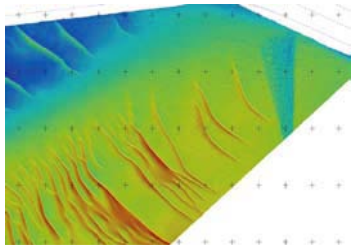
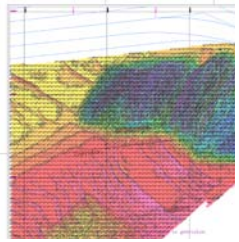
# Modelling the ecological potential of sand extraction in the Southern North Sea



Source: PUMA



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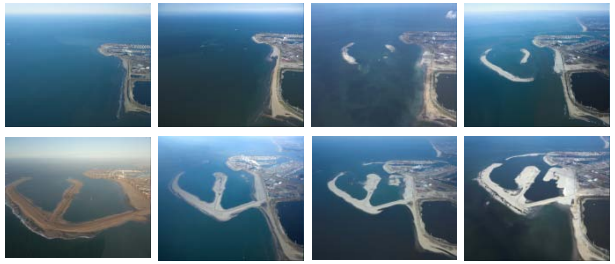

Source: HbR

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# Effects of sand extraction

- Direct removal of benthos.

- Seabed composition, bathymetry and hydrodynamic regime is altered heavily.

- Recolonisation of benthos is estimated to be 6yr.

But

- Can also lead to higher overall habitat diversity when designed wisely.

Investigate biological and physical effects of large scale deep sand extraction and ecological landscaping

Create ecologically valuable habitats through sand extraction and ecological landscaping

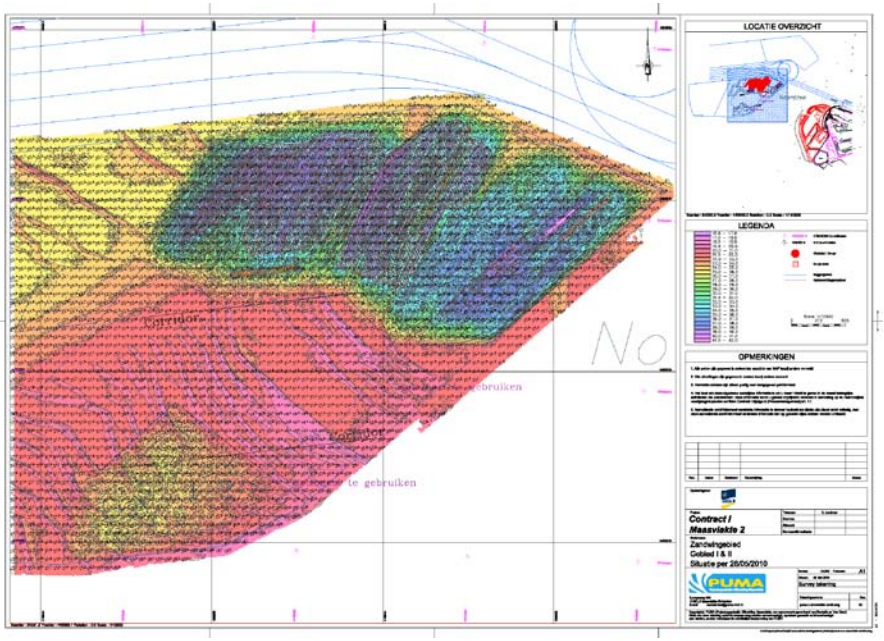
Identify most effective ecological borrow pit designs in the North Sea

# Sand extraction for the construction of the second expansion of Rotterdam harbour (MV2)

We use MV2 borrow pit as a pilot

- Scale, volume and extraction depth is new, biological and physical response unknown

- 220 $Mm^3$ marine sand is needed for the construction of the first phase of MV2




