

Sledgehammers, cranes and bulldozers: restoring dunes and marshes by removing buildings and soil

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Abstract

Flanders has the most urbanised coastline of Europe, north of the Pyrenees and the Alps. During the 20th century seaside resorts grew to one another to finally form one urban agglomeration from the Dutch to the French border, only locally interrupted by some rather small not built up areas of dunes. However even the remaining and legally protected 'natural areas' often include buildings, roads or even dredging sludge dumps. In this situation of an extremely damaged and fragmented natural environment, management by mowing and grazing is not sufficient to restore it to a satisfactory level. Open space and physical conditions have to be restored in order to create chances for the redevelopment of natural habitats and wild species. In this paper an overview is given of the most important nature restoration works that have been or are currently being carried out by the Nature Division along the Flemish coast since the year 1995. These projects include: (1) the demolition of the buildings of the former children-home 'Georges Theunis' - to reactivate large scale sand drift (1995) and the removal of a soil dump - to recreate a wet dune slack (1997) in the Flemish Nature Reserve 'Ter Yde' at Oostduinkerke; (2) the digging off of soil dumps and the excavation of a former raceway - to restore decalcified fossil dunes (1997-2000) in the Flemish Nature Reserve 'D'Heye' at Bredene; (3) the complete demolition of the former military harbour and the digging off of the dredging spoil-dumps - to restore mud flats, salt marshes and sand dunes (1999-2003) in the Flemish Nature Reserve 'The Yzer-rivermouth' at Nieuwpoort; (4) the demolition of the former 'Swimming Pool' - to create a pond, a wet dune-slack and grey and white dunes (2004) in the Flemish Nature Reserve 'Zwin-dunes and polders' at Knokke; (5) the demolition of the former sewage treatment plant of Nieuwpoort - to restore calcareous marshland and humid dune slack areas (2004-2005) in the fossil beach-plain of the regional nature domain 'Groenendijk'. The paper describes how these projects have been conceived, planned, prepared and finally executed and, if the necessary data are already available, it compares their results with their initial objectives concerning stimulating natural processes and increasing biodiversity. All the concerned sites are included in the proposed Special Area for Conservation 'Dunes including Yzer-rivermouth and Zwin' which has been proposed under the European Habitat-directive 92/43/EEC. All the above mentioned projects aim at an active implementation of this directive. Although it is more economic to demolish constructions than to restore them, such large scale demolition- and ground-works are relatively expensive in proportion to the rather limited budgets which are available for nature conservation. EU financial contribution was obtained under the LIFE nature - projects 'Integral Coastal Conservation Initiative' (ICCI) and 'Fossil Estuary of the Yzer-Dunes Restoration Action' (FEYDRA).

It has been of significant importance to facilitate the dismantlement of the military harbour and the demolition of the sewage treatment plant, both of which were situated at Nieuwpoort.

Keywords: Nature restoration; Demolition of buildings; Earthworks; Flemish coast. LIFE.

Introduction

Common measures of nature management include mowing hayfields, cutting down shrubs and trees and grazing by stock, cattle or horses. Along the Flemish coast these methods, based on traditional agrarian activity are generally applied in nature reserves. . Nevertheless, the urbanisation of the Flemish coast has reached such a high degree that restoring the natural environment to a satisfactory level in the remaining coastal dune areas requires more drastic measures. Of the 38 remaining legally protected coastal areas, consisting mainly of dunes and sometimes including adjacent salt marshes and polder areas, only two areas have a surface area exceeding 500 ha, while 23 areas have a surface area of less than 50ha (De Loose *et al.*, 1996). Most of these protected areas are still cut through by roads and contain isolated buildings or clusters of buildings. On some sites the ground level has been raised, on others the natural relief has been levelled off. In certain cases demolition of buildings, roads and earthworks is necessary to restore natural processes and habitats. Since 1996 the scientific inspiration for such nature development and restoration projects along the Flemish coast is provided by the Ecosystem Perspective for the Flemish Coast (Provoost *et al.*, 1996) which includes orientations for nature development in the remaining natural areas. This paper reviews the most important projects that have been or are being carried out since 1995 for conservation purposes along the Flemish coast (Fig. 1).

