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The Interreg IVB North Sea Region Programme

<u>WP5 Measures</u>

Basic analysis reports

Measure nr° 17. Paardenschor wetland - small scale brackish tidal wetland restoration in the Sea Scheldt (Zeeschelde)

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1 Description of measure

- Measure Category: Biology/Ecology
- Estuary: Scheldt
- Salinity zone: Mesohaline
- Pressure: Habitat loss and degradation
- Status: Implemented (in 2003-2004)
- River km: Scheldt-km 58-71; TIDE-km 89-99
- Country: Belgium
- Specific location: Sea Scheldt, Flanders, province Antwerp, Beveren, between Zoetenberm and left bank of Scheldt, north of nuclear plant Doel
- Responsible authority: Antwerp Port Authority
- Costs: /
- Cost category: > 5,000,000 €

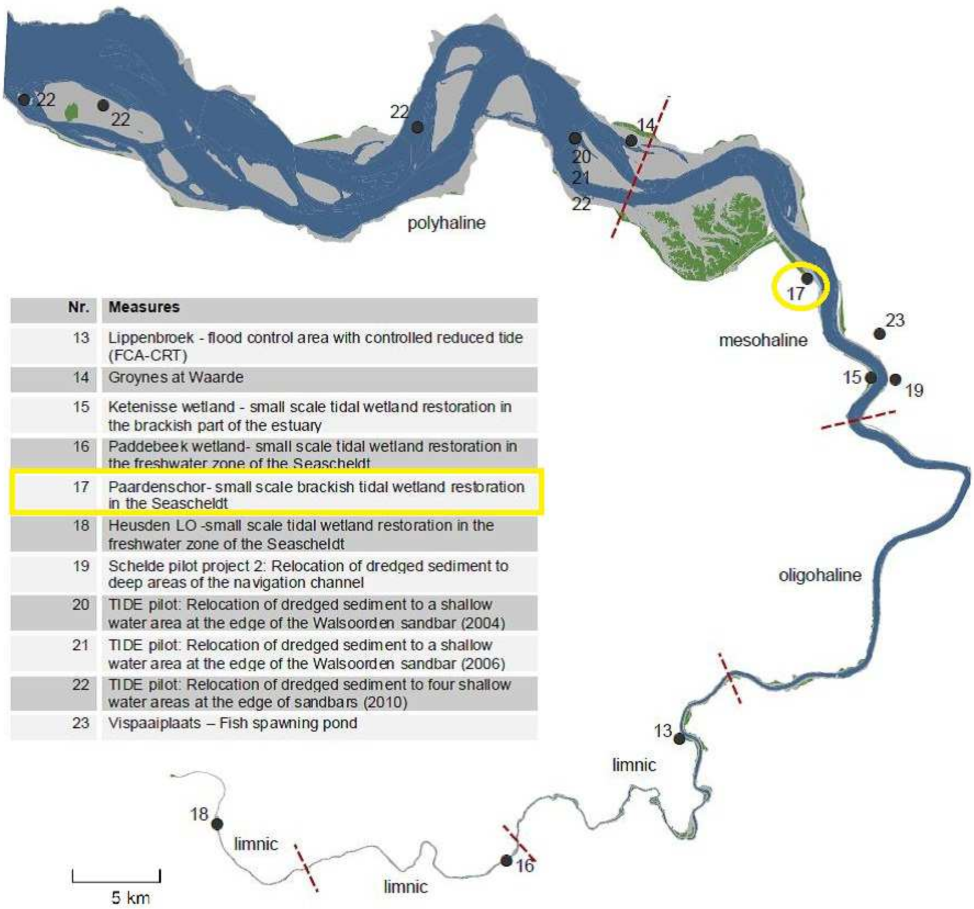


Figure 1. Location Paardenschor wetland

Figure 2. Air views tidal wetland Paardenschor

1.1 Measure description

The restoration of the Paardenschor was a compensation measure for lost intertidal marshes by building a new tidal dock (Deurganckdok) in the Port of Antwerp. To restore the Paardenschor, an area of 12ha was separated from the inland by the construction of a new dike (Sigma dike 11mTAW) and the area itself was lowered (had been elevated for the building of the nuclear plant in Doel in the 1960s and was diked in the 1980s, but there was never built on it). A faint slope was created between 5m TAW and the level of the mudflat already in front of it, to create a good situation for marsh formation. The new dike was constructed next to the old dike and afterwards the old dike was excavated. This site resembled a breached site because some existing tidal mudflats remained between the river and the restored area.

Developing this kind of habitat is expected to contribute in de reduction of tidal energy, increase of flood protection, improvement of oxygen condition, improvement of nutrient conditions, and improvement of self-purifying power.

Analysis of the evolution after restoration fits in with the decisions about the Development outline 2010 and Long Term Vision 2030 (Dutch and Flemish agreement on integrating accessibility, naturalness and flood safety) and the updated Sigmaplan (Flemish plan for flood protection combined with ecological objectives), of the Dutch and Flemish governments, that committed them to leap forward with the ecological rehabilitation of the Scheldt estuary. An important challenge is the creation of tidal wetlands by transformation of woods or agricultural land into tidal mudflats and marshes. In order to assess the feasibility and to identify possible problems any similar small scale projects already in place, such as Paardenschor, are studied in detail to improve our apprehension of the larger scale future plans.

1.2 Monitoring

The monitoring program is still in progress. In 2011 a second report on the project monitoring for the period 2006-2009 was published (Speybroeck et al. 2011).
The monitoring program is included in the global monitoring of the Scheldt estuary (Moneos) plus monitoring of variables that give information about evolution and success of restoration, most intensively immediately after restoration with declining frequency thereafter. At each of the project sites changes in geomorphology, sediment characteristics, sediment quality, vegetation, macrozoobenthos, avifauna and fish were studied in the first years after restoration. Eight monitoring locations were used on the Paardenschor for sampling sediment and benthos (Figure 3).