MV2 borrow pit (28 May 2010) parallel sandwave in progress

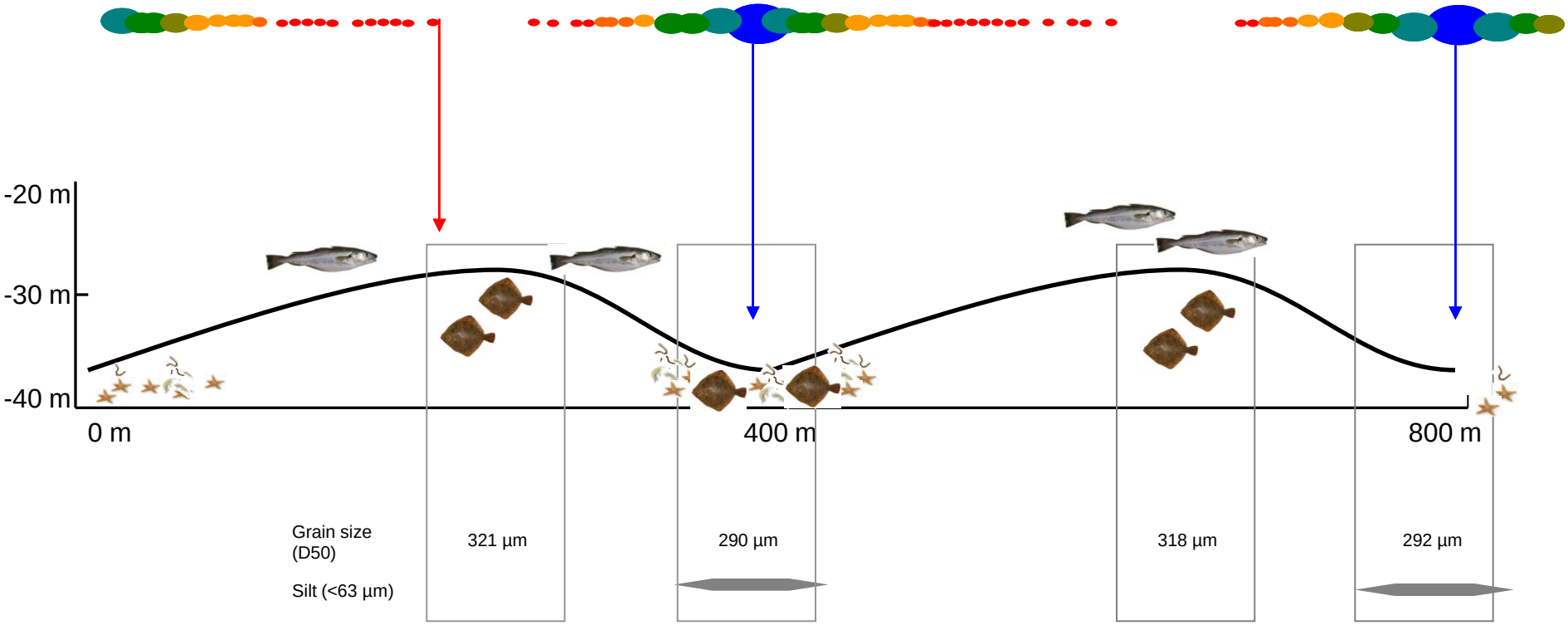
source: PUMA

# Ecological landscaping (I)

- Hypothesis: Mesoscale bedforms in the pit enhance local biodiversity and productivity.

- Bedforms and related differences (e.g. grain size and hydrodynamic regime) → high habitat heterogeneity → high biomass and biodiversity [Auster *et al.* 1995], [Baptist *et al.* 2006] and [Gibson and Robb 2000].