The projects are described according to the chronology of their execution. All the described projects are situated within the limits of the special area for conservation 'BE 2500001 Dunes including the Yzer-Rivermouth and the Zwin' which, on the basis of the 'European Habitat Directive', is included in the list of areas of Community importance.

Review of the major nature restoration works along the Flemish coast

(1) Ter Yde at Oostduinkerke (municipality of Koksijde)

With its surface area of 261ha, Ter Yde is one of the three largest remaining dune-areas of the Flemish coast and one of the very few places where sand drift on a quite large scale is still possible. This site has a very varied landscape consisting of fore-dunes, high parabolic dunes formed in the wake of a large drifting dune-front, a largely afforested fossil beach plain (the 'Hannecartbos') and medieval low 'hedgehog-dunes'. Until the early 1990's a 16ha large part of Ter Yde was owned by a children's' care organisation. On this private estate a gigantic building, the Home Georges Theunis, was erected in the 1930's, on top of a high dune (Fig. 2a). This building was four storeys high, with a base-area of 1ha and foundations to a depth of 8m below ground level. After a fierce public discussion about a new usage for the huge building, which lasted from 1989 to 1994, the

ownership of the estate was transferred to the Nature Development Service of the Flemish Region in 1994. In April 1995 the Flemish minister of the Environment ordered its demolition to restore the original, once drifting sand dunes which it was built upon.

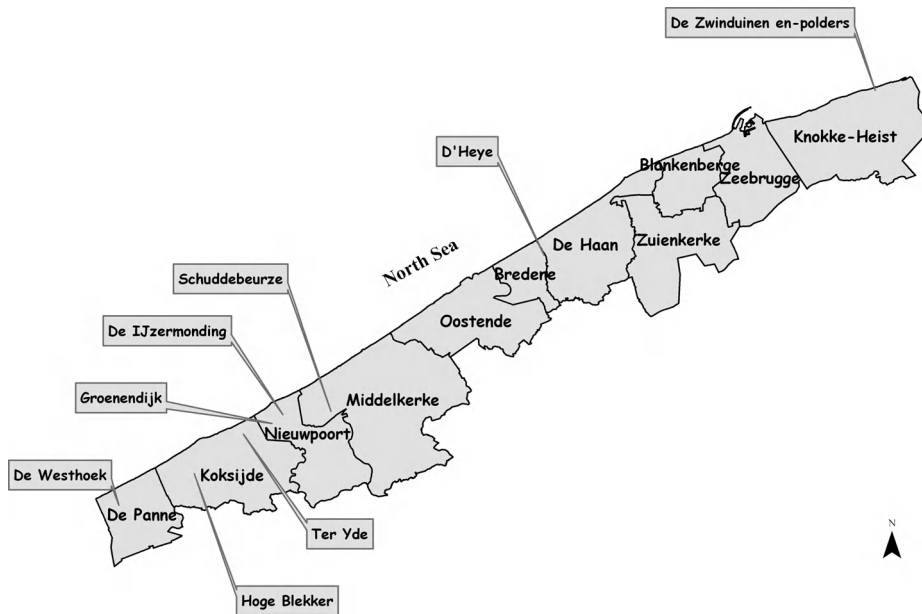


Fig. 1. Location of the most important demolitions and earthworks for conservation purposes along the Flemish coast.

This decision is considered to be a historical turning point in the coastal conservation policy of the Flemish government. After the demolition, the 2m thick upper layer of soil on the demolition site was sifted through a sieve with a mesh of 10mm x 10mm to get rid of stone fragments. After a couple of years, an armoured soil surface formed itself by the accumulation of stone fragments that were too small to have been removed by the sifting. The reactivated sand drift that had been one of the purposes of the removal of the building stopped. The rather flat surface of the former demolition site was since then gradually being colonised by Biting Stonecrop (*Sedum acre*), *Erodium glutinosum*, Sand Cat's-tail (*Phleum arenarium*) and other pioneer species of arid sandy and rocky soils (Fig. 2c). Two of the main potentialities of the Ter Yde site that are mentioned by the Ecosystem Perspective (Provoost *et al.*, 1996) are the occurrence of a quite large sand drift and actually humid dune slacks. The management - plan of the Flemish Nature Reserve Ter Yde (Van Nieuwenhuysse, 2003), that was approved by ministerial order in 2003, sets out that the dune-hill of the former Home Georges Theunis - building should be excavated into a bowl-like shape in order to reactivate large scale sand drift again. These earthworks will now soon be carried out. Also to stimulate the pursued sand drift, in 2004 Sea buckthorn (*Hippophae rhamnoides*) scrubs have been mechanically

removed from the opposite slope of the same dune over a surface area of 2.8ha. The litter and the upper soil-layer that was enriched with organic material were also mechanically removed to denude the mineral sand. The removal of scrub here is a part of the Life nature - project 'FEYDRA' (abbreviation of 'Fossil Estuary of the Yzer Dunes Restoration Action').



a.



b.



c.

