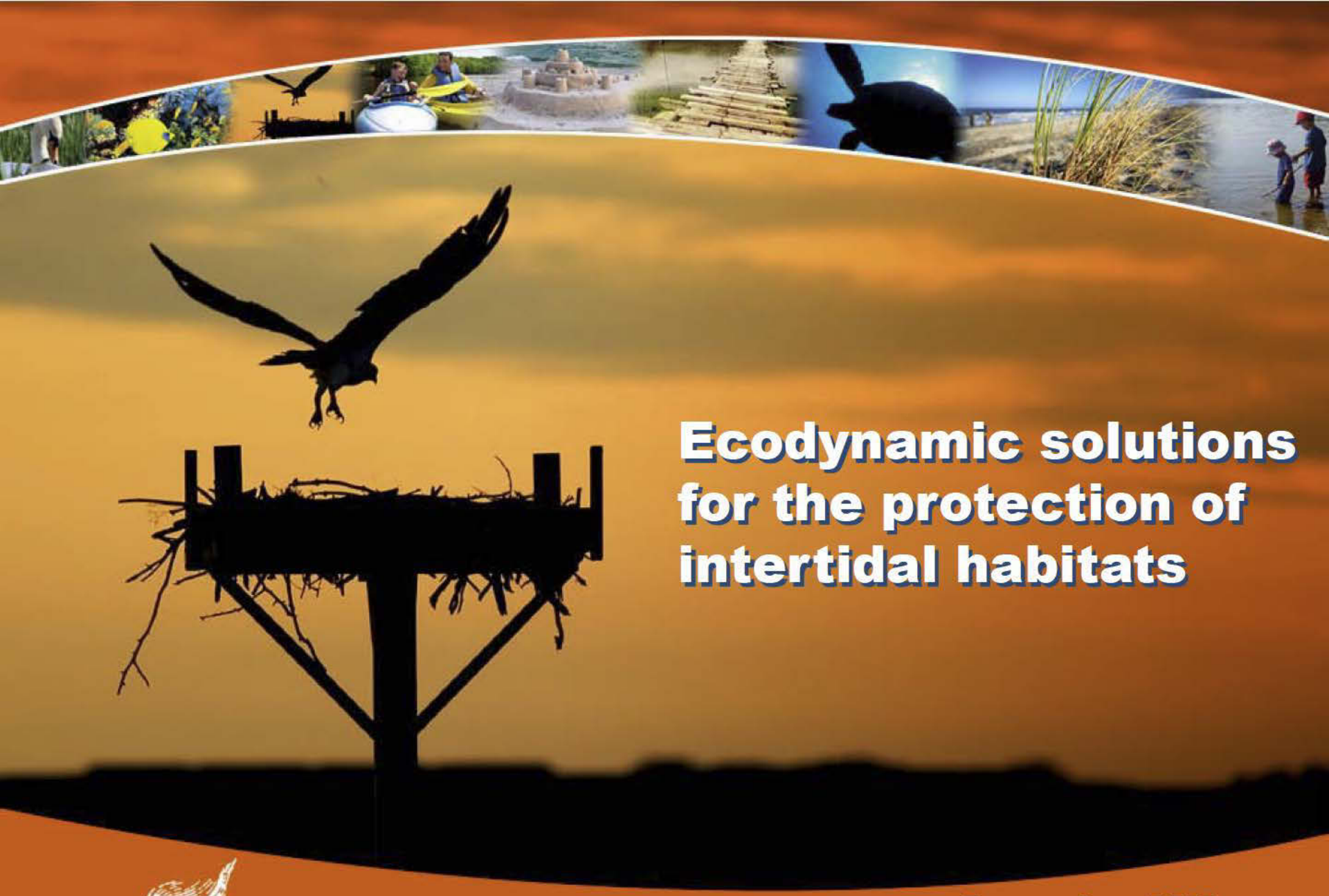
EcoShape
building with nature



Ecodynamic solutions for the protection of intertidal habitats

EcoShape | building with nature

Anneke Hibma
Tom Ysebaert

Coastal erosion: a worldwide problem

- a serious threat along many coastlines
- will increase due to human-induced changes and climate change (sea level rise, increased storminess)
- Oosterschelde (SW Netherlands)
  - Fast erosion of tidal flats due to infrastructural works