Figure 3. Overview of Paardenschor with monitoring locations: restored site of the Paardenschor (DO1-DO3) and original mudflat (DO4-DO5). Orthophoto of January 2009.(Speybroeck et al. 2011)

Changes in geomorphology (sedimentation and erosion) were evaluated on three different spatial scales: locally with sedimentation/erosion plots ('sederplots'), along trajectories perpendicular to the river with Real Time Kinematic-GPS and full cover with LIDAR (Laser Imaging Detection And Ranging) and aerial photography (DTMs - Digital Terrain Models). A Riegl scanner was used for studying geomorphological changes. Changes in the creek pattern were studied using orthophotos. Other aspects that were monitored primarily during the first years after restoration were: development of vegetation, sediment quality (grain size, % organic, pigment concentration (chlorophyl a), fysicochemistry), colonisation by macrozoobenthos (including oligochaeta), fish, and the use of the area by water birds. These developments were compared as much as possible to the situation on nearby tidal wetlands.

1.3 Monitoring results

1.3.1 Geomorphology

The sedimentation-erosion trend on the Paardenschor did not change significantly in the first years after the restoration (Figure 4). The sedimentation rate was however positive and increased over time: 1.8 cm/yr between 2004 and 2005, 2.2 cm/yr between 2005 and 2006, and 3.4 cm every year between 2006 and 2009. The sedimentation rate is higher in the north-western part and smaller in the southern part of the Paardenschor (Figure 4 & Figure 5). The spatial difference in sedimentation rate could be explained by the hydrodynamics: the north-western part is, in the shadow of the Schor van Oude Doel, low hydrodynamic and the southern part is, in the opening to the Scheldt, high hydrodynamic (turbulence, waves, etc).

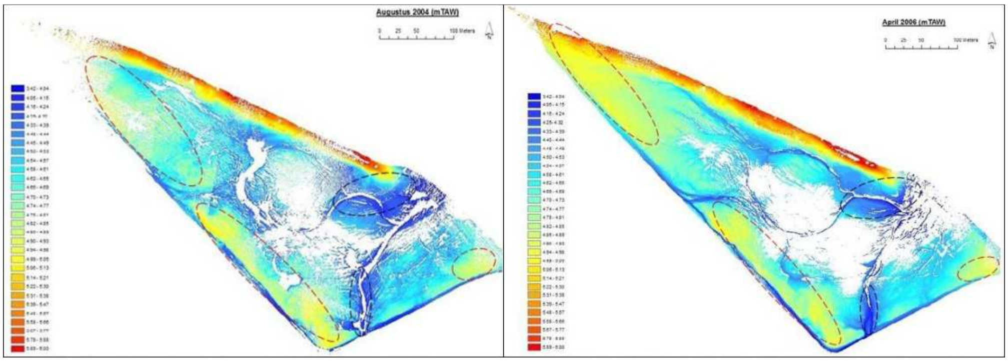


Figure 4. 3D-picture of the Paardenschor (left in August 2004, right in April 2006). The red circled zones are elevated relatively high, the black circled zones low. (Brys et al. 2005)

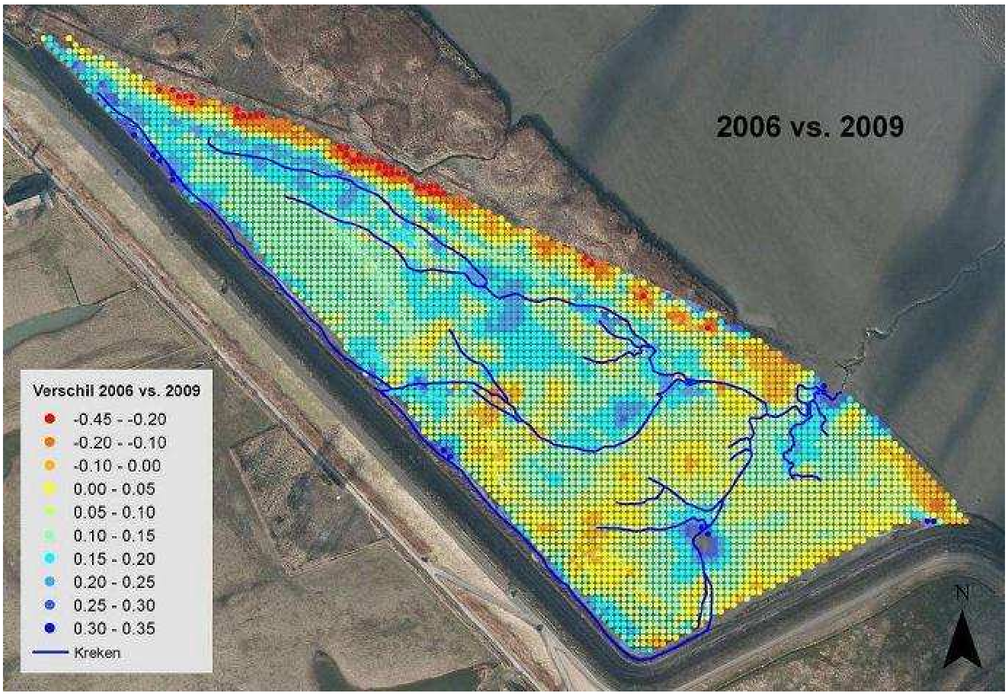


Figure 5. Difference map of the Paardenschor between 2006 and 2009. The positive values refer to sedimentation (yellow to dark blue), the negative to erosion (orange to red). (Speybroeck et al. 2011)

1.3.2 Sediment characteristics

The sedimentation at the Paardenschor influenced the sediment composition over the years. After the restoration, grain size was much larger compared to the original intertidal flat (Figure 6). After three years, grain size was comparable on the restored and original intertidal flat. Parallel, silt content and content of organic material in the restored area were lower in the first years but increased gradually in the following years (Figure 7 & Figure 8).

