Locating suitable areas for the use of oyster reefs (*Crassostrea gigas*) in erosion control in the Eastern Scheldt

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Introduction

After the 1953 flood, the 'Deltaplan' was initiated to close off the waters in Zeeland (Figure1) from tidal and fluvial influences.

Figure 1: Location of the research area. [source: www.maps.google.com]

The storm surge barrier (Figure 2) and secondary dams changed the hydrodynamics and geomorphological characteristics of the Eastern Scheldt area. This caused a disequilibrium between erosion and sedimentation.

Figure 2: The Eastern Scheldt storm surge barrier. [Tjark van Heuvel]

Today there is a sand deficit and consequently the tidal flats are eroding, threatening the long term stability of flood defenses and food sources for estuarine birds and water clarity.

After 1963 the 'Pacific oyster' was introduced for aquacultural purposes. They have spread now over the tidal basin and cover 9-10 km^2 of the intertidal area. As ecosystem engineers the oysters can influence flow, wave action, sedimentation and erosion patterns within and around the reef. We are investigating the potential use of the properties of *Crassostrea gigas* reefs as a living and adaptable coastal defense system.

Figure 3: A natural oyster reef and a man-made oyster reef in the Eastern Scheldt near the Oesterdam. [Mindert de Vries]

Methodology

The bathymetry of the Eastern Scheldt is measured frequently by Rijkswaterstaat. Figure 4 shows deep tidal channels near the storm surge barrier, sand flats and the natural oyster reefs, in 2010.

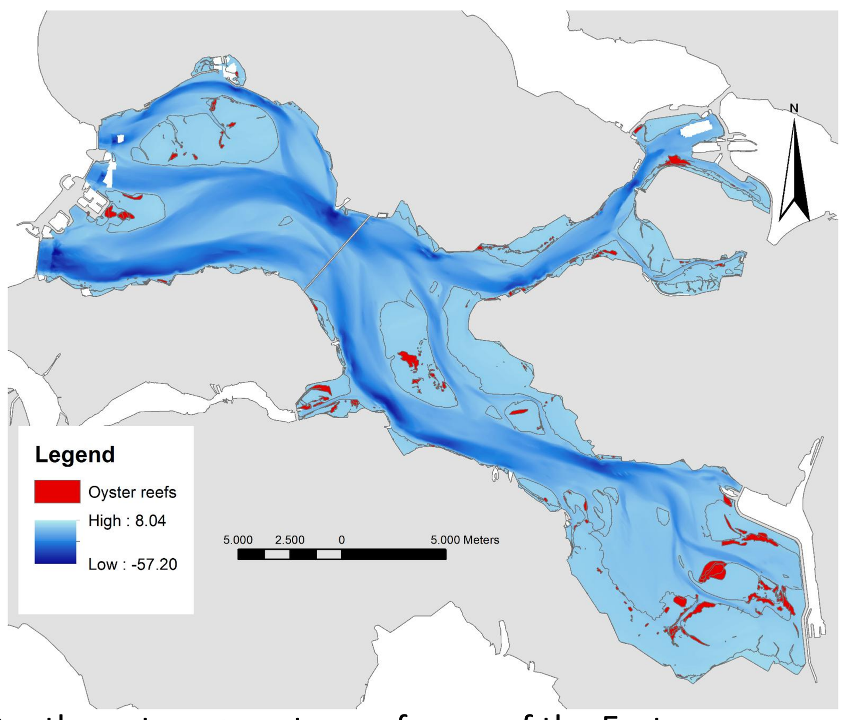

Figure 4: Depth contour + oyster reef map of the Eastern Scheldt in 2010.

Erosion/sedimentation rates were determined by comparing maps from 2000 and 2010. Evidence suggests that flats loose sand into the deeper channels, up to 10 cm/year. Several pilot projects have been carried out to restore the situation with a sand nourishment and using gabions filled with live oysters, to block the sand transport.

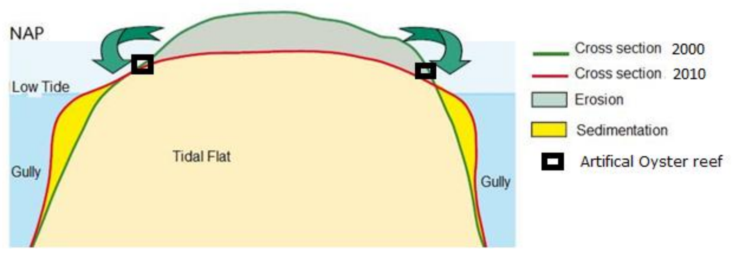

Figure 5: Yearly measurements of a transect crossing an oyster reef.

The most effective locations to place gabions were determined in Arcinfo-GIS, by selecting an erosion rate of 5 cm/yr up to a sedimentation rate of 1 cm/yr.

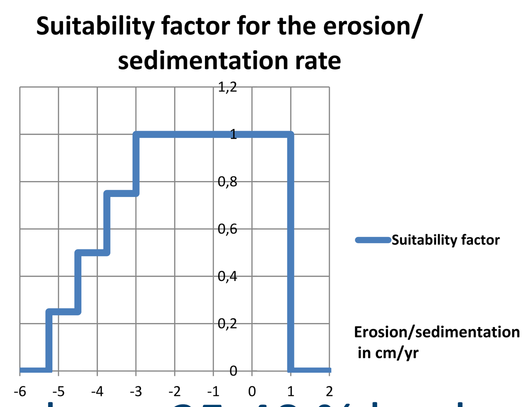

Figure 6: Suitability function for effective use of gabions.