Fig. 2. Ter Yde at Oostduinkerke: a. The Home George Theunis; b. The demolition of the Home George Theunis in 1995; c. The site of the Home Georges Theunis in 2004.

The main target habitat of these works on the dune of the former Home Georges Theunis building is '2120 Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)'.

The estate also included a 50 years old Pine- and White poplar- plantation on the site of a former dune slack which was artificially raised with superfluous soil from the construction of the adjacent road. In 1997, in agreement with the Life nature - project 'ICCI' (abbreviation of 'Integral Coastal Conservation Initiative'), the exotic trees were removed and the heightened ground on which they had been planted was excavated to the average height of rise of the groundwater level, in order to restore the original humid dune slack (code 2190) over a surface of 0.5ha. Within three years after the excavation a wet dune slack vegetation with amongst others Grass-of-Parnassus (*Parnassia palustris*) and Marsh Helleborine (*Epipactis palustris*) had developed.

(2) D' Heye at Bredene

The rather small Flemish Nature Reserve D' Heye (20ha) is situated on the relic of a fossil, decalcified dune-tongue that penetrates 2.5km into the polder area. The Flemish Region acquired the land in 1996. The Ecosystem Perspective for the Flemish Coast (Provoost *et al.*, 1996) mentions the following potentialities for nature development in the fossil dunes of Bredene:

- strongly dried up (by the water extraction, which should end in 2005), but potentially humid dune site;
- grasslands of decalcified dunes;
- possibility for nature development by cutting sods or excavations and restoration of relief after the restoration of the hydrology.

A management plan was ordered by the Nature Division of the Ministry of the Flemish Community and drawn up in 1997 (Econnection, 1997). The plan gives a further interpretation of the Ecosystem Perspective.

According to the management plan the following works were carried out:

- The former horse raceway, which was levelled off in the 1920's, and had been heavily fertilised, was dug away up to the mineral substrate in 1997. A volume of 1,450m³ of soil that was enriched with organic material was removed from the site.
- Between September 1999 and January 2000 (Fig. 3):
 - a former depression that had been filled up with sand, was dug out again over a surface area of 8,400m²; also two ponds were excavated.
 - a levelled off and too strongly fertilised area was excavated at the same time over a surface area of 9,200m².



Fig. 3. 1999: The excavating of a fertilised area in D'Heye at Bredene to restore '2190 humid dune slacks' and '2150 EU-Atlantic decalcified fixed dunes (*Calluna-Ulicetea*)'.

The dug out soil from both locations was spread out over a zone containing the stony remnants of a tramway and demolition material from bunkers with a total surface area of 2.2ha. The displaced earth was spread in such a way that a slightly undulating relief was created. About 8,200m³ of soil was displaced within the framework of these nature restoration works. Target-habitats of this project were '2190 Humid dune slacks' and '2150 EU-Atlantic decalcified fixed dunes (*Calluna-Ulicetea*)'. The results obtained are satisfactory and include the appearance in the excavated areas of Three-nerved Sedge (*Carex trinervis*), Glaucous Sedge (*Carex flacca*) and Lesser Centaury (*Centaureum pulchellum*) on lime rich soils and Heath-grass (*Danthonia decumbens*), Tormentil (*Potentilla anglica*), Oval Sedge (*Carex ovalis*) and *Montia minor* on decalcified soils. Even the vegetation of the area that was heightened with the excavated soil includes plant species that are typical for decalcified fossil dunes, such as Broom (*Cytisus scoparius*) and Gorse (*Ulex europaeus*).