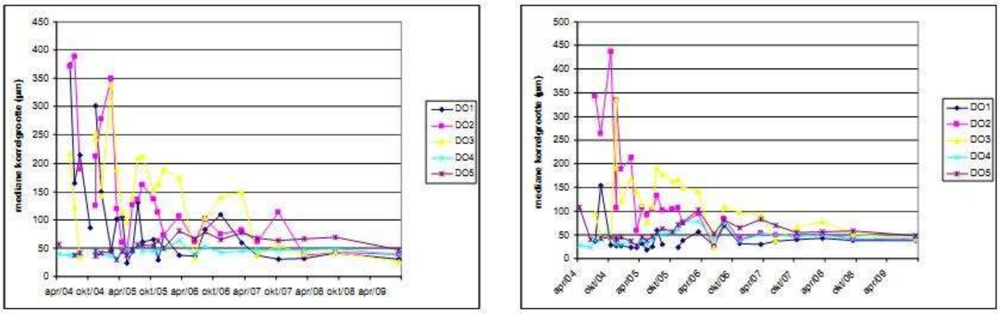


Figure 6. Median grain size in function of time – spring 2004 to autumn 2009: sedimentation from 0 to 10 cm depth (left) and from 0 to 1 cm depth (right) (Speybroeck et al. 2011).

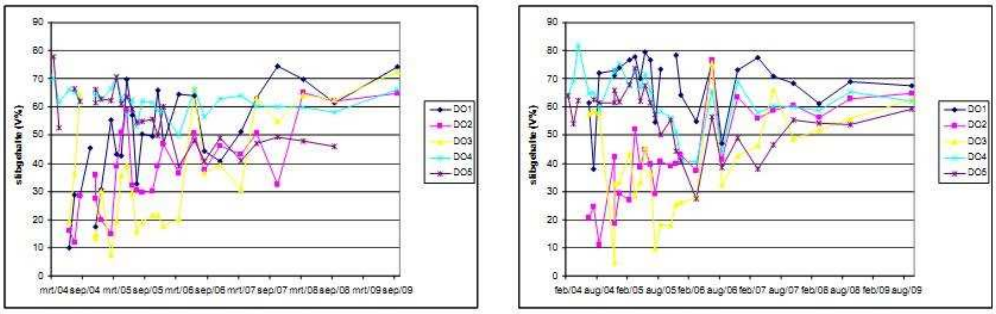


Figure 7. Silt content (volume percentage < 63µm) in function of time – spring 2004 to autumn 2009: Sedimentation from 0 to 10 cm depth (left) and from 0 to 1 cm depth (right) (Speybroeck et al. 2011).

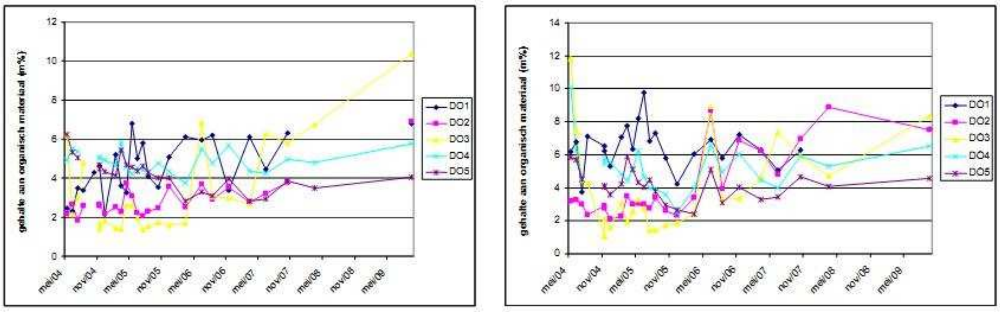


Figure 8.: Content of organic matter (mass percentage) in function of time – spring 2004 to autumn 2009: Sedimentation from 0 to 10 cm depth (left) and from 0 to 1 cm depth (right) (Speybroeck et al. 2011).

1.3.3 Sediment quality

Immediately after the restoration of the Paardenschor the calculated scores for total pollution on the restored areas and the original mudflats were comparable (Brys et al. 2005) and did not change significantly over time (Speybroeck et al. 2011). The most heavily polluted samples were classified as “moderately polluted”.

1.3.4 Vegetation

Five years after restoration, the Paardenschor still consists mainly of bare mudflat. However, every year 3.6% of the intertidal flat became vegetated. Vegetation grows mainly *at the edges of the mudflat and along the channels in development (Figure 9 & Figure 10). Common vegetation in 2009 was mainly Sea club-rush (Bolboschoenus maritimus or Scirpus maritimus) with on the higher parts also Creeping bentgrass (Agrostis stolonifera) and Common Reed (Phragmites australis) (*

