 2019 and ontstruweeld or deforested function of restoring open dune habitats. The periods and surfaces are indicated in each case, if known.

Nature reserve	toponym	Year	Superficies	Used technics
Duinen en Bossen van De Panne	Houtsaegerduinen	1999	10	deforestation
Duinen en Bossen van De Panne	Houtsaegerduinen	2002	0.58	scrub removal
Duinen en Bossen van De Panne	Houtsaegerduinen	2016-18	6.14	scrub removal/sod cutting
Duinen en Bossen van De Panne	De Westhoek	96-02	3.14	deforestation
Duinen en Bossen van De Panne	De Westhoek	(83)92-00	6.06	scrub removal
Duinen en Bossen van De Panne	De Westhoek	97-00	17.56	scrub removal
Duinen en Bossen van De Panne	De Westhoek	2008-14	1.47	deforestation
Duinen en Bossen van De Panne	De Westhoek	2015	0.35	scrub removal/sod cutting
Duinen en Bossen van De Panne	De Westhoek	2016-18	7.08	scrub removal/sod cutting
Duinen en Bossen van De Panne	Cabouduinen	09-12	18.4	deforestation
Duinen en Bossen van De Panne	Garzebekeveld	2015	1.38	deforestation
Duinen en Bossen van De Panne	Oosthoek	2007	0.7	scrub removal
Noord- Belvédèreduinen-Belvédère	Noordduinen	06-07	3.38	deforestation
Schipgatduinen-Doornpanne-Hoge Blekker	Doornpanne IWVA	96-15	2	scrub removal
Ter Yde	Ter Yde s.s.	94-15	4	scrub removal
Ter Yde	Ter Yde s.s.	94-15	1	deforestation
Ter Yde	Hannecartbos	04-06	6.1	deforestation
Ter Yde	Hannecartbos	2018	1.24	deforestation/sod cutting
IJzermonding	Kwartier Lombartsijde	2001-07	1.27	deforestation /sod cutting
Subtotal (ha)			**91.85**	
Dune Dewulf			4.56	scrub removal
Dune Dewulf			2.58	scrub removal+graafwerk
Dune Dewulf		13-18	26.3	Scrub removal (Life-Flandre)
Dune du Perroquet		03-04?	10.6	scrub removal
Dune du Perroquet		03-04?	8.47	scrub removal+graafwerk
Dune du Perroquet		13-18	15.5	Scrub removal (Life-Flandre)
Dune Marchand		88-90	0.3	scrub removal
Dune Marchand		91-96	6.34	scrub removal
Dune Marchand		03-04	1.45	scrub removal
Dune Marchand		13-18	9.6	Scrub removal (Life-Flandre)
Subtotal (ha)			**85.7**	
Total (ha)			**177.55**	

Table 3.5 gives an overview of the areas in which grazing is used as a maintenance management.

Dune site	toponym	Period	Sup (ha)	Remarque's
Duinen en Bossen van De Panne	Oosthoek	xxx-2018	36.39	Pony/horse, sheep, cattle
Duinen en Bossen van De Panne	Houtsaegerduinen	1997-2018	76.87	donkey, sheep
Duinen en Bossen van De Panne	De Westhoek	1997-2018	180.45	pony, cattle, (donkey)
Duinen en Bossen van De Panne	Zwarten Hoek	xxx-2018	8.50	pony/horse
Duinen en Bossen van De Panne	Cabourduinen/Zuidmoerhoek/ Veldhoek	1997-2018	90.63	pony, sheep, cattle
Duinen en Bossen van De Panne	Garzebekeveld	xxx-2018	13.30	pony, sheep