Oosterschelde

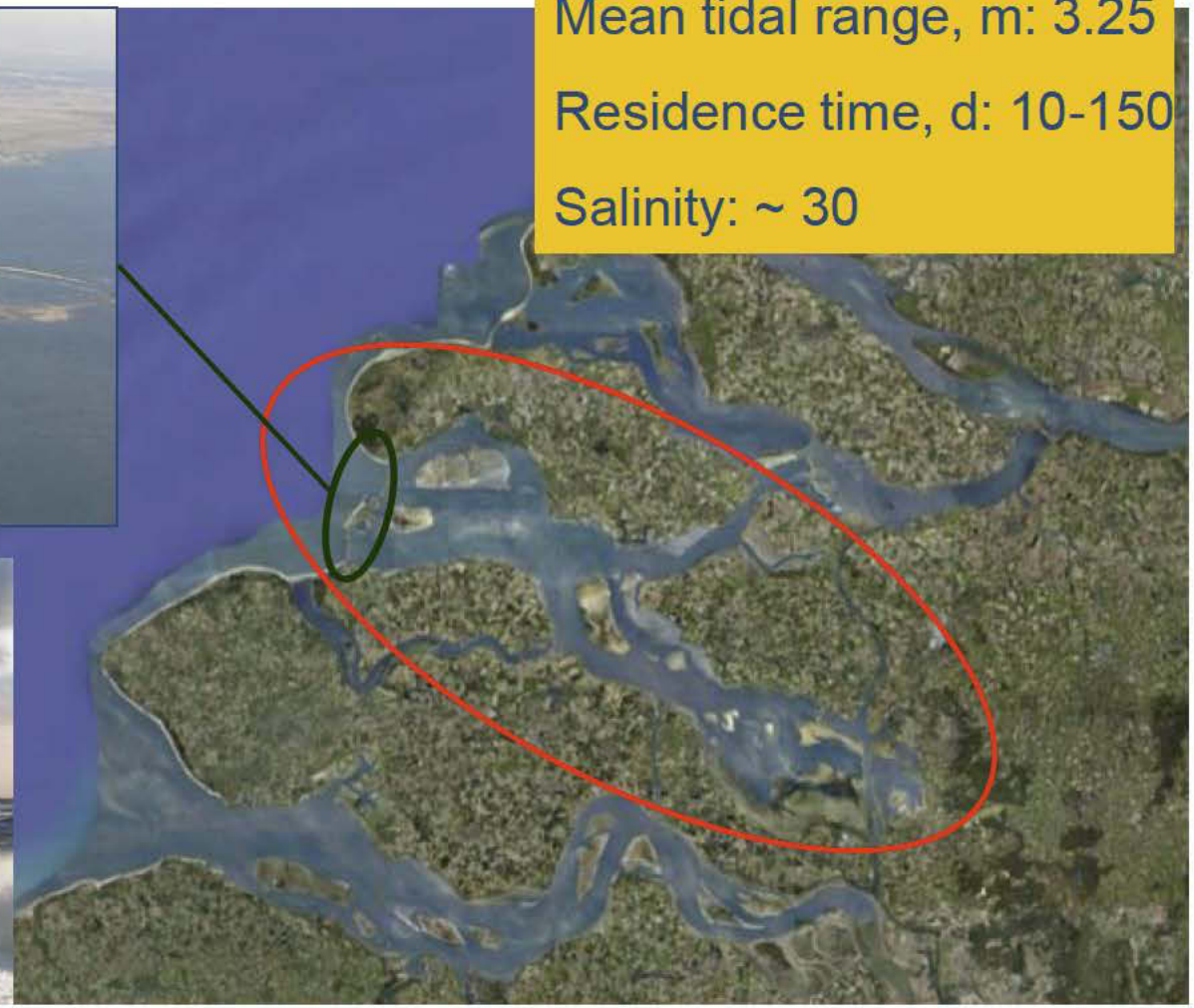
Total surface, km^2: 351

Tidal flats, km^2: 118

Mean tidal range, m: 3.25

Residence time, d: 10-150

Salinity: ~ 30



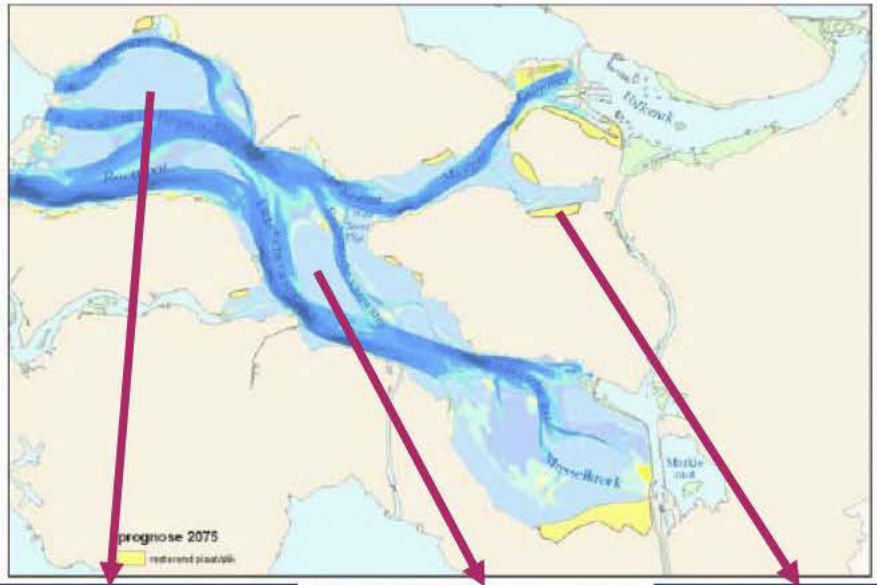
EcoShape
building with nature

“Sandhunger” Oosterschelde

EcoShape
building with nature

Consequences for nature and safety

- Loss of intertidal foraging habitats for birds and resting areas for seals
- Loss of protecting foreland (mudflats, marshes) for dikes



Building with Nature solutions

Short and medium term solutions:

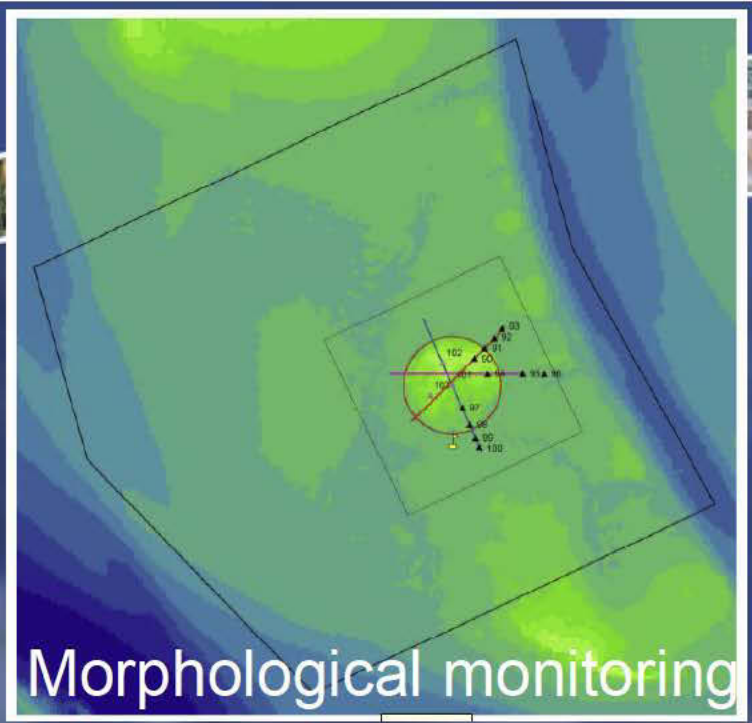
Stabilize intertidal areas

- Sand nourishments for maintaining tidal flats
- Coastal protection by applying the concept of ecosystem engineers

