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Extended Abstract

## The added value of ‘small-scale’ monitoring of the soft-sediment endobenthos around offshore wind farms in the Belgian Part of the North Sea

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**Abstract:** From 2005 onwards, a baseline monitoring programme was carried out to assess whether the construction of offshore wind farms induced changes in the soft-sediment endobenthos in the Belgian Part of the North Sea. The natural, temporal variability of the endobenthos was detected without any apparent effects from the wind farms. To understand underlying processes and detect future effects, a targeted (small-scale) sampling strategy was initiated in 2010, alongside the baseline monitoring activities. The sandy offshore sediments near one gravity based foundation (GBF) can be altered due to (1) previously created pits, (2) changing hydrodynamics, (3) organic enrichment and (4) prohibition of beam trawl fisheries. Benthic samples were therefore taken at 1, 7, 15, 25, 50, 100 and 200 meters from the scour protection system and along four gradients, in order to stress the importance of currents around the GBF. In 2010, high mean total densities and macrobenthic biomass were detected at one and seven meters from the GBF. The natural occurring *Nephtys cirrosa* community shifted to a community dominated by *Monocorophium acherusicum*, *Lanice conchilega* and *Spiophanes bombyx*. One year later, higher macrofaunal densities were also observed at 15 and 25 meters from the GBF and this primarily on the Southwest gradient. Furthermore, a decline in median grain size was observed between 2010 and 2011, suggesting changing hydrodynamics around the GBF. These results illustrate the importance of dedicated small scale and short term investigations in national monitoring strategies for offshore wind farms as they permit a better understanding of the large scale observations.

**Keywords:** North Sea, Benthos, spatial and temporal patterns

### Introduction

During the coming years, the construction of many offshore renewable energy installations have been planned in European waters enhancing the need to investigate potential effects on the marine environment, both at a small and large scale. The implementation of four offshore wind farms has been accepted in the Belgian Part of the North Sea, of which two are currently operational on the Thorntonbank (since 2009) and Bligh Bank (since 2010). From 2005 onwards, a baseline monitoring programme was initiated to assess whether the construction and exploitation of offshore wind farms in the Belgian Part of the North Sea would induce changes in the soft-sediment macrobenthos. No apparent effects of the wind turbines were detected at a large scale during the first years after construction (Reubens *et al*, 2009). However, a smaller scale pilot study in close vicinity to one gravity based foundation was initiated in 2010 to understand underlying processes and enhance our ability to predict future effects. A shift from a *Nephtys cirrosa* community to a community dominated by *Monocorophium ascherusicum*, *Lanice conchilega* and *Spiophanes bombyx* was detected, concurrent with a decrease in median grain size at one and seven meters from the boulders (Coates *et al*, 2011). The objective of the small scale study in 2011 was to further investigate the observations and monitor any considerable changes.

## Materials and Methods

Sediment samples were collected in 2011 along four gradients (Southwest, Southeast, Northwest and Northeast) around one gravity based turbine (D5) on the Thorntonbank. Along each gradient, samples were collected at 15, 25, 50, 100 and 200 meters from the scour protection layer (boulders) with a small Van Veen grab (0.0247m<sup>2</sup>) (Figure 1). Only one macrobenthos sample could be collected by divers at one meter from the boulders (Southwest gradient) using an air-lift suction device. Sampling on the Northeast gradient was limited to 100 and 200 meters from the scour protection system due to the presence of cables on the seabed.

The grain size partition and organic matter content (TOM%) were analysed for every sample. Macrobenthic densities were standardised to the number of individuals per m<sup>2</sup> (abundance) and the biomass of every species in every sample was determined. For further information on the statistical analyses Coates *et al*, 2012 can be consulted.

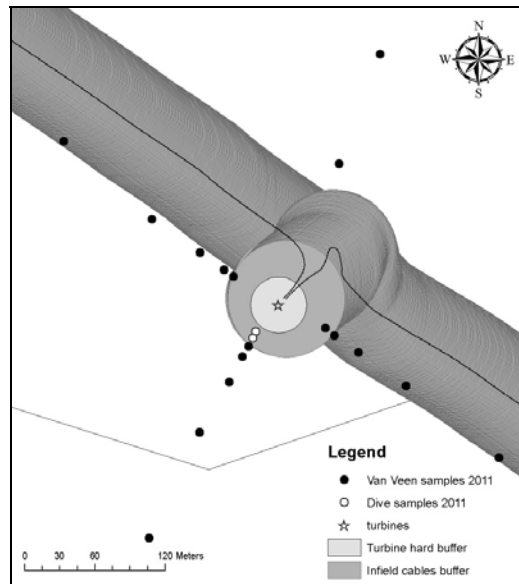


Figure 1. Sampling locations of the 2011 targeted monitoring campaign around a GBF. Stations close to the turbine (White) were taken by divers, stations further away (Black) were taken with a small Van Veen grab.