(3) The Yzer - rivermouth at Nieuwpoort (Deboeuf *et al.*, 2002)

The Yzer is the only river that flows into the North Sea along the Belgian coast. The map published by "Le Dépôt de la Guerre", edition of 1876 shows that in 1860 the eastern bank of the Yzer-rivermouth was still pristine and consisted of a sandy beach, mudflats, salt marshland and dunes. The western-bank was already consolidated since medieval time and bordered on a large dune area which was not yet built-up. During the 20th century the dunes on the western bank of the Yzer-rivermouth got completely urbanised by the development of the seaside resort of 'Nieuwpoort-Bad'. In the years 1950-1970, a military harbour was established on the eastern bank (Fig. 4) and the remaining salt marshes and dunes were covered with 300,000m³ of dredging sludge.



Fig. 4. Aerial photograph of the Yzer-rivermouth in 1957 and 2004.

In 1993 the Ministry of Defence announced that the Naval Basis of Nieuwpoort would be sold off. To prevent real estate speculation, the former Naval Basis was designated as a 'protected dune site' within the framework of the Decree on the Protection of the Coastal Dunes by Order of the Flemish Government of November 16, 1994. In 1995 its status on the Town and Country Planning Map was changed into "natural area with scientific value". To implement the several protection-statuses of the Yzer-rivermouth area, a plan for the restoration of its natural habitats was commissioned by the Nature Division of the Ministry of the Flemish Community to the University of Ghent. This 'Nature Restoration Plan for the Yzer-rivermouth' was finalised in 1996. The former Naval Basis was transferred from the federal Ministry of Defence to the Flemish Region in December 1998. Finally the area of the 'Yzer-rivermouth' was designated as a 'Flemish Nature Reserve' by the Ministerial Order of March 3, 1999. The specifications for the demolition of the former military harbour were deduced from the 'Nature Restoration Plan for the Yzer-Rivermouth' by a contracted civil engineering consultant. The Ecosystem Perspective for the Flemish coast (Provoost et al., 1996) identified transitions between salt-marshes and dunes and the possibility of restoring mud flats and

salt marshes by excavation as main potentialities for nature development at the 'Yzer-Rivermouth'. Target habitats of the project are: '1130 Estuaries', '1140 Mudflats and sandflats not covered by seawater at low tide', '1310 Salicornia and other annuals colonizing mud and sand', '1320 *Spartina* swards (*Spartinion*)', '1330 Atlantic salt meadows (*Glauco-Puccinellietalia*)', '2120 Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)' and '2150 Fixed dunes with herbaceous vegetation (grey dunes)'.

The execution of the Nature Restoration Plan was split up in four phases:

Phase 1: the 'dry works' or demolition of the buildings and roads of the former Naval Basis. These works started on September 13, 1999 and ended on January 28, 2000. They consisted of the removal of: asbestos; a total volume of 50,000m³ of buildings; a total surface of 14,000m² of concrete roads; a total length of 3,600m of pipes.

Phase 2: the 'wet works' or the removal of the jetties and quays of the former Military harbour (Fig. 5). Those works started on 18 September 2000 and ended on 18 March 2001. The 'wet works' consisted of the removal of:

- eight jetties consisting of wooden and concrete stakes and gangways;
- 1.3km of bank revetment in blue stone and sheet piles (with a surface of 20,200m²);
- a slipway for 500 ton ships;
- a surface of 4,500m² of concrete roads.

Also a volume of 178,000m³ of soil was dug out, of which 35,000m³ was transported to destinations outside the nature reserve. The remaining volume of sand that was excavated from the quays around the slipway was used for creating dunes above the pits left by the removal of the buildings ('dry works').



Fig. 5. Phase 2: the 'wet works' or the removal of the jetties and quays of the former Military harbour.

Phases 3 and 4: the digging away of 333,000m³ soil from the dredging sludge dump, of which 275,000m³ were transported to destinations outside the nature reserve. The remaining volume of soil was used to reinforce the coastal defence around the restored tidal area. The works started on January 14, 2002 and ended on March 2, 2004.