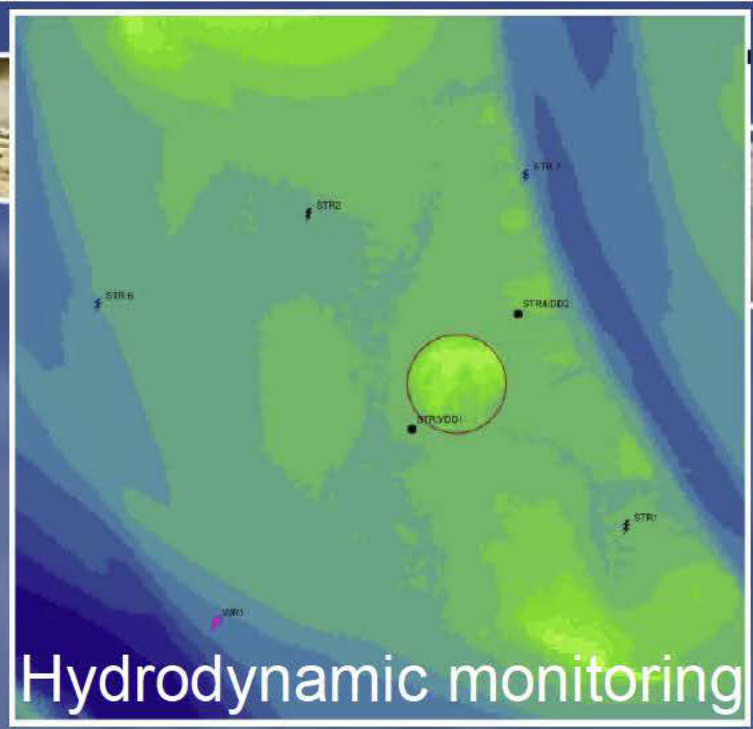
Long term solutions: **sand import**

EcoShape
building with nature

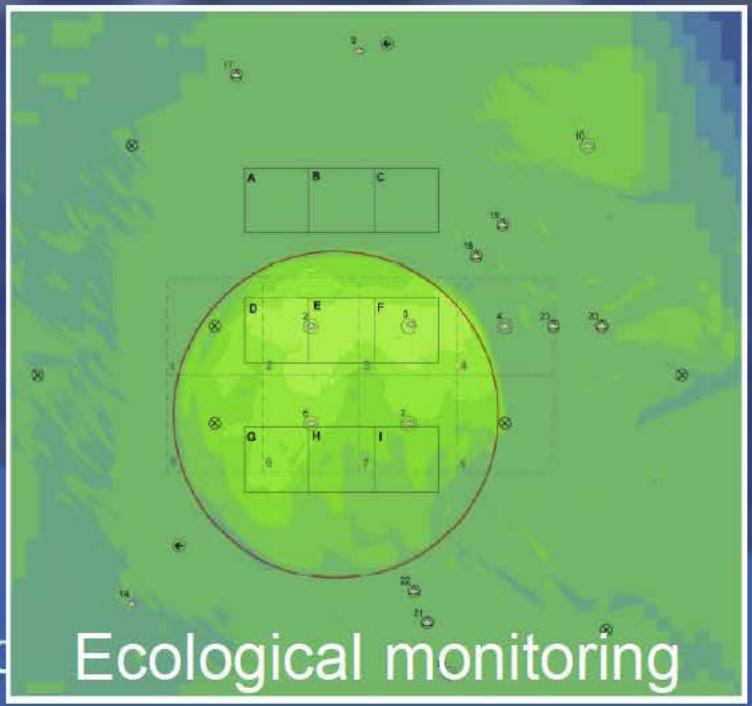
Nourishment Galgeplaat



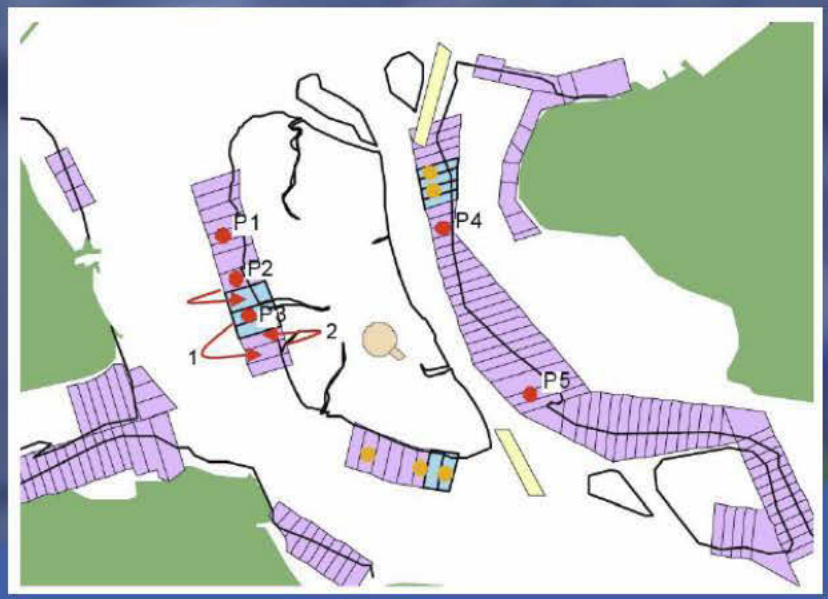
Morphological monitoring



Hydrodynamic monitoring



Ecological monitoring



Monitoring mussel beds

Argus-bio

EcoShape | building with nature

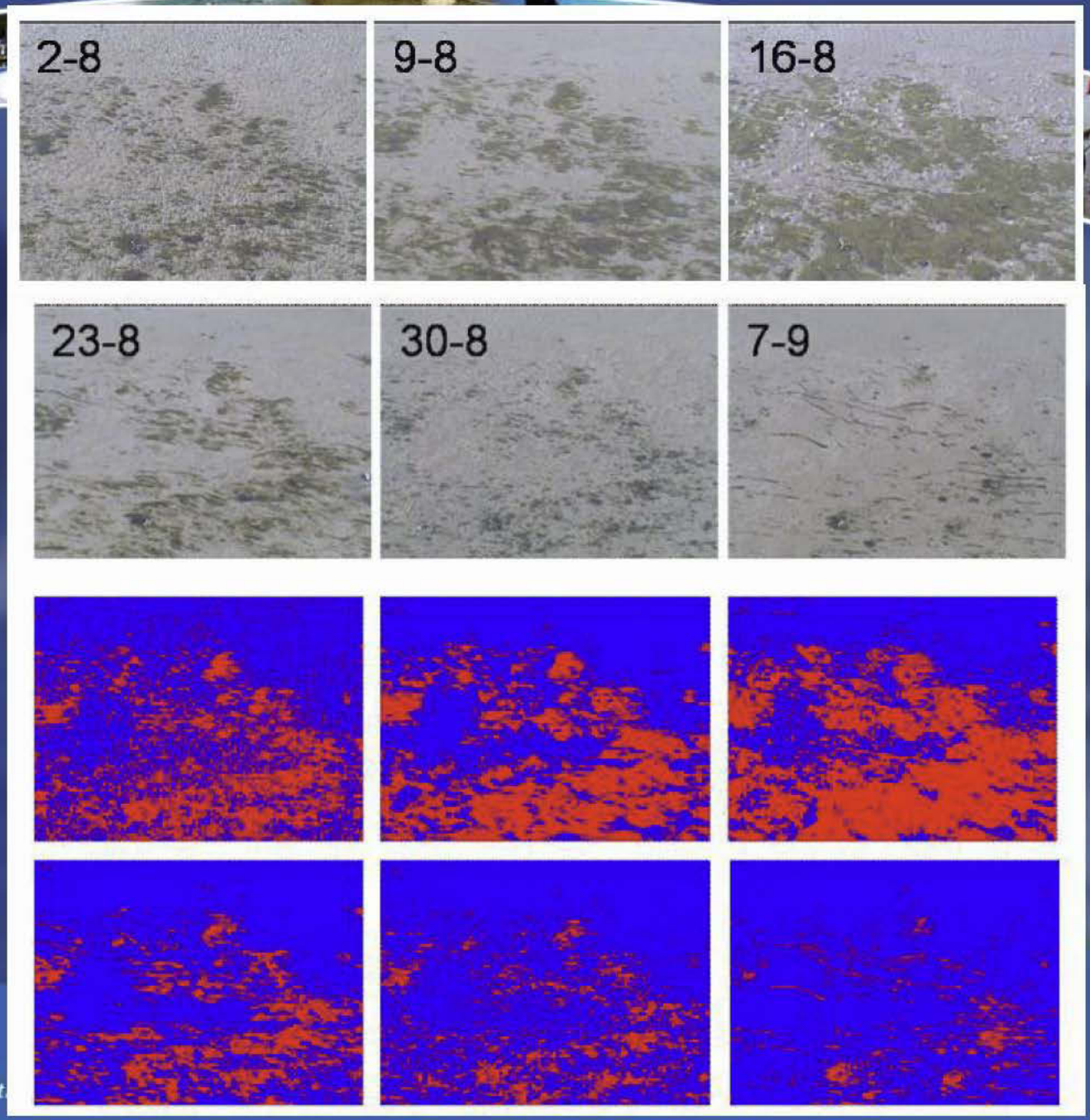
Argus-bio

EcoShape | building with nature

argus-data.wldelft.nl/sites/galg/2009

Argus-bio

Argus-bio



EcoShape | building wit

Nourishment strategies

- Locations
- Shape
- Volumes
- Frequency

EcoShape | building with nature

Building with Nature solutions

Short and medium term solutions:

Stabilize intertidal areas

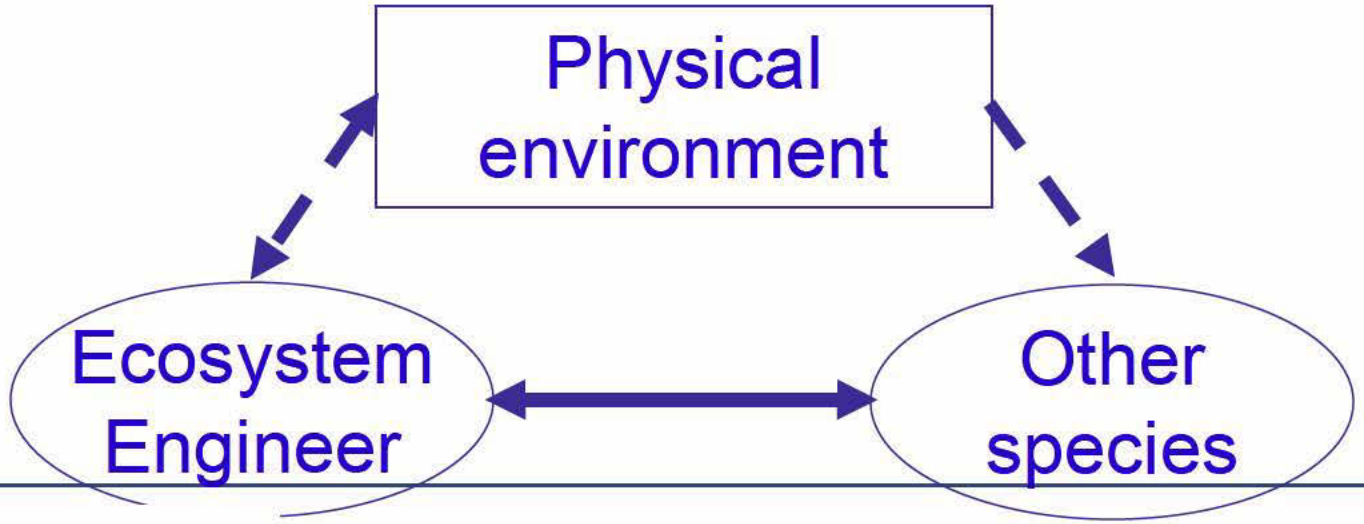
- Sand nourishments for maintaining tidal flats
- Coastal protection by applying the concept of ecosystem engineers