## Results and discussion

Significant sedimentological changes were observed around the GBF. Results illustrate a decreasing median grain size in close vicinity to the turbine on the Southwest and Northwest gradients (Figure 2A). The lowest value measured was 247µm at one meter on the Southwest gradient and a significant difference was detected between 15 and 200 meters on the Northwest gradient.

The total density was mainly dominated by juvenile starfish (*Asteriidae* juv.) on the Southwest gradient with a peak of 62132 ind./m<sup>2</sup> at 25 meters from the boulders around the turbine. Omitting the juvenile starfish from the dataset revealed an increasing density closer to the turbine and this mainly on the Southwest and Northwest gradients (Figure 2B). Species richness and taxonomic distinctness showed similar results with significantly higher values at 15 and 25 meters distance from the boulders.

In 2010, changes in the macrobenthic community were observed at a distance less than 15 meters from the boulders with an accumulation of the polychaete *Spiophanes bombyx* and the ecosystem engineer *Lanice conchilega*. One year later, the changing macrobenthic community extended up to 50 meters distance, this time with an accumulation of the juvenile starfish.

Up till now, the targeted monitoring has revealed its significance by illustrating how dynamic the macrobenthic community is in close vicinity to the GBF, both spatially and temporally. These results enable a better prediction of wind farm effects on sediment communities after the construction of the planned offshore wind farms across Northwest Europe in the future.

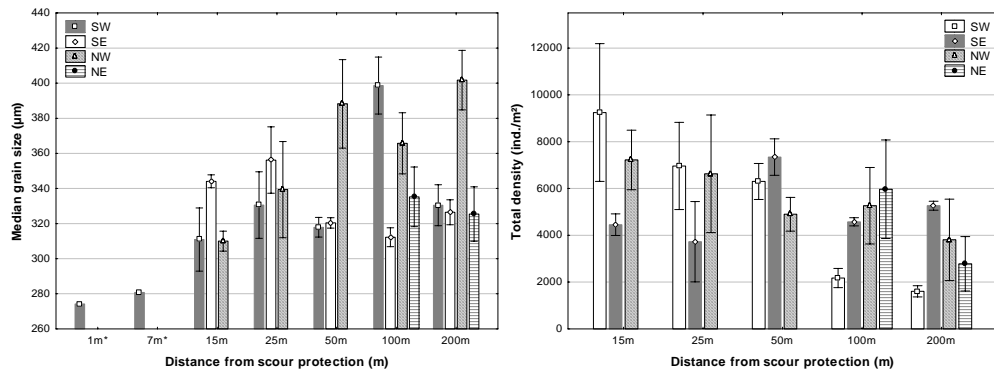


Figure 2. A: Median grain size ( $\mu\text{m}$ ) and B: Total density ( $\text{ind./m}^2$ ) from one to 200 meters from the boulders along four gradients in 2011. \* Samples at 1&7m taken during diving activities.

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### References

- Coates D, Vanaverbeke J, Rabaut M, Vincx M (2011) Soft-sediment macrobenthos around offshore wind turbines in the Belgian Part of the North Sea reveals a clear shift in species composition. In *Offshore wind farms in the Belgian part of the North Sea: Selected findings from the baseline and targeted monitoring.*, Degraer S, Brabant R, Rumes B (eds), Chapter 6, pp 47-63. Royal Belgian Institute for Natural Sciences, Management Unit of the North Sea Mathematical models.
- Coates D, Vanaverbeke J, Vincx M (2012) Enrichment of the soft sediment macrobenthos around a gravity based foundation on the Thorntonbank. Royal Belgian Institute for Natural Sciences, Management Unit of the North Sea Mathematical models. In prep.
- Reubens J, Vanden Eede S, Vincx M (2009) Monitoring of the effects of offshore wind farms on the endobenthos of soft substrates: Year-0 Bligh Bank and Year-1 Thorntonbank. In *Offshore wind farms in the Belgian part of the North Sea: State of the art after two years of environmental monitoring.*, Degraer S, Brabant R (eds), Chapter 6, pp 61-91. Royal Belgian Institute for Natural Sciences, Management Unit of the North Sea Mathematical models.