Hypothetical benthic fauna and demersal fish distribution

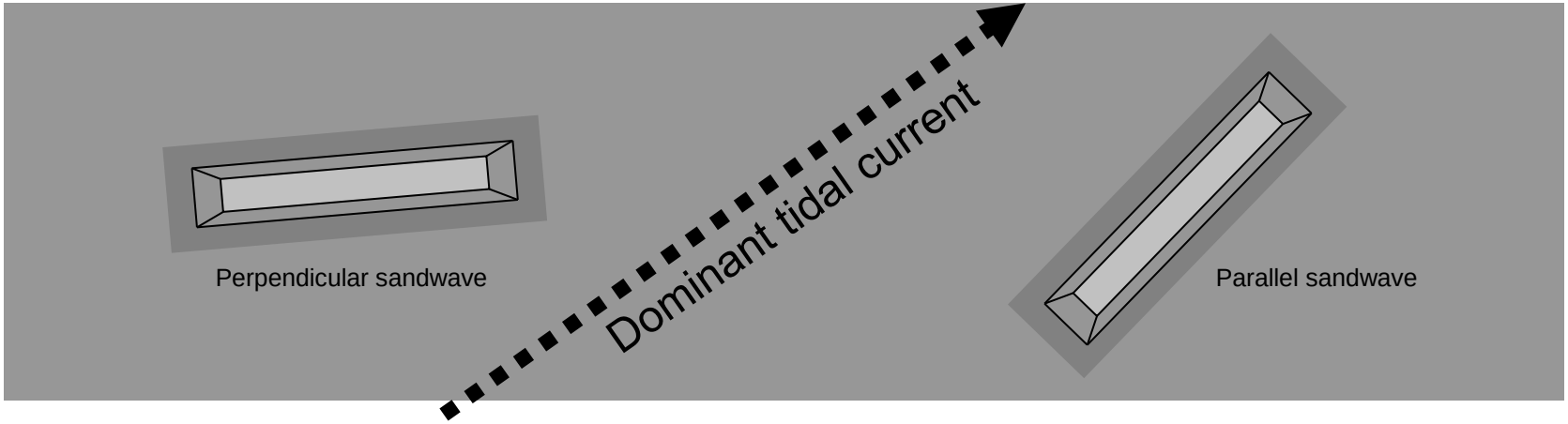


# Ecological landscaping (II)

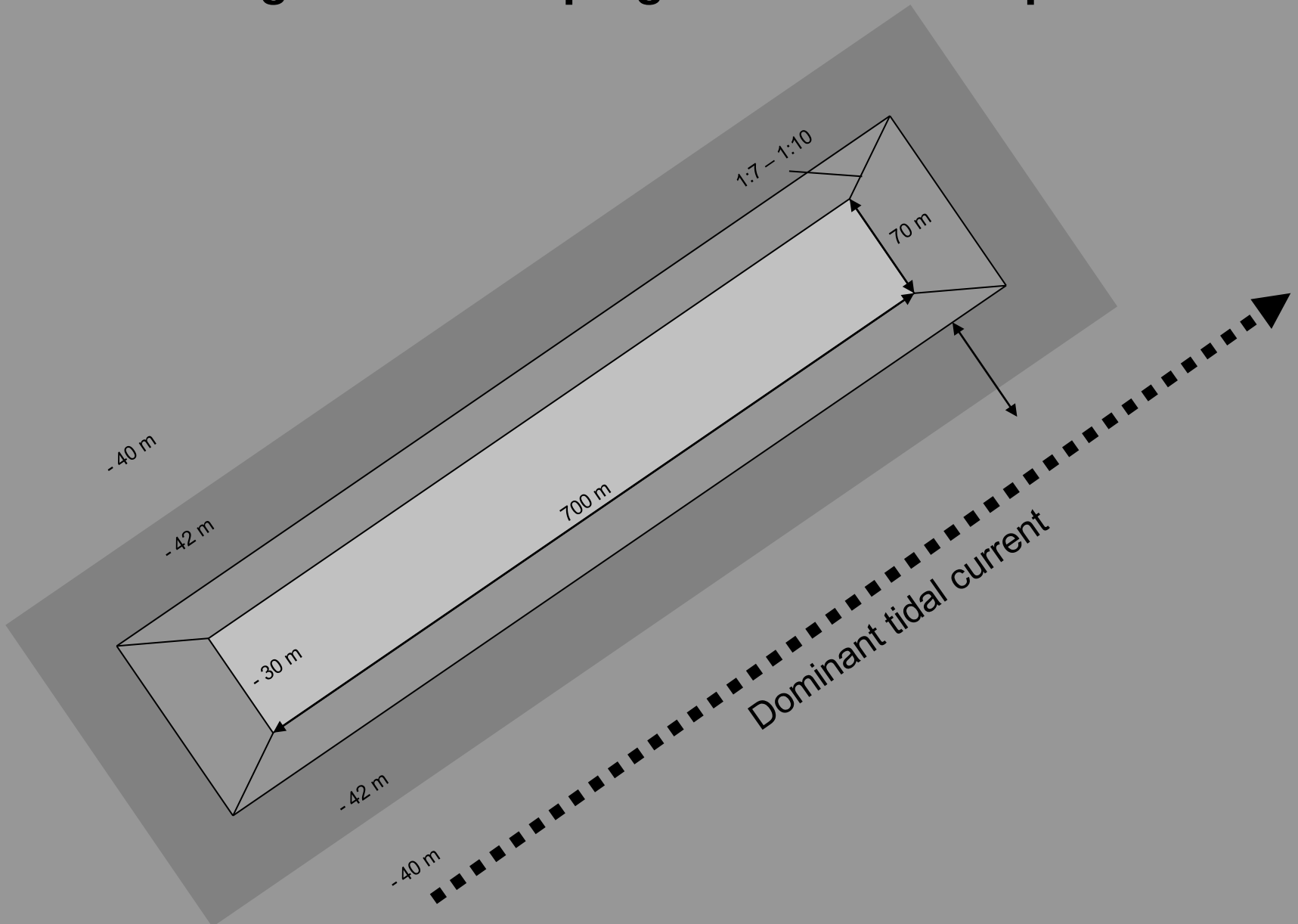
Artificially created sandbars in the borrow pit