Long term solutions: **sand import**

EcoShape
building with nature

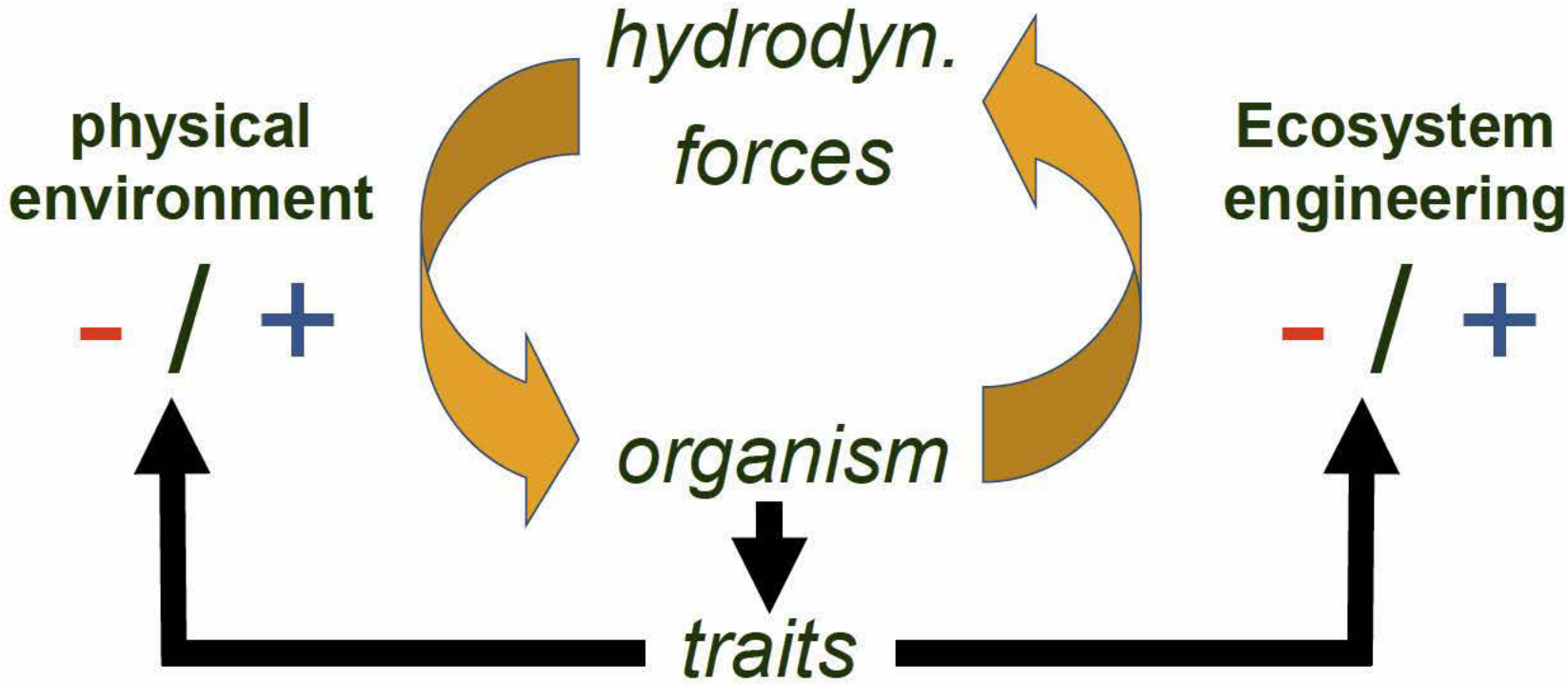
Ecosystem engineering

- EE = “modification of the abiotic environment by biological activity” (Jones et al. 1994)
- biologically mediated modification of the abiotic environment has a major impact on the structure, function, and biodiversity of a wide range of ecosystems



EcoShape
building with nature

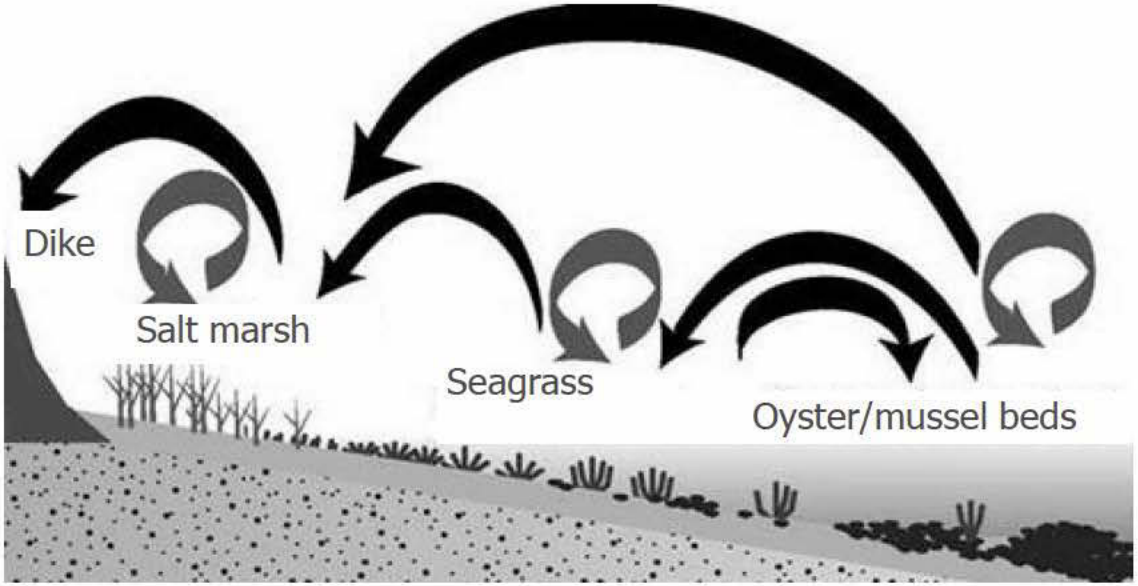
The concept of ecosystem engineers



EcoShape
building with nature

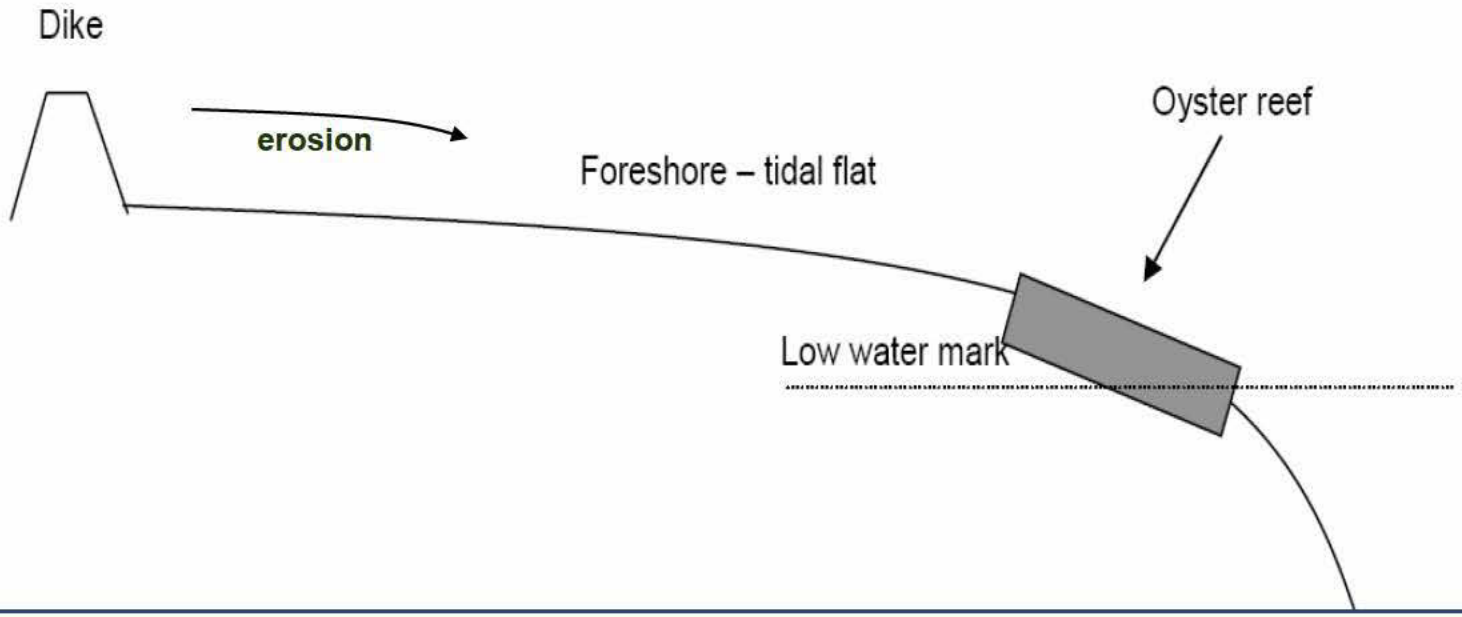
Coastal protection by applying the concept of ecosystem engineers

Ecosystem engineers such as reef building oysters can protect tidal flats from erosion, reduce wave energy, trap sediment, …and protect dikes



The use of ecosystem engineers in EDD

- the use of ecosystem engineers is successful when they are self-sustainable and stabilize tidal flats => artificial oyster reefs seem promising as substrate