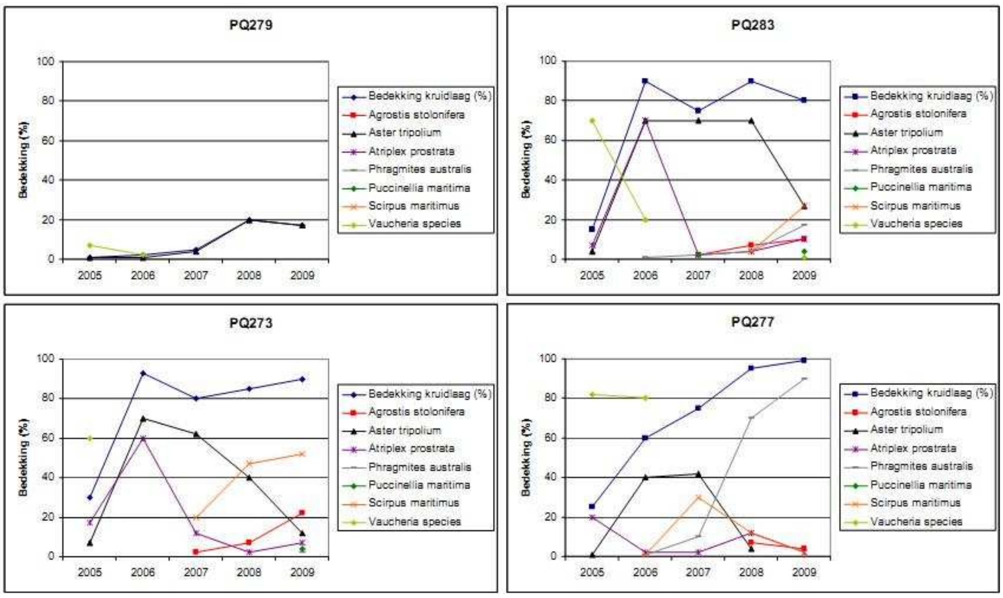


Figure 11). At lower parts, in the direction of the bare mudflat, pioneer vegetation appears dominated by Sea Aster (Aster tripolium) or Vaucheria (Vaucheria spec.).

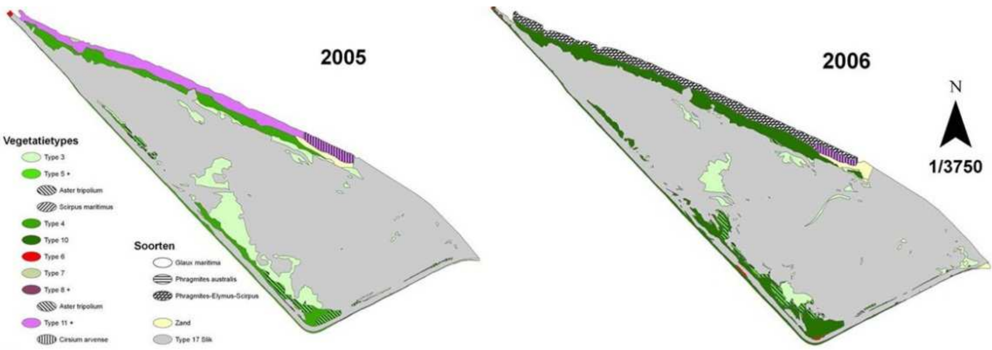


Figure 9. Vegetation map of the Paardenschor in 2005 and 2006 (Brys et al. 2005)

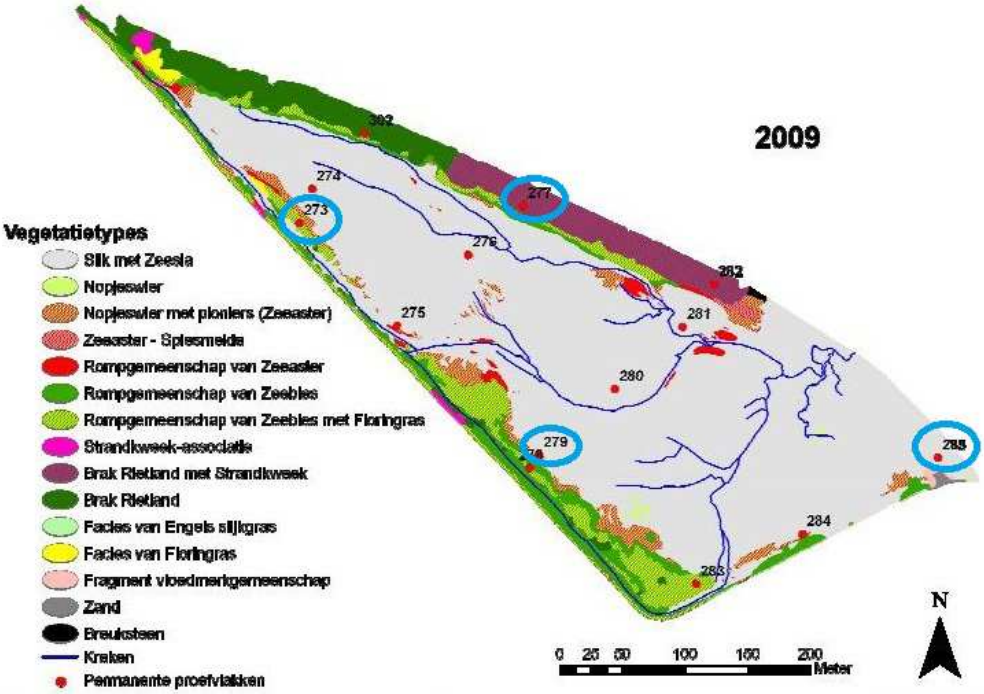


Figure 10. Vegetation map of the Paardenschor in 2009 (Speybroeck et al. 2011)