Exposure of oysters to air above 35-40 % leads to mortality. Based on water level data of several years, the exposure is calculated for flats above NAP -200 cm. Parameters like salinity, water temperature, water quality are here evenly distributed, and therefore not significant.

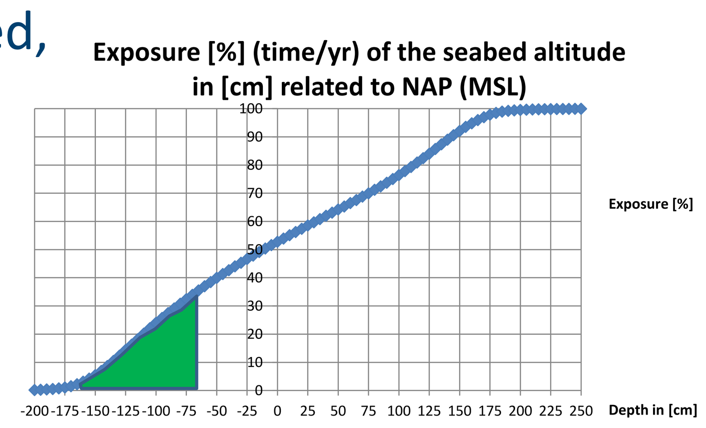

Figure 7: Suitability range in the bathymetry for oyster reefs.

Results

The combination of the suitability factors air exposure [%] and erosion rate [cm/yr] in the Eastern Scheldt, produces a suitability map for man-made oyster reefs. On these locations the gabions can be placed and monitored at LW.

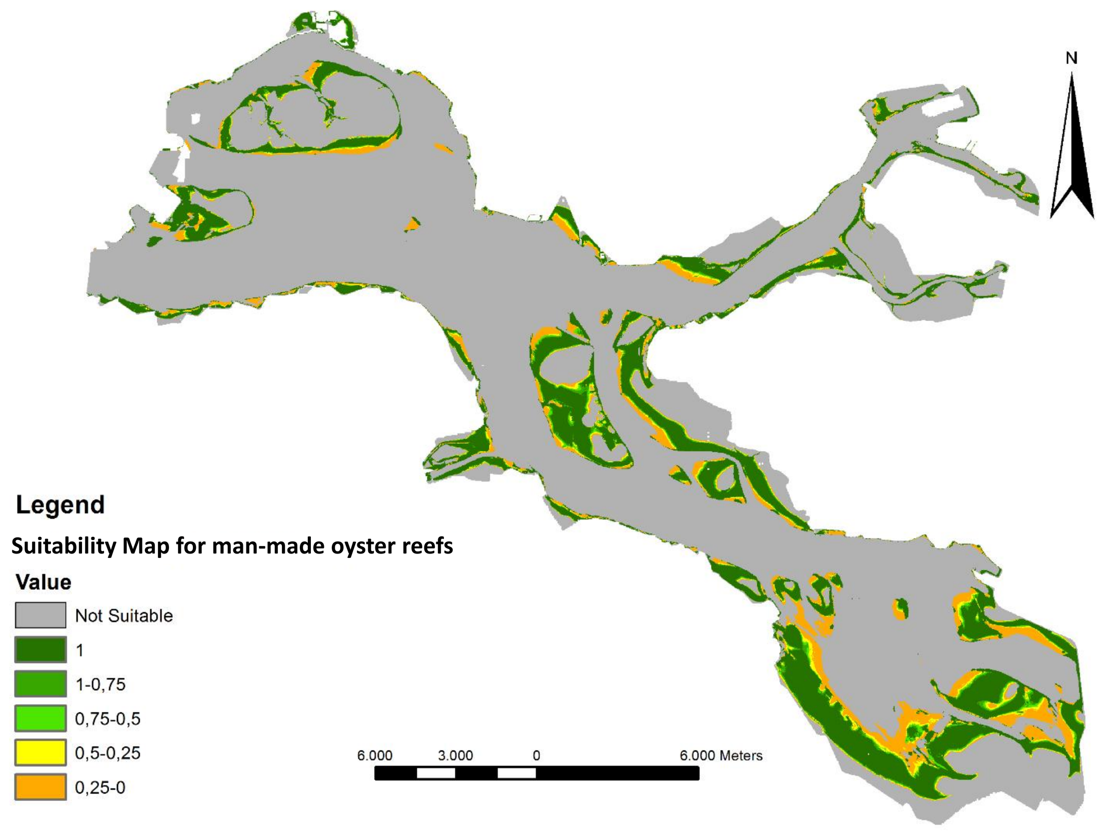

Figure 8: Eroding areas where oyster reefs are likely successful to establish on newly offered substrates, in the Eastern Scheldt.

Conclusions

Crassostreas gigas could potentially be used in artificial reefs as breakwaters for sediment stabilization and wave attenuation, in about 50 km^2 of the Eastern Scheldt with the advantage of adaptability to changing climate conditions.

The HZ 'Building with Nature' research group is involved in the monitoring up to 2016, determining the effectiveness of the man-made oyster reefs both for the oyster community and for sediment stabilization in and around the structures.

Figure 9: The research group on a natural oyster reef. [Tjark van Heuvel]

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