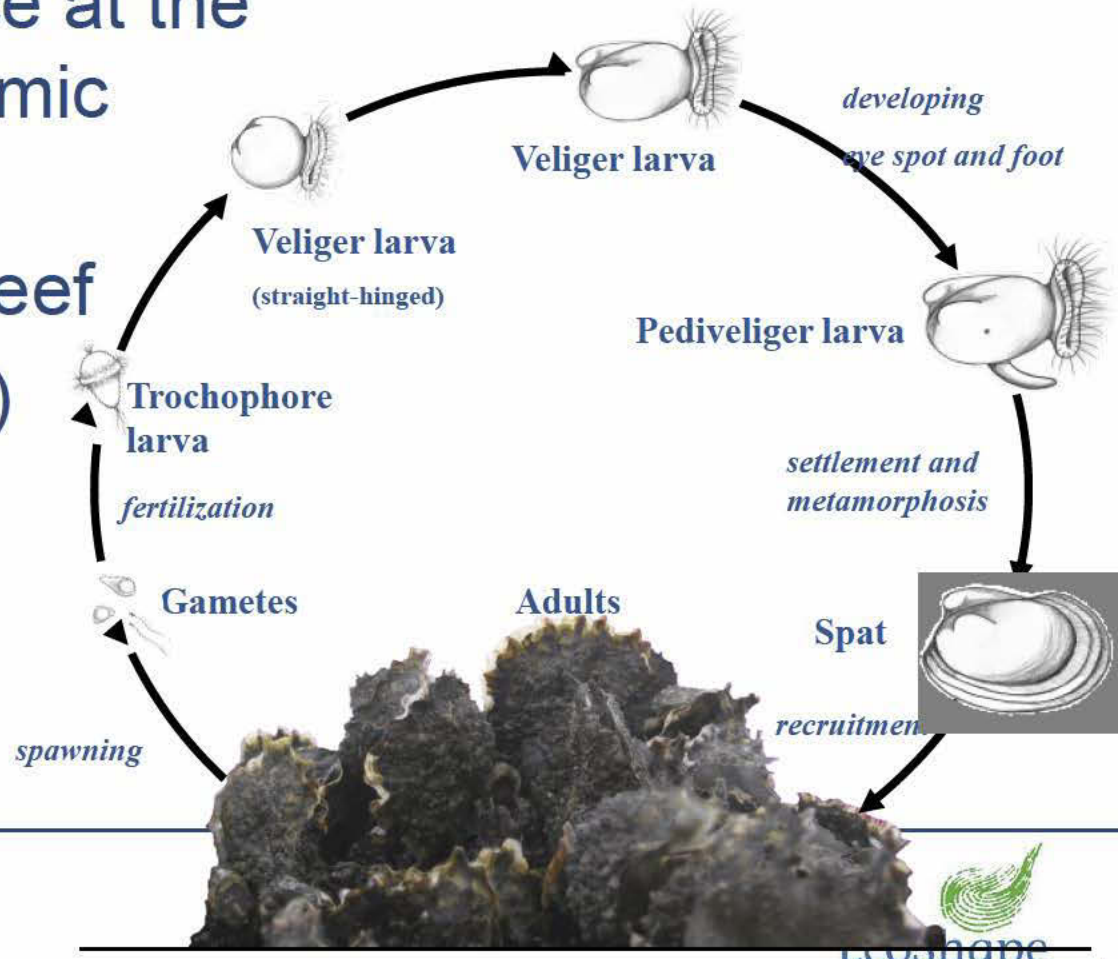


EcoShape
building with nature

The use of ecosystem engineers in EDD

- To become self-sustainable reefs, oysters need to settle, grow, survive and reproduce at the prevailing hydrodynamic conditions

⇒grow out to a living reef (and provide habitat)



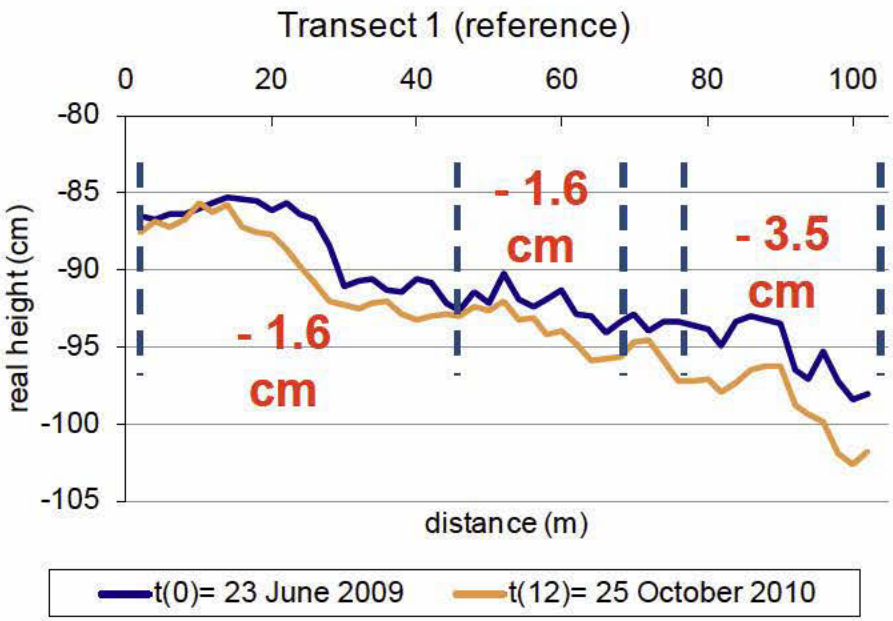
Pilot Ecosystem engineers

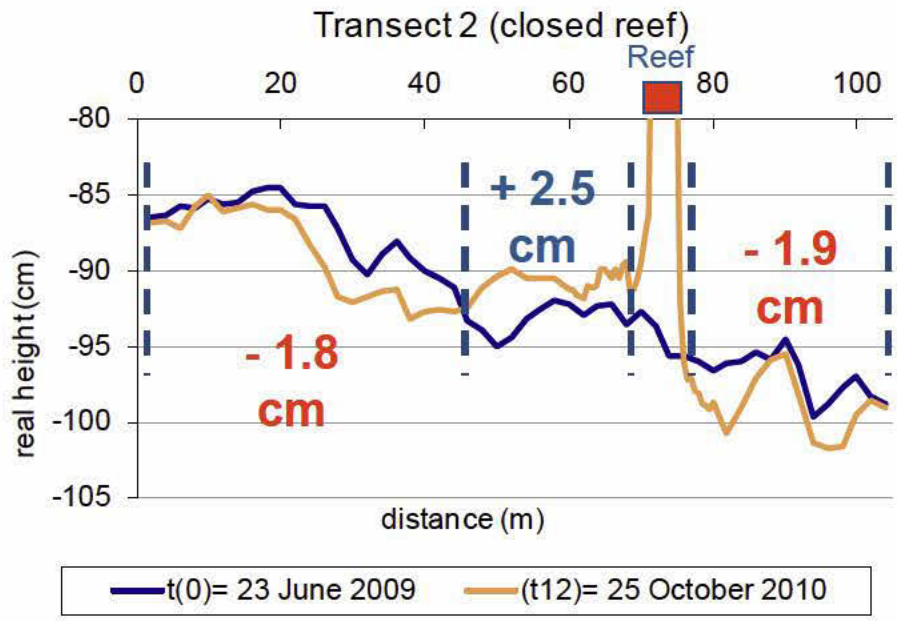
1. testing of different materials and cages in small-scale experiments => use of gabions most promising
2. Small scale pilot June 2009: gabions filled with oyster shells