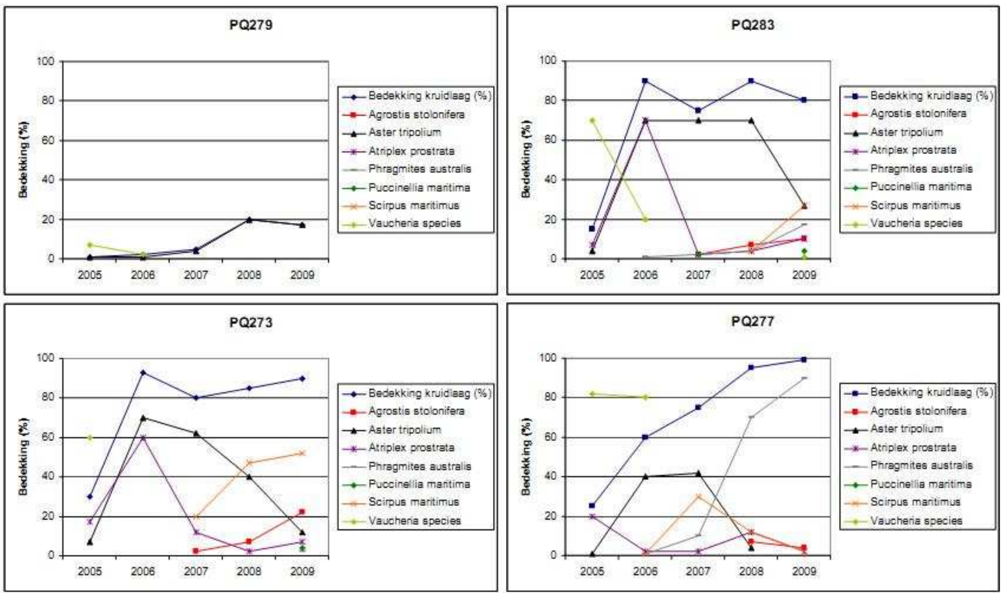


Figure 11. Trend in coverage of the main vegetation species in four permanent squares at the Paardenschor from 2005 to 2009 (Speybroeck et al. 2011)

1.3.5 Macrozoobenthos

In an average sample of the Paardenschor, 57% mudshrimp (*Corophium volutator*), 19% earthworms (*Oligochaeta*) and 17% Ragworm (*Nereis diversicolor*) was found (Figure 12). Those three taxa determine 93% of the present macrozoobenthos. Other species that were also found are *Cyathura carinata*, Baltic tellin (*Macoma balthica*) and *Heteromastus filiformis*. The diversity in macrozoobenthos is really poor.

The biomass of macrozoobenthos is mainly determined by Ragworm (*Nereis diversicolor*) and also a little by mudshrimp (*Corophium volutator*) (Figure 12).

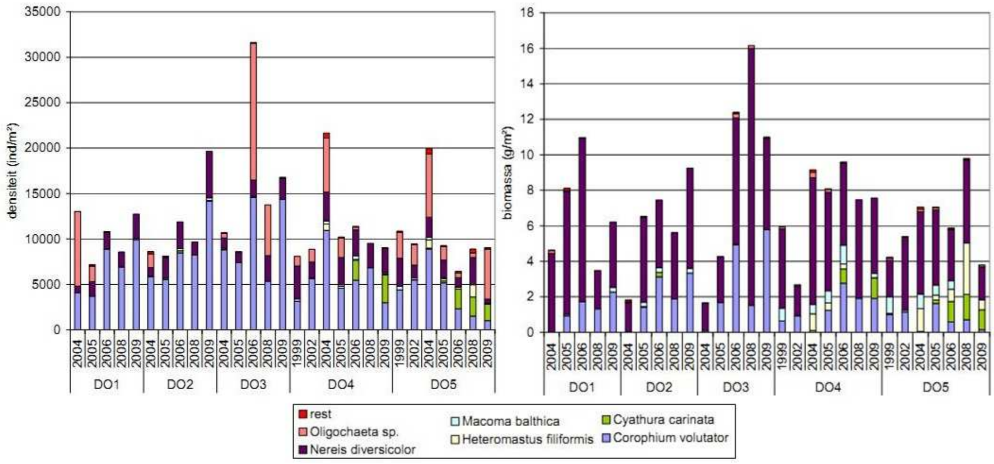


Figure 12. Average density (left) and biomass (right) per specie per year (Speybroeck et al. 2011)

After the restoration of the Paardenschor, a density increase was identified both on the restored area (DO1-3) and on the original mudflat (DO4-5) (Speybroeck et al. 2011). Immediately after the restoration of the Paardenschor (during the first measurement campaign), almost no macrozoobenthos is present on the restored mudflat (Figure 13). This is followed by a strong increase both on the restored and the original mudflat (Van den Neucker et al. 2007, Speybroeck et al. 2011).

One outlier is visible on Figure 13 (red circle). The high density in the autumn of 2006 at location DO3 is due to the presence of Vaucheria sp. (dutch: Nopjeswier) at the sample location. High densities of living Oligochaeten can house in this weed. However, the presence of this weed is highly dynamic with the effect of large variation in Oligochaeten densities. Location DO3 is also highly dynamic as a consequence of the development and morphologic changes of a creek channel that developed only randomly at location DO3.
The evolution in biomass (Figure 13) is similar: steady increase in the new restored mudflat to a level of dynamic equilibrium. The first period after restoration shows however no initial peak compared to the evolution of the density. The density peak in combination with no biomass peak indicates a large amount of light and hence small young organisms. This is typical for young systems occupied by a large number of newcomers, followed by a density decrease but a steady asymptotic biomass evolution.

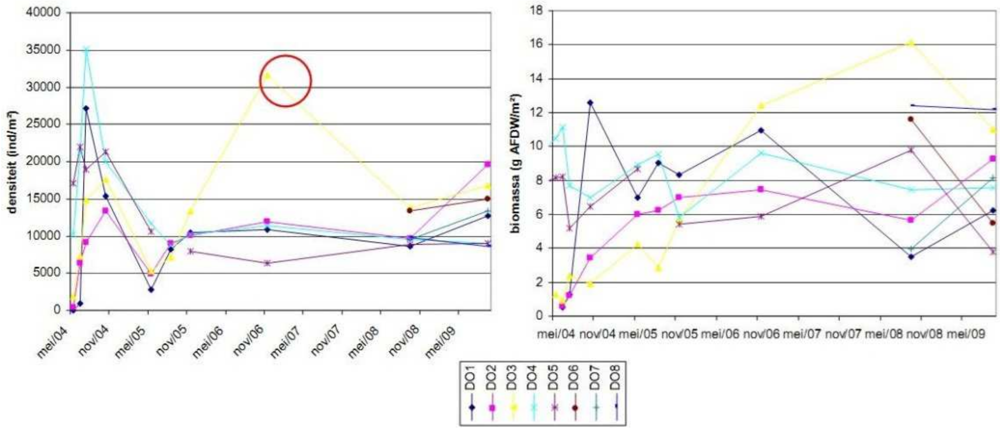


Figure 13. Density (left) and biomass (right) in function of time – spring 2004 – autumn 2009. The red circle indicates the Vacheria-related outlier. (Speybroeck et al. 2011)