Noord- Belvédèreduinen - Belvédère	Noordduinen	xxx-2018	52.64	Pony, horse, cattle
Noord- Belvédèreduinen- Belvédère	Belvédère	xxx-2018	7.04	cattle
Schipgatduinen-Doornpanne-Hoge Blekker	Pylyserlaan	xxx-2018		(paard), rund
Ter Yde	Ter Yde s.s.	1998-2018	56.07	pony, sheep
Ter Yde	Hannecartbos	1994-2018	30.12	pony
Ter Yde	Oostvoorduinen	xxx-2018	15.82	Cattle, horse
Ter Yde	Labeurhoek	xxx-2018	5.73	Cattle, horse
Simliduinen-Groenendijk-Sandeshoved	Groenendijk	08-15	3.21	Cattle, pony
Schuddebeurze		xxx-2018	6.40	Cattle, horse
IJzermonding – Sint-Laureinsduinen	IJzermonding	99-04	41	sheep
Subtotal (ha) Flanders			**624.17 ha**	
Dune Dewulf	Dune Dewulf	05-09	19	pony
Dune Dewulf	Dune Dewulf	10-15	19	pony+sheep
Dune Dewulf	Dune Dewulf	17-..	23.4	pony+goat+sheep
Dune Marchand		95-02	wisselend	pony
Dune Marchand	centrale	02-15	23	pony
Dune du Perroquet	Dune du Perroquet	05-10	15	pony
Dune du Perroquet	Dune du Perroquet	11-14	15	pony+goat
Dune du Perroquet	Dune du Perroquet	14-15	15	pony+goat+sheep
Dune du Perroquet	Dune du Perroquet	17-..	6.6	pony+goat
Dune fossile Ghyvelde	s.s.	96-15	91.8	pony
Dune fossile Ghyvelde	Dune aux Pins	XX-15	6.4	sheep
Dune fossile Ghyvelde	Mahieu		20.2	
Dune fossile Ghyvelde	Debruyne	07-15	10.5	pony+goat+sheep
Dune fossile Ghyvelde	Dubois/ La Garenne	04-15	7.4	sheep
Subtotal (ha) France			**223.3**	
Total (ha)			**847.47**	

Table 3.6. gives an overview of the areas in which mowing 2015 (haymaking) as a recurrent management measure was used. In addition still considerable superficies are mowed to control regrowth of scrub after scrub removal and deforestation (e.g. 60 FTE-days in Flanders) or as a kind of soil impoverishing tool or to comply with legal obligations (including thistle control).

Belgian dunes	**32.4**
France	**23.7**
Totaal/Totale (ha)	**55.1**

5. Masterplan vision and operational objectives

The dunes of the Flandre-project area are an important biodiversity hotspot

Therefore the main question to solve is how to manage this area in a sustainable way in order to optimise coastal biodiversity vis-à-vis other requests e.g. recreation, drinking water production, coastal defence projects ...

The main nature conservation objectives are:

- Put conditions to ensure to protect and restore the typical mosaic of coastal dune habitat types in order to create opportunities for the conservation or re-establishment of populations of sensitive, coast specific plant and animal species (optimization of biodiversity);
    - Keep dune areas as large as possible in order to maintain heterogeneity and dispersion capacities (see e.g. A3-map 5.2a –b);
    - Strengthen or build ecological links between (almost) isolated dune complexes in order to mitigate barrier effects (fragmentation, (see e.g. A3-map 5.2a –b and 6.1a+b)).
    - Preserve and strengthen macro-gradients in the project area for instance:
        - sea-foreshore-dune gradient
        - dune-polder gradient

Those ecological transition zones are very important because they offer a lot of environmental variation which is essential to preserve coast specific and rare habitat and species (optimise biodiversity)

- Restore and increase abiotic heterogeneity by fighting against
    * water stress
    * eutrophication (Nitrogen & Phosphorus)

  And restore or create
    * salt environmental conditions

- Coordinate on the EU-nature conservation policy. This means prior protection and restoration of Eu-habitat (e.g. grey dunes and dune slack habitat) in order to enlarge their area and to enhance quality. This will imply:
    - To keep certain desired plagioclimax situations by restoration or conservation of target habitats
    - Several nature management measures such as deforestation, scrub removal, sod cutting, mowing, grazing,...
    - Restoration and conservation of populations of target species which will need for well-balanced species management plans.