- Sandwave parallel to tidal current (1-7-2010)

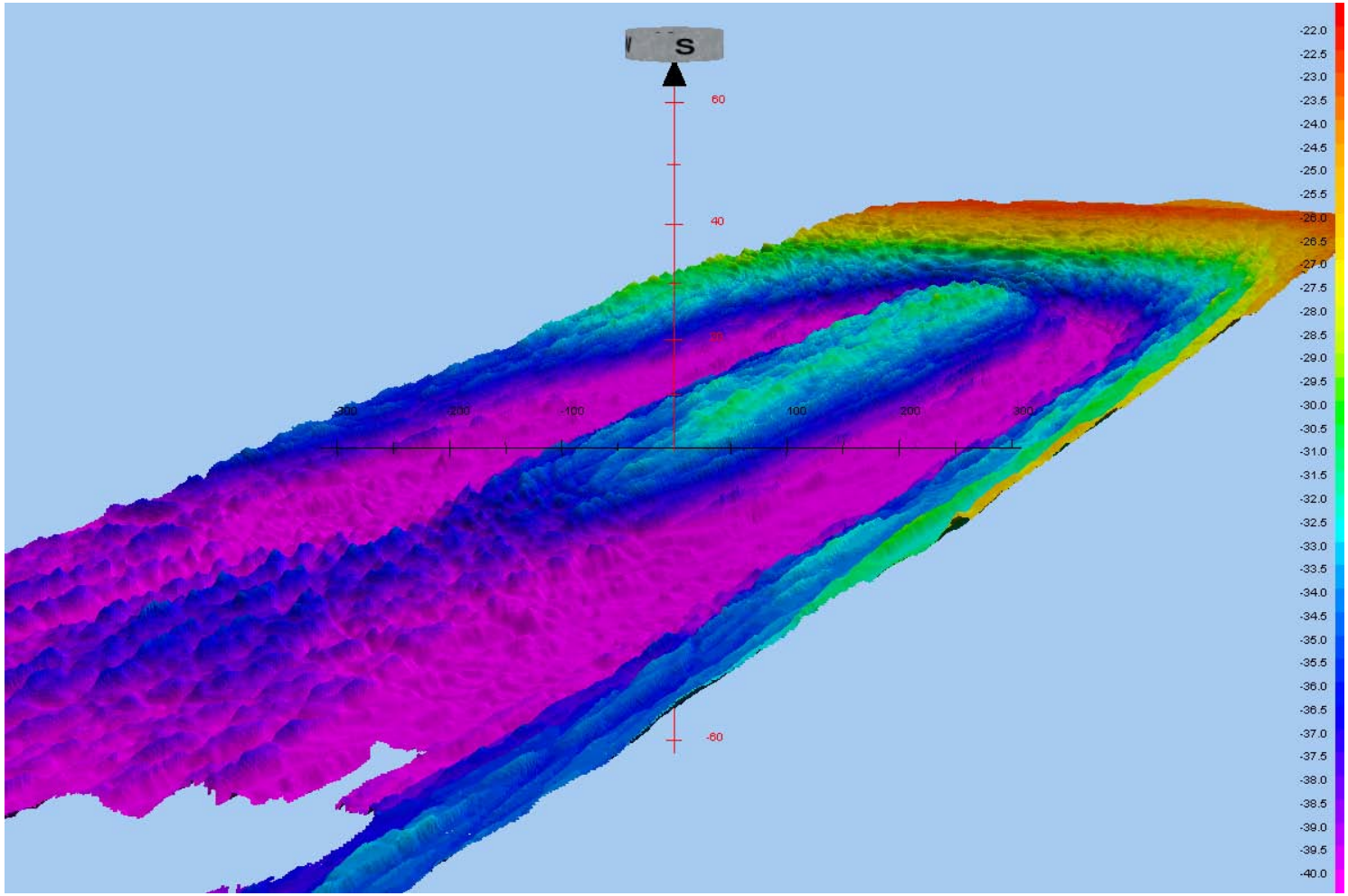
- Sandwave ‘perpendicular’ to tidal current (spring 2011)