1.3.6 Avifauna

A total of 19 species of water birds were recorded at the Paardenschor (Table 1) (Van den Neucker et al. 2007). Common Shelduck (*Tadorna tadorna*), Mallard (*Anas platyrhynchos*), Curlew (*Numenius arquata*) and Oystercatcher (*Haematopus ostralegus*) were almost always observed. The restored site is used for foraging as well as roosting. Benthic invertebrates are abundant and the inundation time of the newly created mudflat is limited. Only few suitable breeding sites were available throughout the study period. The importance of the Paardenschor as a breeding ground is expected to increase as parts of it develop into tidal marsh.

Table 1. Number of water birds identified on the Paardenschor between October 2004 and December 2006 (Van den Neucker et al. 2007)

Soort	okt/04	nov/04	dec/04	jan/05	feb/05	mrt/05	apr/05	mei/05	jul/05	aug/05	okt/05	nov/05	dec/05	jan/06	feb/06	mrt/06	apr/06	mei/06	jun/06	aug/06	sep/06	okt/06	nov/06	dec/06
Aalscholver (*Phalacrocorax carbo*)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Bergeend (*Tadorna tadorna*)	23	24	22	50	19	97	33	95	89	29	2	23	18	0	0	20	45	30	75	24	10	13	10	7
Canadese gans (*Branta canadensis*)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
Grauwe gans (*Anser anser*)	0	4	0	8	0	0	1	0	184	8	0	0	3	7	0	0	0	5	0	0	460	0	5	0
Groenpootruiter (*Tringa nebularia*)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0
Kievit (*Vanellus vanellus*)	0	0	0	0	0	5	3	5	61	0	0	0	0	0	0	0	1	3	0	0	45	0	0	0
Kluut (*Recurvirostra avosetta*)	0	55	1	6	0	8	13	21	52	7	0	0	0	0	0	0	15	4	1	24	0	0	0	0
Kokmeeuw (*Larus ridibundus*)	1	0	0	0	1	2	62	85	62	0	0	0	0	0	0	1	9	36	24	0	4	0	0	0
Oeverloper (*Actitis hypoleucos*)	0	0	0	0	0	0	8	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pijlstaart (*Anas acuta*)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
Scholekster (*Haematopus ostralegus*)	5	9	14	9	2	7	7	4	6	8	0	0	0	16	2	2	4	4	4	1	0	0	0	5
Smient (*Anas penelope*)	0	12	5	7	0	0	17	0	0	0	0	2	0	0	0	0	0	0	0	0	10	0	0	0
Tureluur (*Tringa totanus*)	0	0	0	2	0	0	15	7	6	1	0	0	0	0	0	0	13	5	0	0	0	0	0	0
Wilde eend (*Anas platyrhynchos*)	0	14	76	92	54	11	21	13	14	5	18	16	44	0	0	7	3	9	12	0	4	34	0	2
Wintertaling (*Anas crecca*)	0	33	63	0	0	7	10	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0
Wulp (*Numenius arquata*)	10	39	6	9	8	7	5	1	12	8	2	4	13	0	2	4	3	0	0	3	1	1	0	0
Zilvermeeuw (*Larus argentatus*)	1	0	0	0	0	0	0	0	16	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0
Zilverplevier (*Pluvialis squatarola*)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Zwarte ruiter (*Tringa erythropus*)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Totaal	40	190	187	183	84	144	195	231	511	66	22	45	78	23	4	34	100	101	117	52	538	48	15	14

1.3.7 Fish

No monitoring results available.

2 Execution of main effectiveness criteria

2.1 Effectiveness according to development targets of measure

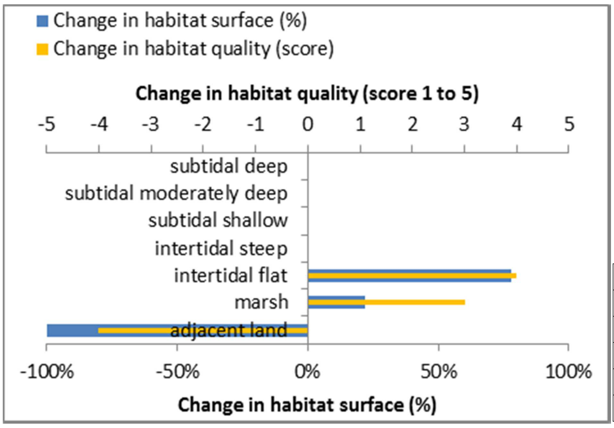
Step 1: Definition of development target
The creation of new ecological valuable intertidal wetlands can contribute to estuarine restoration as it enables habitat development and biodiversity. Success factors are related to the improvement of estuarine processes (such as sedimentation-erosion, creek formation and soil development).