Given the level of importance to conserve and restore 'fixed dunes with herbaceous vegetation or grey dunes (Eu-habitat 2130)', 'Dunes with *Salix arenaria'* (Eu-habitat 2170) and 'humid dune slacks' (Eu-habitat 2190) it will be essential to use techniques to restore open dune habitats in areas mainly covered by scrub whilst ensuring the conservation of all habitat types and landscape values (see e.g. A3-map 5.2a –b).. One of the major nature restoration measures foreseen in most nature management planning is the removal of scrubs from several locations. In order to enhance the establishment of the typical habitat communities, sod cutting of these places will be essential. Since the 1980s, the reduction of the populations of rabbits, which restricted the growth of trees and shrubs, has encouraged the installation of scrub, including sea buckthorn. The restoration measures

are to clear e.g. manually (pruning shears, saws etc.) or mechanically (brush cutters, tractors...) the adjacent areas of grey dunes or dune slacks.

Another major challenge is the preservation of natural dynamics at several dune areas. The option is to promote sand dynamics at least in well-defined parts of these dune areas. One of the current problems is the rapid succession in which Ammophila has fixed the sand, and the rapid invasion and spread of sea buckthorn (*Hippophaë rhamnoides*) forming dense and impenetrable thickets (see e.g. A3-map 5.2a –b).

Another important challenge for the beach-dune transition area is the installation of a zone with limited access (only accessible with a nature guide). These areas can be expected at certain places but will need a lot of convincing. Such measures can help in order to ensure favourable conditions for the nesting of the Crestedl ark (*Galerida cristata*) and the Meadow pipit (*Anthus pratensis*).

In order to protect beautiful areas of grey dunes from trampling and to encourage the populations of some vulnerable species of insects, such as *Bembix rostrata*, *Issoria lathonia, Oedipoda caerulescens* and *Hipparchia semele*, which all suffer from trampling by people or livestock dune areas with a significant area of this habitat can be excluded from grazing and recreational use.

As recurring management in most areas extensive grazing is foreseen. At all locations areas will be fenced to allow grazing with domestic stock (mainly horses and cattle in addition or sheep). In this way it is aimed that further scrub invasion and scrub regrowth would be controlled and the desired mosaic of low dune grassland with bare sand patches would be restored and maintained. Any regrowth not controlled by grazing stock could be treated later by cutting or mowing.
Last but not least, to ensure the conservation of the Great Crested Newt and of the Natterjack toad one will enforce the already existing network of fresh waterponds.

Other very important aims are:

- To preserve and develop specific (coastal) ecosystem services
- To be aware of the coast as a coping area in relation to future climate impacts
- Finally working together to achieve a robust cross-border natural structure by 2035
- Putting conditions to the sustainable accessibility for hikers, horse riders, cyclists and MTB to several dune areas

6. Action program

The operational objectives are translated into 15 main actions to be undertaken between 2020 and 2035. This 15 actions are summarised below.

1. Develop an appropriate planning framework

2. Extension to sea and connecting the dune areas

Formulate and execute a dynamic and useful plan to ensure sand and dune stability and ecological functionality by adopting several new techniques and insights in coastal defence.

- Extensions to the sea: Opportunities vis-à-vis the coastal defence
- (different techniques to adapt to the impacts of climate change) Various strategies are possible e.g. inserting artificial sand dune seawards of the current dune areas

3. Establishing a harmonized cross-border beach management

Points of attention:

- Zoning pelagic species activities;
- Promotion of ecological beach cleaning actions to preserve foreshore and embryonic dunes;
- Ridding plastics and other inorganic waste from the beach.

Perhaps the **outermost important action points** will contribute to the establishment of a high qualitative cross-border cross-border natural space between De Panne-Adinkerke and Bray-Dunes Ghyvelde (see A3-map 6.1 a+b). Three sub-actions are recognized dealing with:

4. The Perroquet-Westhoek dune area

Aim: Restoring the physical connection of the "Dunes du Perroquet" and Westhoek in view of the ecological recovery of the northern border zone. Therefore one should foresee:

- Acquisition of new dune area and mobility of land ownership;
- Develop a management plan to establish a physical connection between both natural dune areas;
- Run scenario according to a predefined plan in order to be able to remove existing recreational facilities from this dune area