# Ecological landscaping in MV2 borrow pit



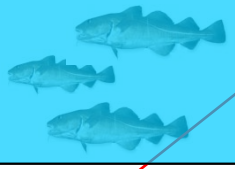
# Ecological landscaping (II)




Parallel sandwave in 3D (final)

# Monitoring program (T0,1,2)

CTD measurements (26 + 45)



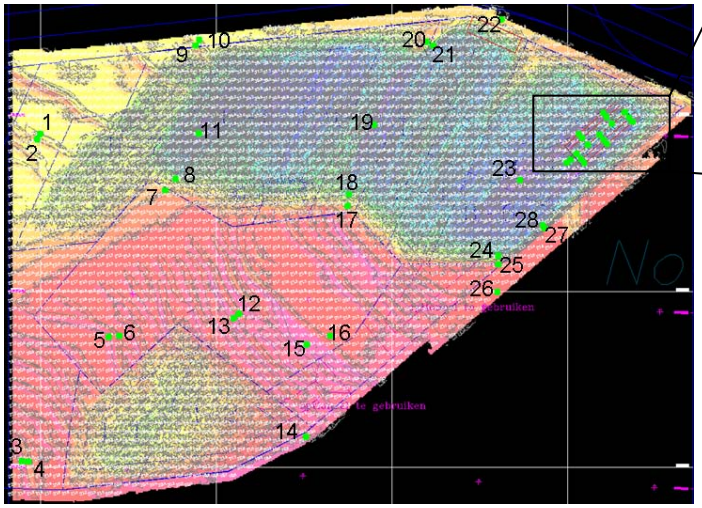
Bathymetry (side-scan sonar and multibeam)

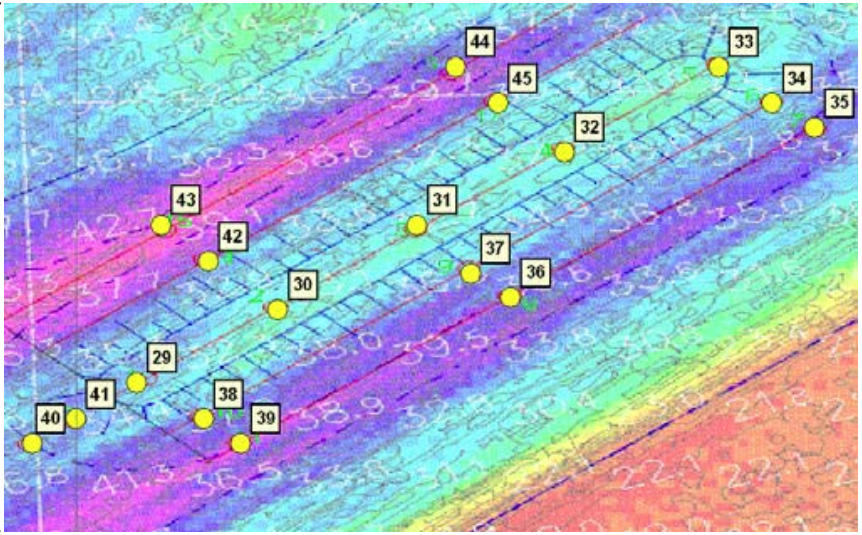
Epifauna (26) + Demersal fish (2*10)