The first two phases were realised with the financial support of the European Community in the framework of the LIFE Nature – project ‘ICCI’. The removal of the former military harbour and dredging sludge dump allowed the restoration of about 50ha of tidal habitats and coastal dunes (Fig. 4). The first summer after the dismantlement of the military harbour and after the excavation of the dredging soil dumps, Glasswort (*Salicornia spp.*) and Annual Sea-blite (*Suaeda maritima*) already quite massively appeared on the soil-substrate which once more had come under tidal influence after the excavation of previously raised areas. The restoration of mud and sand flats have also resulted in a significant increase in the numbers of foraging Dunlin (*Calidris alpina*), Great Ringed Plover (*Charadrius hiaticula*) and Redshank (*Tringa totanus*) (Devos *et al.*, 2004) and also of resting Sandwich Terns (*Sterna sandivencis*) and Common Terns (*Sterna hirundo*). The natural development of the site after the works has been monitored by a multidisciplinary scientific project, called MONAY (abbreviation of MONitoring NATure - restoration at the Yzer-rivermouth).

(4) The Zwindunes and -polders at Knokke-Heist

The Flemish Nature Reserve 'The Zwindunes and -polders' has a surface area of 222ha and is situated within one of the two largest remaining natural areas of the Flemish coast. 'The Zwindunes and -polders' consist mainly of rather low coastal dunes and a large fossil beach plain that were cut off from marine influence in the second half of the 19th Century. The Flemish Region acquired the land in 2002. In the north-western corner of the site a vast Swimming Pool - complex (Fig. 6a) with a surface area of 3.5ha was derelict since 1980. The Swimming Pool - complex was built in the years 1950-1960 and was, at its time, made to Olympic standards. It included the large building of an indoor swimming pool and an open-air swimming pool, and also lots of bitumen pathways and asbestos pipes. The Ecosystem Perspective for the Flemish Coast (Provoost *et al.*, 1996) mentions the removal of infrastructure as a possibility for nature development at the former Swimming Pool-site.



Fig. 6a. The Swimming Pool – complex.

Having learnt from previous experiences, especially the poorly prepared demolition of the Home Georges Theunis building, the preparation of the demolition and earthworks for the former Swimming Pool was contracted out to an engineering consultant. Of course the target habitats were determined by the Nature Division on the basis of the potentialities offered by the area itself:

- the open-air swimming pool, which reached a depth of 5m below ground level, was taken out and replaced by a permanently inundated pond that corresponds with '3140 Hard oligo - mesotrophic waters with bentic vegetation of Chara formations' (Fig. 6b);
- fountains and the soil underneath them were removed to create humid dune-slacks (code 2190);
- the pathways and indoor swimming pool were demolished and the original sandy soil underneath was planted with Marram grass (habitat '2,120 Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)') or covered with sods of dry dune-grassland that had previously been removed over a surface of 4,450m² and put apart [habitat '2,130 Fixed dunes with herbaceous vegetation (grey dunes)'].



Fig. 6b. The demolition of the Swimming Pool-complex.

Just to give an idea of the extent of the project, it included the removal of:

- 18,000m³ of construction-material of the indoor-swimming pool:, of which 4,000m³ below the ground level;
- 3,125m³ of construction-material of the open-air swimming pool;
- 150m³ of construction material of the outbuildings;
- surface of bitumen pathways: 850m²;
- surface of concrete hardening: 2,050m²;
- length of underground pipes: 1,350m.

The landscaping of the demolition site into more natural looking dunes also required the felling of 500 Pine- and Poplar-trees, the removal of Sea-Buckthorn thickets over a surface of 6,800m², the displacement of 12,000m³ of soil and the plantation of 2,500 indigenous trees and shrubs.

The works were executed between January 10, 2004 and April 1, 2004. The first results during the vegetation season 2004 were encouraging (Fig. 6c). Pioneer water plants such as Lesser Pond-weed (*Potamogeton pusillus*) and Common Water-crowfoot (*Ranunculus aquatilis*) quickly colonised the pond. On its shore Sea-Milkwort (*Glaux maritima*) and Saltmarsh Rush (*Juncus gerardii*) appeared, probably as a result of a local persistent seedbank. The newly dug out dune-slack was rapidly colonised by, among others, Lesser Centaury (*Centaureum pulchellum*), Seaside Centaury (*C. littorale*) and Knotted Pearlwort (*Sagina nodosa*). On the higher and dryer grounds upon which sods had been spread out, a mostly rough vegetation of plants developed that are typical for wastelands on lime-rich soils such as Perennial Wall-rocket (*Diplotaxis tenuifolia*), Evening-primroses (*Oenothera div. spp.*), Great Mullein (*Verbascum thapsus*) and Common Stork's-bill (*Erodium cicutarium*). A further change towards dry dune-grasslands is expected in the area where sods were spread.