± 100 m^2, 11000 kg oyster shells

Small-scale pilot: elevation changes

- Detailed height measurements along transects

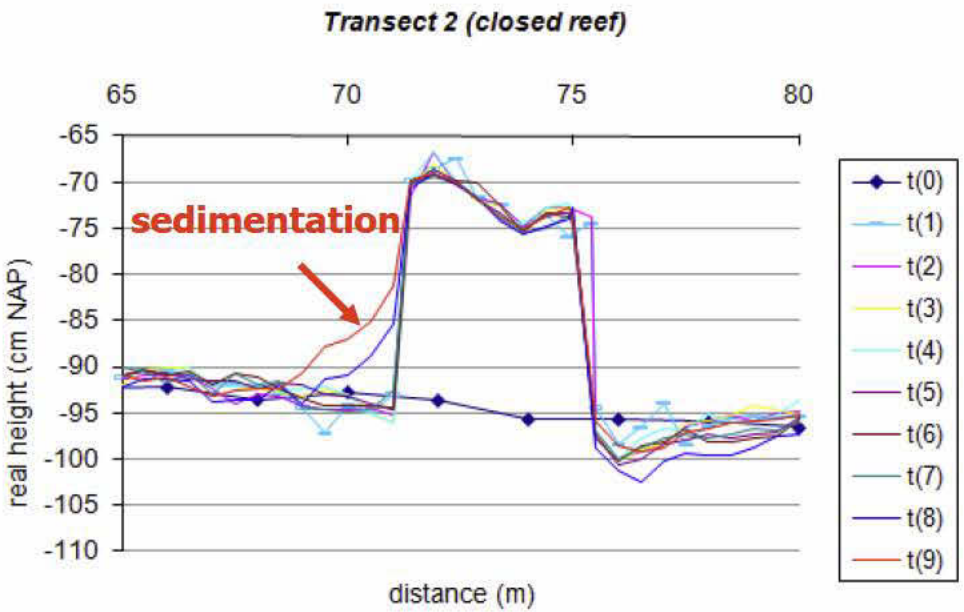




EcoShape
building with nature

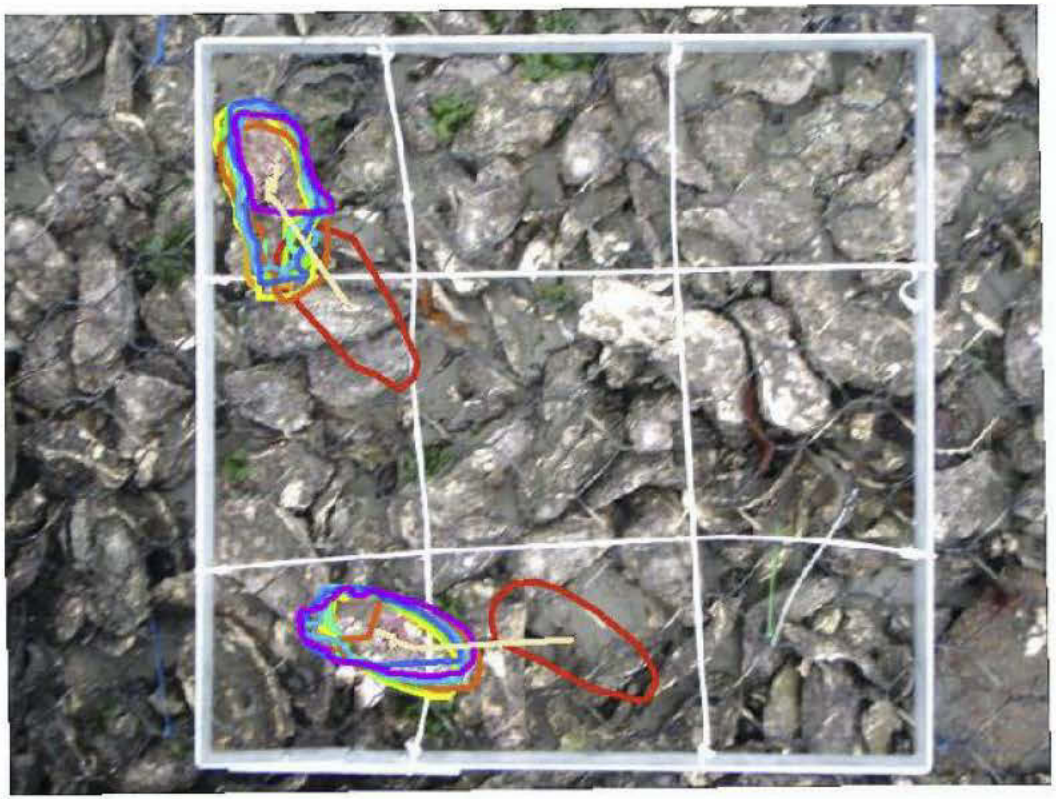
Small-scale pilot: elevation changes

- Sedimentation behind reefs



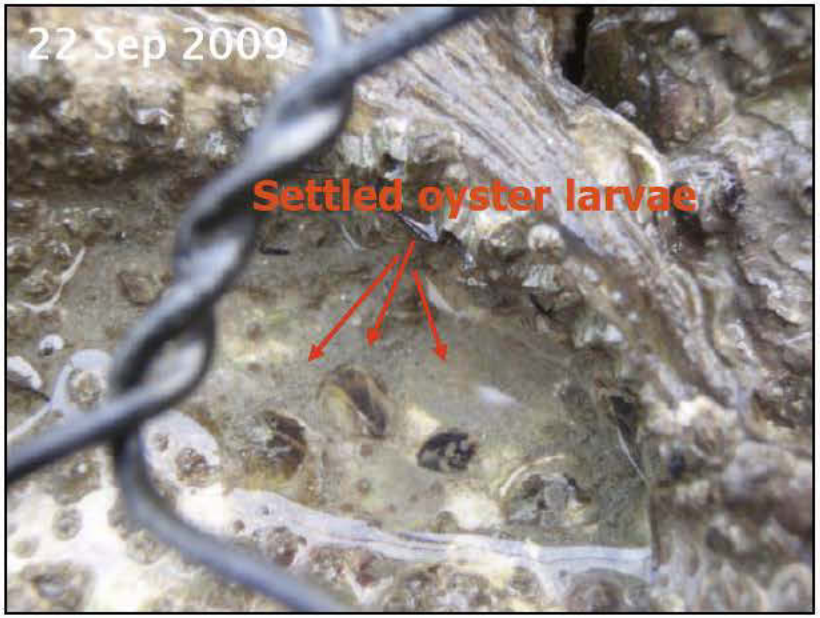
Small-scale pilot: shell stability

- Movement of oyster shells inside artificial reefs



EcoShape
building with nature

Small-scale pilot: settlement of oyster larvae



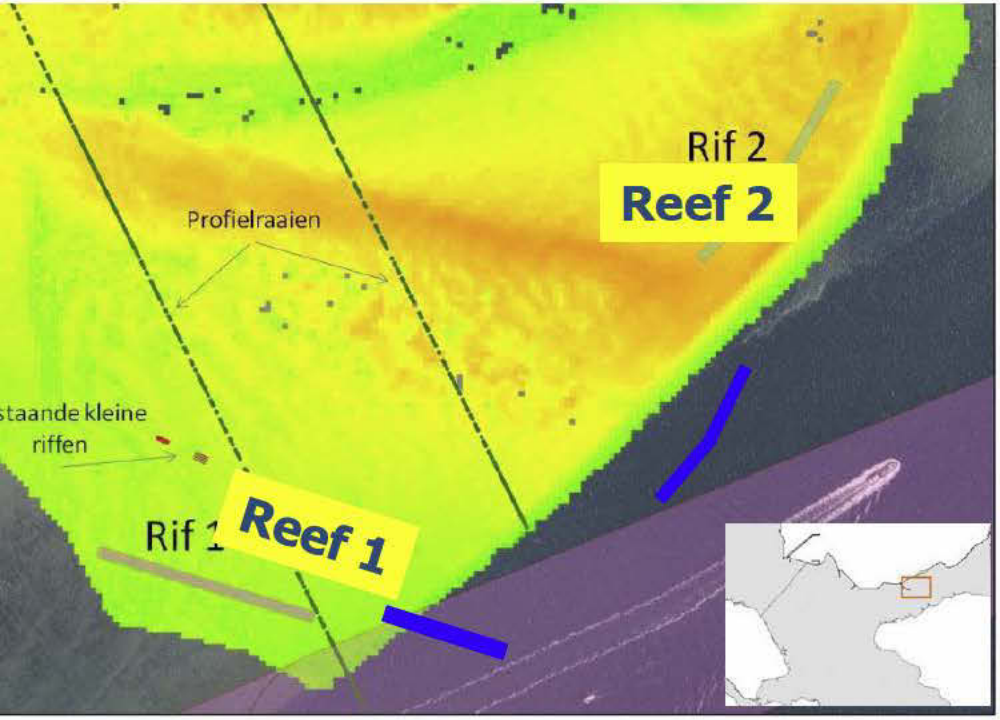
Small scale pilot: summary

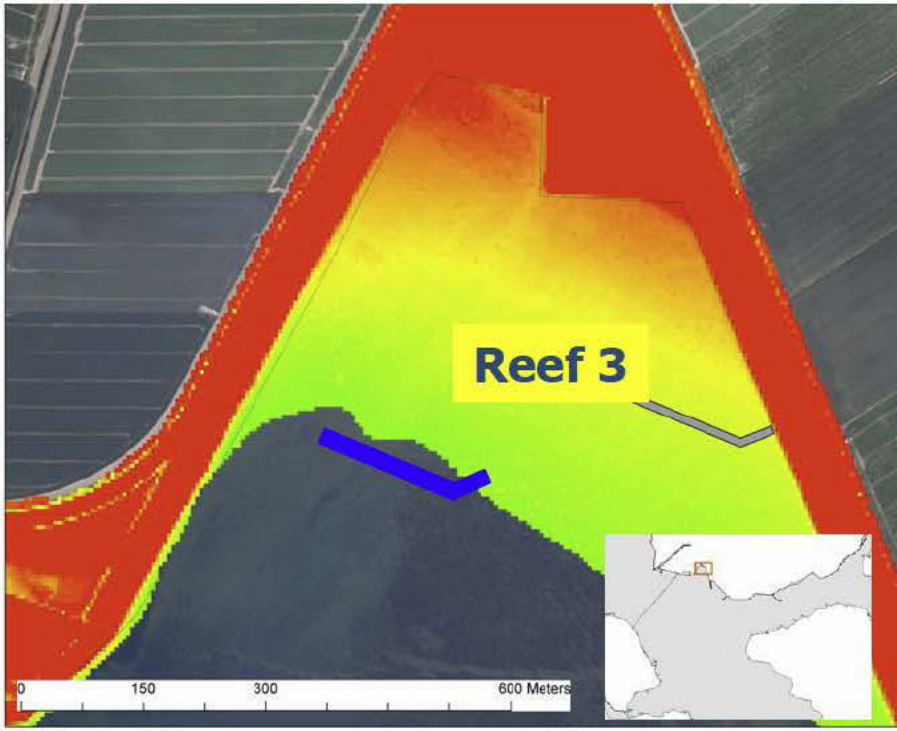
- Promising results with small artificial oyster reefs after one year:
  - Gabions with oyster shells are stable structures
  - Local sedimentation and reduced erosion observed behind reefs, surrounding tidal flat further eroding (± 2cm)
  - Oyster larvae settle and grow on artificial reef