Infauna + grain size analyses (45)

# Monitoring program (t0,1,2)

17 BC samples at top

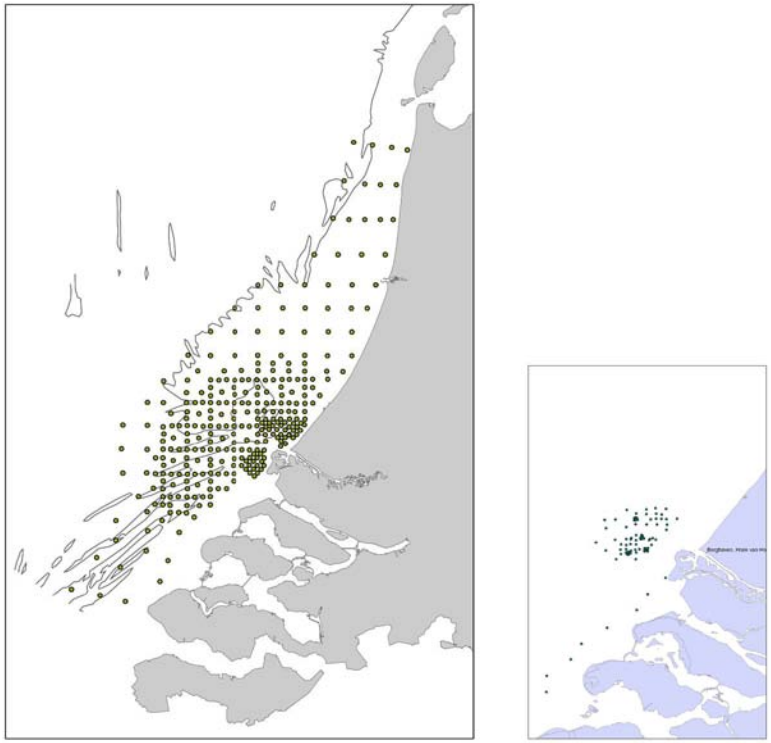


# EIA monitoring HBR + BwN monitoring program

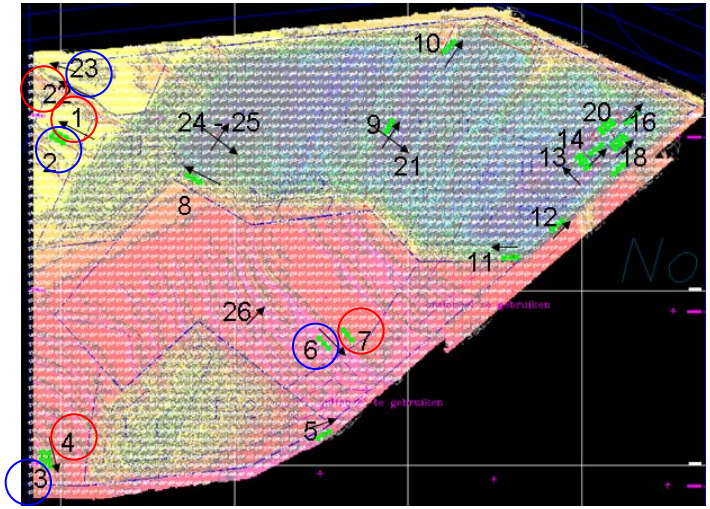
All data fully exchangeable with EIA monitoring of HBR (same sampling methods)

HBR monitoring (2006 (300 boxcore and bottom dredge), 2008 (300), 2009 (100) and 2010 (300)