Step 2: Degree of target achievement
Immediately after restoration (2004), the Paardenschor existed of 12ha bare mudflat. Under influence of the tidal floods twice a day with brackish water from the Scheldt, the Paardenschor rapidly transformed to a tidal wetland with a Good Ecological Potential (Brys et al. 2005), with clear creek formation in the mudflats and typical marsh vegetation at the higher areas (such as Common Glasswort (*Salicornia europaea*), Sea Aster (*Aster tripolium*) and Common Cordgrass (*Spartina anglica*)). The sediment is colonised by benthic invertebrates, predated on by water birds and fish. The site is functional as a roost and foraging site rather than as a breeding site. This type of low dynamic mudflats, relatively high in the tidal frame adds valuable foraging time and space for water birds. However, its design could have been adapted to enhance its habitat functions for fish.
The initial tidal elevation and site slope were well chosen (Van den Neucker et al. 2007). Creek network systems seem to establish without the specific excavation of a creek onset. However, creek onset might have enhanced the habitat differentiation within the site and its suitability as fish habitat. The old dike could have been excavated more, but this might have led to erosion on the transition to the adjacent marsh (Schor Ouden Doel). Overall there is net sedimentation, with local erosion in the developing creek network system.

2.2 Impact on ecosystem services

<u>Step 1</u>: Involved habitats

The measure Paardenschor in the mesohaline zone of the Scheldt estuary was about the creation of intertidal habitat by transforming adjacent land (agricultural land) into mainly intertidal flat habitat and also marshland with a high change in the habitat quality. The transformation was realized by separating the area from the inland by the construction of a new dike (Sigma dike 11mTAW) and the area itself was lowered.



Score habitat quality
1 = very low quality
2 = low quality
3 = medium quality
4 = high quality
5 = very high quality

Figure 14. Ecosystem services analysis for Paardenschor wetland: Indication of habitat surface and quality change, i.e. situation before versus after measure implementation. The change in habitat quality, i.e. situation after the measure is implemented corrected for the situation before the measure, is '1' in case of a very low quality shift, and '5' in case of a very high quality shift.

<u>Step 2</u>: Expected impact on ecosystem services, compared with targeted ecosystem services, and expected impact on beneficiaries

More information about the methodology and the correct interpretation of the results could be found in the overall measures report (Saathoff et al. 2013).

(1) Overall expected impact on ES:

From the ES assessment it is concluded that this measure generates overall a positive expected impact for many ES, with a very positive expected impact for the ES "biodiversity"; cultural services (Aesthetic information; and Inspiration for culture, art and design); and the regulating service Erosion and sedimentation regulation (by water bodies).

(2) Expected impact on targeted ES

The key objective of this measure is the creation of a new intertidal wetland to improve the general functioning of the Scheldt estuary (habitat services "biodiversity"). The expected impact for the development target "biodiversity" is very positive.

(3) Expected impact on beneficiaries

The expected impact for the different beneficiary groups is overall positive, with a very positive expected impact for future use.

Table 2. Ecosystem services analysis for Paardenschor wetland: (1) expected impact on ES supply in the measure site and (2) expected impact on different beneficiaries as a consequence of the measure

Paardenschor- small scale brackish tidal wetland restoration in the Seascheldt

Cat.	Ecosystem Service	Score
S	"Biodiversity"	3
R1	Erosion and sedimentation regulation by water bodies	3
R2	Water quality regulation: reduction of excess loads coming from the catchment	2
R3	Water quality regulation: transport of polutants and excess nutriënts	0
R4	Water quantity regulation: drainage of river water	0
R5	Erosion and sedimentation regulation by biological mediation	2
R6	Water quantity regulation: transportation	0
R7	Water quantity regulation: landscape maintenance	2
R8	Climate regulation: Carbon sequestration and burial	2
R9	Water quantity regulation: dissipation of tidal and river energy	2
R10	Regulation extreme events or disturbance: Wave reduction	2
R11	Regulation extreme events or disturbance: Water current reduction	1
R12	Regulation extreme events or disturbance: Flood water storage	0
P1	Water for industrial use	0
P2	Water for navigation	0
P3	Food: Animals	0
C1	Aesthetic information	3
C2	Inspiration for culture, art and design	3
C3	Information for cognitive development	2
C4	Opportunities for recreation & tourism	2

Beneficiaries:	
Direct users	0
Indirect users	2
Future users	3
Local users	2
Regional users	1
Global users	1

X Targeted ES

Legend: expected impact*	
3	very positive
2	positive
1	slightly positive
0	neutral
-1	slightly negative
-2	negative
-3	very negative

*: Indicative screening based on ES-supply surveys and estimated impact of measures on habitat quality and quantity. Quantitative socio-economic conclusions require local supply and demand data to complement this assessment.

2.3 Degree of synergistic effects and conflicts according to uses

The public acceptance during the planning process was rather low. An important challenge in the Sigmaplan measure program is the realisation of tidal nature with projects by which reasonable areas of forest or agriculture are converted into estuarine nature. The societal sensitiveness of these projects is extremely high and local actors want clarification on the success rate and the effectiveness of the provided estuarine restoration projects. This became clear during information sessions with local stakeholder during the planning phase were local farmers became emotional (2002). This was also a topic in public newspapers (March 2003), for example with the title "licence for excavation of the Paardenschor despite heavy protests by farmers." The agricultural sector is worried about the stability of the new dike and for salinization of agricultural land.
In contrast, this measure also has some synergistic effects between port development (creation of Deurganckdok) and nature conservation (new tidal wetland).

3 Additional evaluation criteria in view of EU environmental law

3.1 Degree of synergistic effects and conflicts according to WFD aims

This measure, in the mesohaline zone of the Scheldt, aimed to create a new intertidal wetland with a clear positive effect on habitat loss and degradation and this piece of land is given back to the estuary. At a larger scale this type of measure could also generate a positive effect on the hydrographic regime, water and sediment chemical quality and relative sea level rise. Finally, sedimentation on the wetland can reduce the need for maintenance dredging in the main river.