EcoShape
building with nature

Upscaling 2010: large scale pilot

- Large scale pilot with three reefs of 200 x 10 meters





EcoShape
building with nature

Large scale pilot – realization

- First attempts with harness

EcoShape
building with nature

Large scale pilot – realization

- Adopted methodology

Large scale pilot – realization

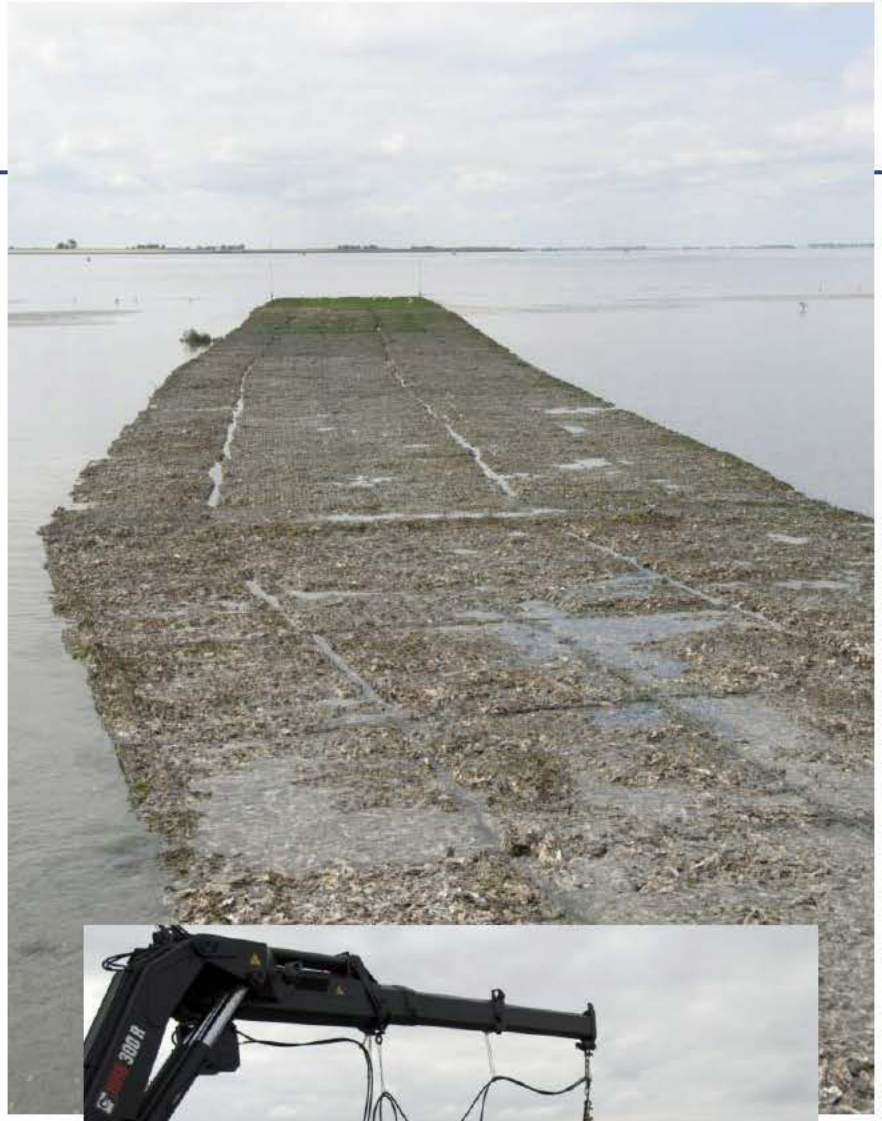
- Adopted methodology

EcoShape
building with nature

Large scale pilot – realization

- Adopted methodology

EcoShape
building with nature

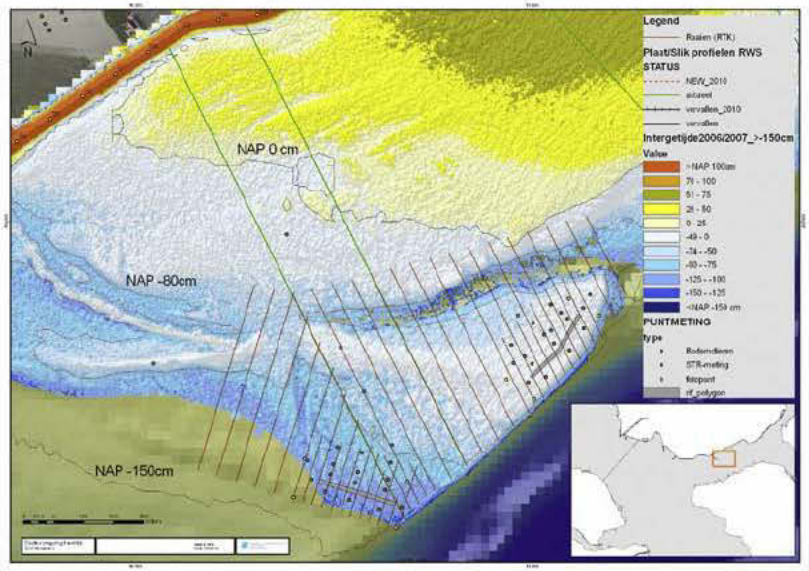


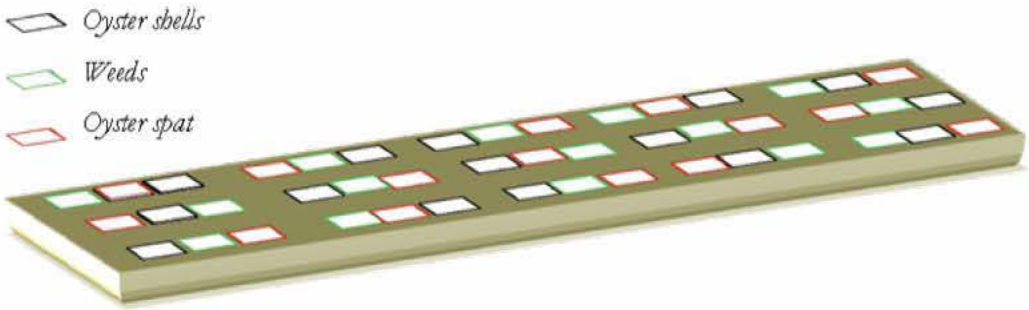
Each reef: 400 m^3,

± 230 tons of oyster shells

Monitoring programme

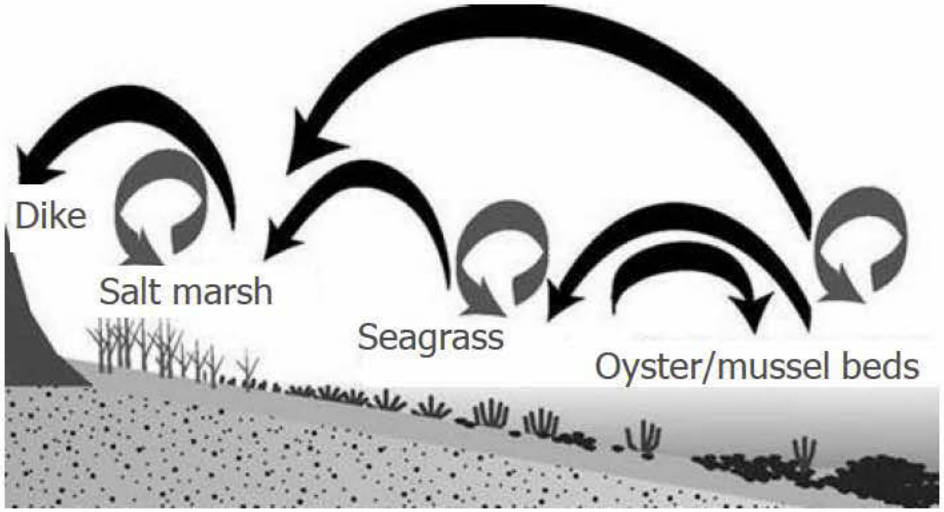
- Reef stability, oyster shell stability, algal coverage,