5. Pseudo polder area (in between the Perroquet-Westhoek dune area and the so called fossil dunes of Ghyvelde-Adinkerke)

Aim:

- The development of a cross-border, massive natural area with a rich biodiversity, as a result of a large-scale nature development measures aimed to bring to the surface the existing environmental variation (soil texture, specific water level and water quality (brackish-fresh water…); This means that soil, geological and hydrological conditions will largely shape the future natural environment

- The development of a robust cross-border, natural structure to provide additional space and opportunities for sustainable recreational use (hiking, biking, horse riding, fishing, canoeing ...) perhaps including the limited implantation of recreational infrastructure (natural campsite, pick nick area ...).

Therefore one should foresee:

- Acquisition of polder area and mobility of land ownership;
- Management contracts for farmers;
- Recreational opportunities (infrastructure);

6. Cross-border fossil dune area of Ghyvelde and Adinkerke

Aim:
Review and harmonize existing management plans e.g. is it possible to organise cross-border grazing management etc.
Taking measures to redevelop the Maerestraat as an important recreational axis

• prioritization of soft modes of transport;
• reduce speed of motorized vehicles (30km/h) and give priority to hiking and biking
• Promoting a shared space for recreational use by reducing the impact of the paved road.

Also involve an take into account the Veldstraat (Adinkerke) and the Rue de la Frontière (Ghyvelde) in this strategy.

7. Optimize natural richness in dune areas

- Create more open dune area in order to be able to conserve and restore 'fixed dunes with herbaceous vegetation or grey dunes (Eu-habitat 2130)', 'Dunes with *Salix arenaria'* (Eu-habitat 2170) and 'humid dune slacks' (Eu-habitat 2190). Therefore it will be necessary to apply several specific nature conservation and development techniques such as removal of scrubs, sod cutting, mowing of restored places to prevent regrowth of scrub and trees (see e.g. A3-map 5.2a –b).

- Connect micro-territories in the open dunes within existing dune area in order to facilitate the movement of species which are specific to these open dune areas as well within as between them. Such species specific measures will contribute to the restoration and strengthening of populations of vulnerable insects and other arthropod specis, such as *Bembix rostrata*, *Issoria lathonia, Oedipoda caerulescens* and *Hipparchia semele*, which all suffer from fragmentation of open dune area.
  Some of these species also suffer from trampling by people or livestock. Therefore certain dune area has to be excluded from grazing and recreational use.

8. Fight against non-native invasive species

More and more species are introduced outside their natural geographic range due to the increasing rate of trade in the world. Some of them are able to establish in their new environment and to develop dense populations where they can outcompete native species or disrupt ecosystem functioning. They are called invasive alien species. An eclectic spectrum of management or control actions has been developed and used against these species, with adaptations to local realities and

conditions. One of the main management actions is the eradication of such species as Populus alba/canescens, Prunus serotina, Mahonia, Rosa rugosa… Priority is given to the restoration of vulnerable Eu-habitats e.g. grey dunes, mobile dunes etc.

9. Develop nature and landscapes in the transition areas between the dunes and the polders

This action aims to preserve the unique but rare dune-polder transition zones and establish a robust natural structure along the inner dune ridge which will serve as an ecological connection between isolated dune fragments (see A3-map 6.1 a+b and 5.2a –b)). These transition zones often show a rich variety of environmental gradients, eg. mineral / humus, dry / wet, chalk / lime content, sandy / clayey and salty / fresh water. Within the polder-dune transitional area several kinds of habitats may be presented. Besides European protected habitat types (in 2190 and some 2130) there will also be regionally important habitats (*Cynosurion* and *Lolio-potentillion* vegetation communities). Furthermore these areas can be developed as a foraging, resting and wintering area for wetland birds and should offer suitable habitat are for amphibians especially for the great crested newt and the natterjack toad.

The size of some areas offer unique opportunities to bring alive the underlying abiotic variety in a sustainable way, provided a judicious development and management. Two focus areas are shown on each of both maps below.