Fig. 6c. On the former location of the open-air swimming pool a permanently inundated pond was built. This habitat corresponds with '3140 Hard oligo-mesotrophic waters with benthic vegetation of Chara formations' (situation in September 2004).

(5) Groenendijk at Nieuwpoort

'Groenendijk' is the name of a fossil beach plain that in the 14th Century still was a part of the estuary of the river Yzer. Probably around the 16th Century this beach plain was definitively cut off from the sea by the formation of high dunes. Originally the now largely afforested plain, the so-called 'Hannecartbos', in 'Ter Yde' and the cultivated plain of 'Groenendijk' were both parts of the same beach plain, but got spatially separated from each other by the development of holiday-villages and camping grounds in the second half of the 20th Century. In the 1950's a water treatment plant was built here (Fig. 7a). The water treatment plant was closed down in 1996. The lands of the derelict water treatment plant, with a surface area of 5ha, were purchased by the Flemish Region in 2002.



Fig. 7a. A part of the derelict water treatment plant at Groenendijk.

The humid hayfields that remained were heavily fertilised for many years in the past. Nevertheless after a couple of years of management by mowing and grazing without fertilizing, the biologically valuable humid dune-slack vegetation has already been able to restore itself to such a degree that species like Tubular Water-dropwort (*Oenanthe fistulosa*), Ragged-Robin (*Lychnis flos-cuculi*) and Western Marsh-orchid (*Dactylorhiza majalis*) have reappeared.. An old record of Creeping Marsh-wort (*Apium repens*) on the site or in the immediate surroundings underlines the potentialities of the area. The Ecosystem-perspective for the Flemish Coast (Provoost *et al.*, 1996) mentions the following potentialities for nature development:

- site with estuarine origin;
- actually humid dune site and presence of seepage;
- 'old' dune slack vegetation;
- possibility to restore open space and nature development by cutting sods or excavations and restoration of relief.

The rare geomorphologic formation of a fossil estuarine beach plain and the potentialities of its lime-rich soil and typical hydrology for the restoration of a calcareous marshland, led to the decision to demolish and remove the buildings and infrastructure of the water treatment plant. Within the framework of the LIFE nature - project 'FEYDRA', the elaboration of the specifications of the works was again entrusted to an engineering consultant. These specifications were based on the target habitats and species that are determined by the Nature Division in accordance with the 'European Habitat Directive': '3140 Hard oligo-mesotrophic waters with benthic vegetation of Chara formations', '2190 Humid dune slacks', '2170 dunes with *Salix arenaria*', Creeping Marsh-wort (*Apium repens*) and Crested Newt (*Triturus cristatus*).



Fig. 7b. The demolition of the derelict water treatment plant at Groenendijk.

The works started on the 11 January 2005. These works involve the removal of 810m³ of polluted sludge, 2,042m² of uild-up area, 5,100m² of concrete surface, 620m of pipes, and a displacement of soil of 30,910m³ (Fig. 7b). As part of the LIFE nature-project 'FEYDRA' a multidisciplinary scientific monitoring-project is carried out to study the natural development of the demolition site.

(6) Smaller works

Besides the 'large scale' works that have been reviewed above, a number of 'smaller' demolition works were carried out in order to rid coastal dunes of disturbing buildings: the villa 'La Cigogne' on top of Flanders' highest dune, the 'Hoge Blekker' in Koksijde (2000), two small 'twin dwellings' on the fossil dunes of Westende (2005), the derelict 'Halewyck' -farmhouse on the fossil dunes of Bredene (2005) and the derelict villa 'Mosselkot' on a dike of the nature reserve 'Yzer-Rivermouth' (2005).

Conclusion

Although in most cases it is not possible to restore the original habitat in its entirety, the removal of buildings, roads and (alien) soil allows for improvement of abiotic conditions, and for the development of biologically valuable natural habitats. Demolition

and excavations have become quite common and are well accepted, even indispensable tools for nature restoration along the Flemish coast. A thorough investigation of the potentialities and the precise inventory of the actual fragile nature values of the sites to be restored, form an essential part of the elaboration of the specifications for the works which are to be carried out. The European co-funding by LIFE - nature of two projects has given an important impulse for the nature restoration policy of the Flemish Region and is gratefully acknowledged.

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