- Oyster recruitment, survival and growth
- (Hydro)morphological and ecological impact on tidal flat





A combination of measures

- Cascade of ecosystem engineers



- Nourishment of tidal flats

hape
building with nature

Building with Nature is
Building our Future

Thank you for your attention!

EcoShape | building with nature

www.ecoshape.nl

More ecosystem engineers in BwN programme:

Sea grass

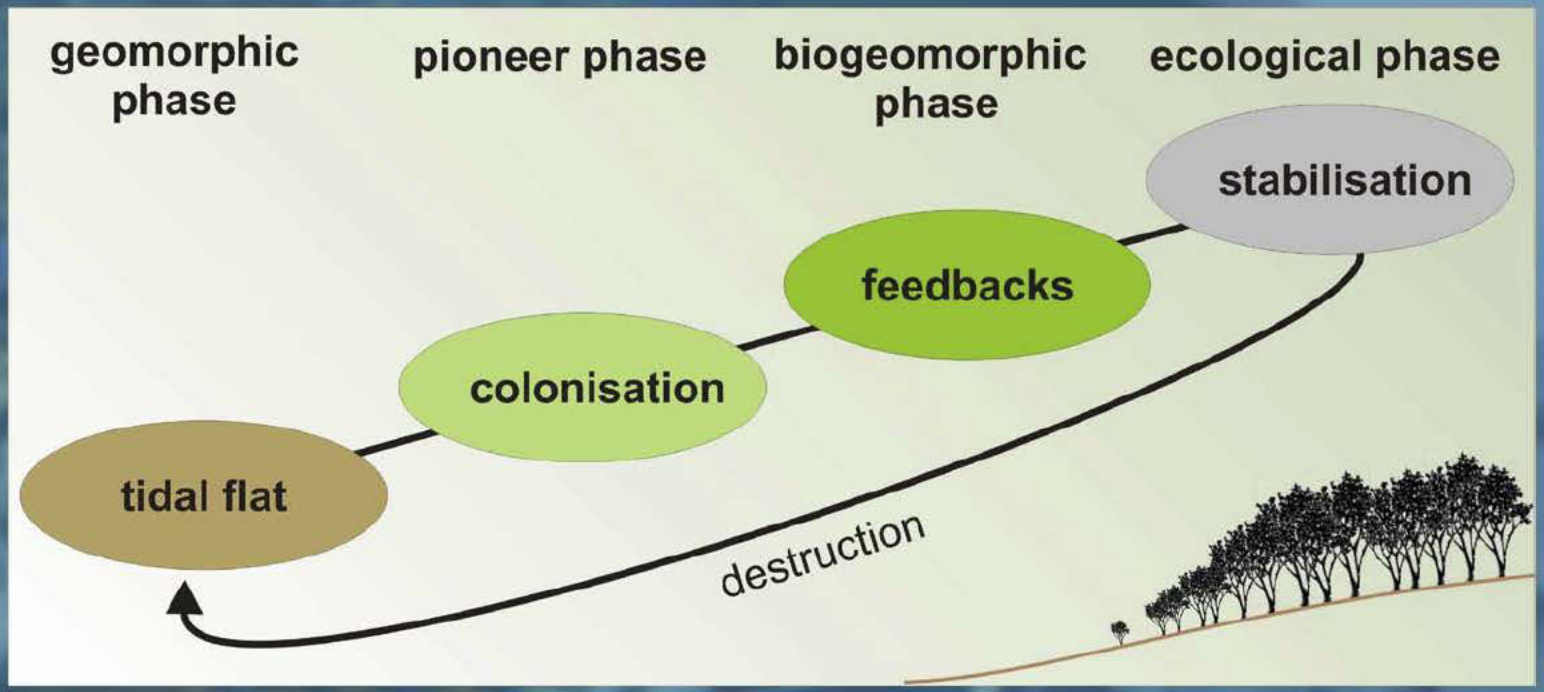
Salt marches

Mangroves

EcoShape | *building with nature*

Biogeomorphic succession of mangroves

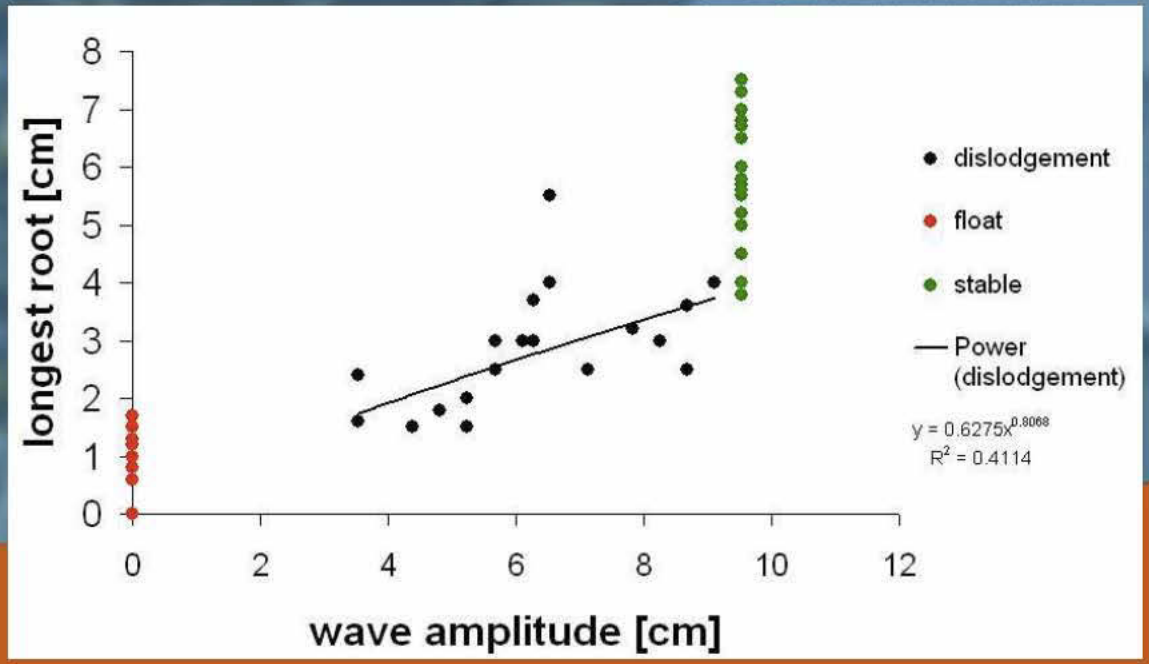
PhD research: Thorsten Balke



Concept of biogeomorphic succession by Corenblit (2007) modified for mangroves

EcoShape | *building with nature*

Flume tests on early establishment



EcoShape | building with nature