Dune Dewulf & Marchand (France)

Lenspolder-Labeurhoek-Hemmepolder-Schuddebeurze (Koksijde-Nieuwpoort, Belgium)

10. Defragmentation of the dune landscape creating and optimizing ecological connections

One of the radical changes to the landscape of the past century is its high degree of fragmentation caused by the creation of lots of transportation infrastructure while urbanisation rapidly increased the built over area. Habitat fragmentation, the splitting of natural habitats and ecosystems into smaller and more isolated patches, is recognised as one of the most important global threats to the conservation of biological diversity. Therefore it is needed to fully restore the physical connection

between nature reserves by setting up a defragmentation action program that will eliminate barriers or mitigate the effects of these barriers (see A3-map 6.1 a+b).
The application of specific ecological infrastructure may help to physically reconnect habitat or will facilitate movements between nature areas by target species themselves. One should however keep in mind that the implementation of ecological infrastructure has to take into account the specific needs of targeted butterflies, amphibians, bats, dormouse ... For this purpose, however, a species-specific preparatory research and recommendations are necessary.

11. Promote a nature friendly (sub) urban environment

Gardens and roadsides can offer opportunities to create small scaled habitats for several target species if provided with adaptive equipment and management. This can be an aim of low-treshold civic action encouraging "garden complexes with natural value" by municipal, regional and provincial governments:
• Valorisation of the "garden oasis" as a “surplus natural area”:
• Developing “green deal gardens”, require a strategic approach for their development, planning and management. This approach should take into account specific coastal biodiversity.

12. Optimize the possibility of landscape ecological connections of some linear infrastructure

12.1. *Landscaping of* motorway *A16-E40*
Along motorway A16_E40 many public domain occurs that can be ecologically valued and optimized provided an appropriate design and future nature management. Specific actions should be part of an overall defragmentation plan, should avoid car-animal collisions, and should mitigate the effects of ecological barriers.

12.2. Nieuwpoort-Dunkirk canal
• Manage harmonized way the banks and embankments on both sides of the border
• Create ecological continuity with the peripheral aquatic environments
• Optimize transverse passages for wildlife not flying

12.3. Abandoned railway functioning as an open window on the dune area (with special attention for the dormouse as a target species: species action plan “Dormouse”)
- Combating and eradication of invasive alien species and
- Creation of 'Gardens dormouse' for individuals (orchards, dead wood, bird houses ...)
- Creating nodes discovery peripheral spaces since the green channel

13. Cross-border cooperation for nature-oriented outdoor recreation and environmental and nature education.

• Developing cross-border cycling, hiking, riding and possibly canoe routes.
• Working around recreational infrastructure, possibly developing a common corporate identity
• Development of bilingual nature educational information tailored to the area

14. To cooperate across the border for monitoring target habitats and species

On both sides of the border, there is interest in cross-border cooperation on approach, exchange and processing of data relating to the monitoring and evaluation of the effects of dune management. Because of the French partners, in particular the CRP, but also CERL and the D-59 has specific interest and admiration for the thorough monitoring of groundwater dynamics through an extensive network of piezometers in most Flemish dune nature reserves. This also applies to the geographical processing and interpretation of topographical data in a GIS environment (DTM and aerial photo interpretation linked to groundwater levels and (potential) vegetation development).

In terms of biodiversity, in particular the monitoring of the state of European protected species and habitats exist on both sides of the border interest in the exchange of knowledge and information. It thereby both the exchange of information on applied management techniques and their effects as the effective monitoring (cross-border) population dynamics of species in a cross-border context.

A monitoring programme will give valuable information about the effectiveness of the different nature restoration projects. Monitoring could furthermore include floristic inventories, vegetation surveys, groundwater measurements, specific observations and analysis of populations of rare and target species especially birds, butterflies, grasshoppers, amphibians and bats.

15. Establish an organizational structure and border management

This master plan provides an insight into the needs, policy objectives and an action program which includes an assessment of the organizational and financial resources. The establishment of a cross-border management unit will

- Improve cross-border cooperation
- Need the installation of a project housing office
- Need for the project office 4 FTEs employees for coordination (master) and
- 2 FTEs for administrative and technical support (bachelor)