Indicator	code	Main pressures **mesohaline** zone Scheldt	Effect?					Description
			- -	-	0	+	++	
S.I.	1.1	Habitat loss and degradation during the last about 100 years: Intertidal				X		Newly created intertidal mudflat (small scale)
S.I.	1.5	Gross change of the hydrographic regime during the last about 100 years				X		Opportunity to give more “space” to the river
S.I.	3.1/ 3.2	Decrease of water and sediment chemical quality				X		Wetlands proved to improve the water and sediment quality
D.I.	1.3	Land claim during the last about 100 years				X		The land is given back to the estuary (small scale)
D.I.	1.7	Relative Sea Level Rise				X		Opportunity to increase the flood areas at locations without (or with less) socio-economic costs
D.I.	2.12	Port developments				X		Sedimentation on the wetland means less sediment in the main river

S.I. = state indicator; D.I. = driver indicator

3.2 Degree of synergistic effects and conflicts according to Natura 2000 aims

The Paardenschor is part of the ‘Scheldt and Durme estuary from the Dutch border to Gent’ (BE2300006), a protected area under the Habitat directive. This measure is about the creation of newly intertidal mudflats and hence contributes to the protection and conservation of intertidal wetlands in this protected area.

The Paardenschor is also part of ‘marshes and polders of the lower Scheldt’ (BE2301336), a protected area under the bird directive. The site is functional as a roost and foraging site rather than as a breeding site. This type of low dynamic mudflats, relatively high in the tidal frame adds valuable foraging time and space for water birds. However, only few suitable breeding sites were available throughout the study period because benthic invertebrates are abundant and the inundation time of the newly created mudflat is limited. The importance of the Paardenschor as a breeding ground is expected to increase as parts of it develop into tidal marsh. Frequent visitors on the Paardenschor are Common Shelduck (*Tadorna tadorna*), Mallard (*Anas platyrhynchos*), Curlew (*Numenius arquata*) and Oystercatcher (*Haematopus ostralegus*) (Van den Neucker et al. 2007). But also some other bird directive species (passage and winter birds) visit the Paardenschor. In total nine of the 26 protected non-breeding birds are identified multiple times between October 2004 and December 2006.

The presence of breeding birds is rare on the Paardenschor. Only the Little Ringed Plover (Charadrius dubius) is identified: 2 breeding pairs in 2005 and one pair in 2006 (Van den Neucker et al. 2007). However, this species is not on the bird directive list.

Conservation objectives (Sea Scheldt; Zeeschelde)	**Specification**	**Effect?**					**Short explanation**
		- -	-	0	+	++	
Protected habitats: Coast and brackish habitats	Atlantic marshes (HD, code 1330)				X		Newly created intertidal mudflat in the protected area BE2300006, and quality improvement for this type of habitat.
Protected birds: non-breeding birds (passage and winter birds)	Acrocephalus paludicola			X			Not registered at the Paardenschor.
	Anas acuta				X		Water bird identified between October 2004 and December 2006: 2 individuals in total
	Anas clypeata			X			Not registered at the Paardenschor.
	Anas crecca				X		Water bird identified between October 2004 and December 2006: 117 individuals in total
	Anas Penelope				X		Water bird identified between October 2004 and December 2006: 53 individuals in total
	Anas strepera			X			Not registered at the Paardenschor.
	Anser albifrons			X			Not registered at the Paardenschor.
	Anser anser				X		Water bird identified between October 2004 and December 2006: 685 individuals in total
	Anser brachyrhynchus			X			Not registered at the Paardenschor.
	Anser fabalis			X			Not registered at the Paardenschor.
	Arenaria interpres			X			Not registered at the Paardenschor.
	Recurvirostra avosetta				X		Water bird identified between October 2004 and December 2006: 207 individuals in total
	Aythya ferina			X			Not registered at the Paardenschor.
	Aythya fuligula			X			Not registered at the Paardenschor.
	circus cyaneus			X			Not registered at the Paardenschor.
	Circus bewickii			X			Not registered at the Paardenschor.
	Egretta alba			X			Not registered at the Paardenschor.
	Larus argentatus				X		Water bird identified between October 2004 and December 2006: 20 individuals in total
	Larus canus			X			Not registered at the Paardenschor.
	Larus ridibundus				X		Water bird identified between October 2004 and December 2006: 287 individuals in total
	Numenius arquata				X		Water bird identified between October 2004 and December 2006: 138 individuals in total
	Numenius phaeopus			X			Not registered at the Paardenschor.
	Philomachus pugnax			X			Not registered at the Paardenschor.
	Platalaea leucorodia			X			Not registered at the Paardenschor.
	Pluvialis apricaria			X			Not registered at the Paardenschor.
	Tadorna tadorna				X		Water bird identified between October 2004 and December 2006: 758 individuals in total

4 Crux of the matter

The restoration of the Paardenschor was a success to create a tidal wetland in the mesohaline zone of the Sea Scheldt (Zeeschelde). The Paardenschor rapidly transformed to a tidal wetland with a Good Ecological Potential (Brys et al. 2005), with clear creek formation in the mudflats and typical marsh vegetation at the higher areas.
A detailed evaluation of the monitoring methods is available. For future projects it is recommended to start with the monitoring plan already in the planning phase with clear cost estimation and clear agreements on execution and reporting; make a clear distinction between “site success monitoring” and “impact verification monitoring”; make a photographic survey on a yearly basis to improve interpretation of collected data; reduce the density of the network to reduce the budget for monitoring sediment quality; optimise the comparability of monitoring results of zoobenthos with that of other countries; monitoring of birds and fishes needs to be done from the beginning following fixed protocol; investigate better the contribution of the different variables that contribute to the changes in elevation; take into account better the impact of local estuarine characteristics such as sediment balance and wave impact; experimental research is needed to monitor benthic primary production; and investigate the monitoring of floristic quality of marsh vegetation.
An important knowledge gap exists on the identification of factors that can explain all changes in vegetation changes. The inundation frequency cannot be the only factor. Also changes in elevation should be investigated better and the impact of local estuarine characteristics, such as sediment balance and wave impact should be taken into account better.

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