# First results Bottom Dredge survey (II)

- average number and biomass outside borrow pit at trough and crest of sand wave




Trough

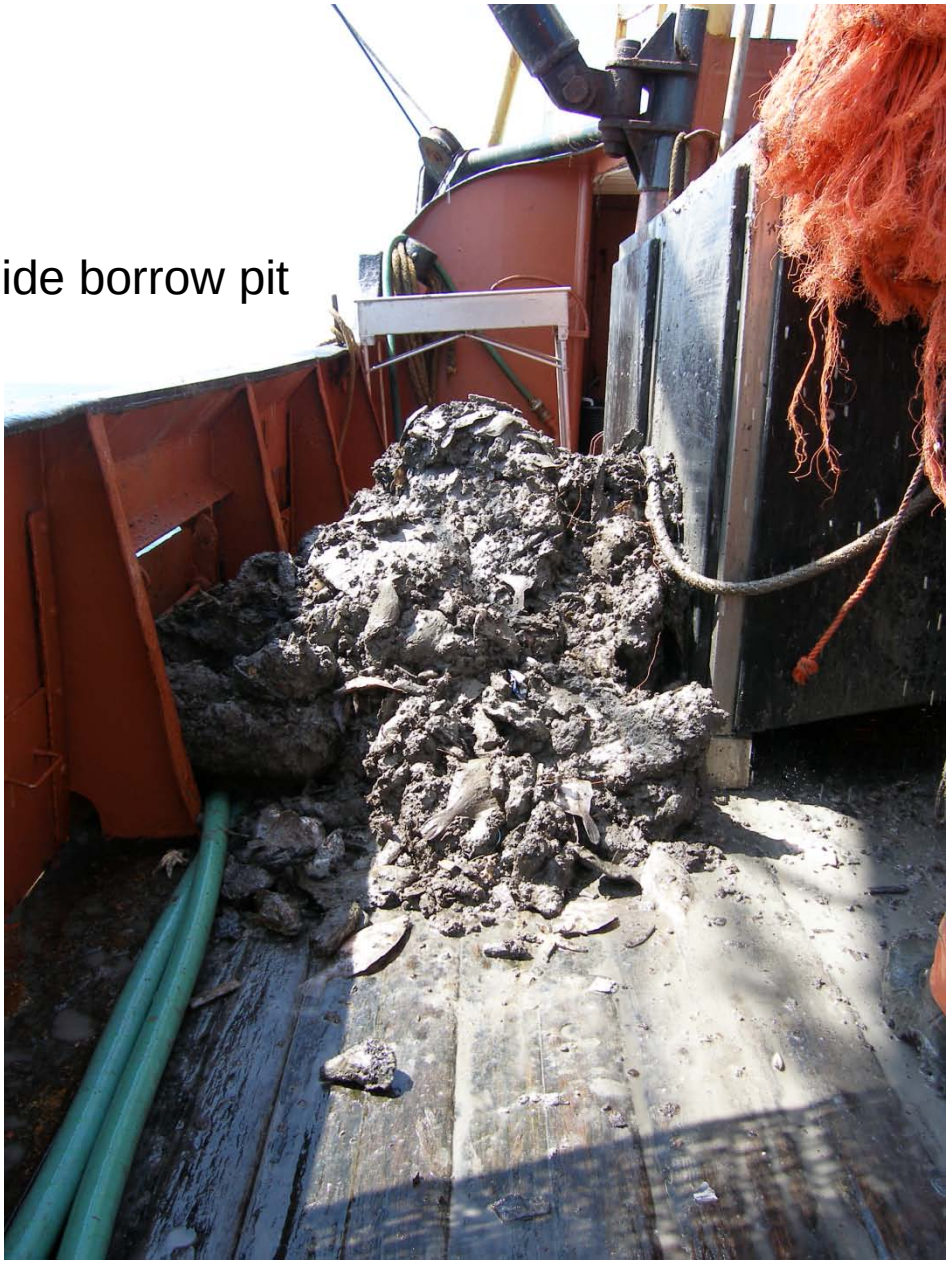
Crest

| | number/ $m^2$ | t-test (10 log) | Biomass ($g/m^2$) | t-test (10 log) |
|---|---|---|---|---|
| Trough | 18.05 | | 40.09 | |
| Crest | 4.05 | 0.079 | 10.76 | **0.047** |

Also significant difference in epifaunal density at crests and troughs of sand waves

# First results

- Inside borrow pit



- Outside borrow pit

# First results fish survey (I)

- Based on first results, no significant difference in numbers of fish (in- and outside)

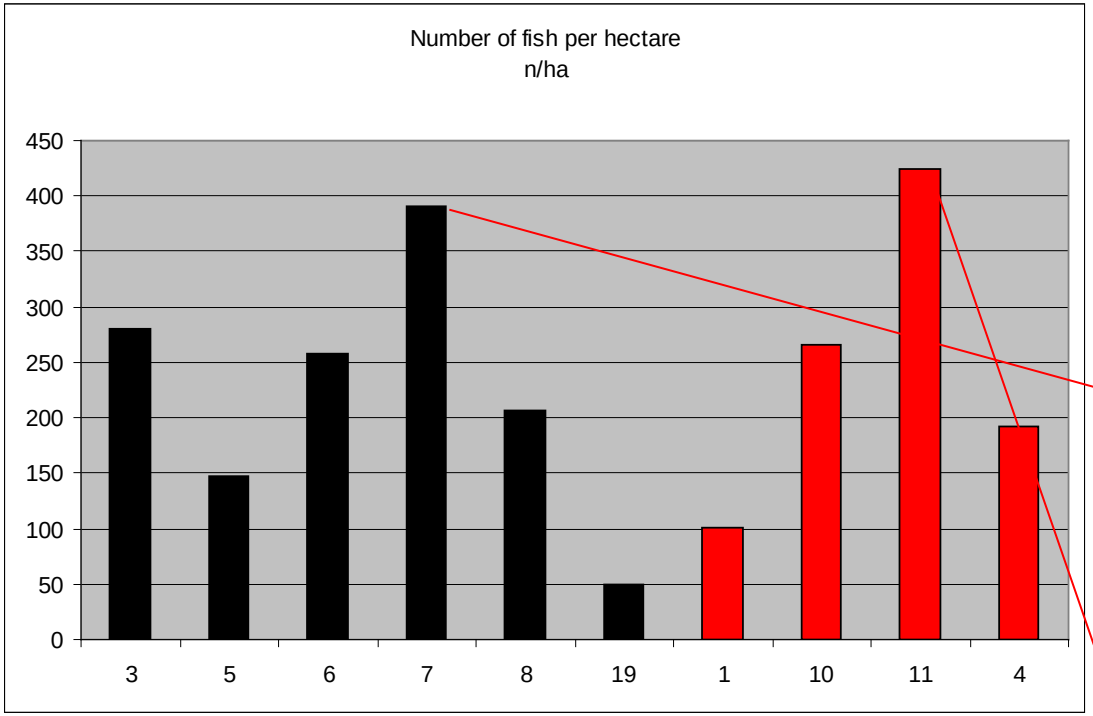
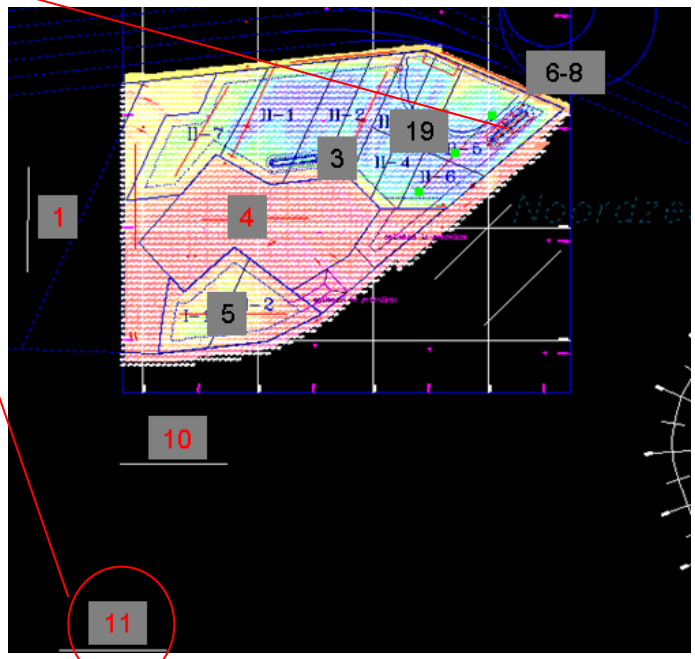



Fig. 1: Demersal fish abundance in- and outside the borrow pit (black and red bars).

Highest number of fish at top op artificial sandwave!



# Coupling to eco-morpho-dynamic model

- Multibeam data were used as input for a Delft3D model (100x100 m grid).
- Simulated environmental variables (bed shear stress, salinity and water depth) are combined with threshold values for biota to produce prediction maps