

A long term standardized assessment of the influence of dredge disposal activities on different ecosystem components in the Belgian part of the North Sea

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Dredging and the associated dredge disposal activities are necessary to prevent harbours and navigational channels from silting up. Possible effects of dredge disposal are for instance smothering of benthic organisms, loss of habitat, contamination of the site and sediment changes. In the Belgian part of the North Sea (BPNS), five locations (Br&W Zeebrugge; Br&W S1; Br&W S2; Br&W Oostende; Nieuwpoort) are designated as disposal sites. These sites are situated in three different habitats (*Abra alba*, *Macoma balthica* and *Nephtys cirrosa* habitat). The Marine Strategy Framework Directive requires monitoring of these sites to assess whether the benthic habitats are adversely affected. At the moment, data is available, covering a period of 15 years (2005-2019) to assess the impact of dredge disposal in the three habitats. Besides the time span, this study is also unique as it focuses on three ecosystem components (macrobenthos, epibenthos and demersal fish), whereas the majority of studies focuses on macrofauna (Dauvin *et al.*, 2022; Bolam *et al.*, 2016). To have a standardized evaluation methodology, the Benthic Ecosystem Quality Indicator (BEQI) (www.beqi.eu) was calculated according to a control-impact design. Within this analysis, four parameters (species richness and composition, density and biomass) were compared between the set of impact samples (disposal sites) and control samples. That way, BEQI scores between 0 and 1 for each parameter were calculated, where values below 0.6 implied that the system deviated from the control. For macrobenthos, the BEQI was calculated per year, while for epibenthos and fish, periods of 4-5 years were used for the calculation (2005-2009; 2010-2015; 2016-2019), since the confidence of the BEQI assessment increased with sampling size. As the disposal intensities (i.e. pressure) differed throughout the years and at the different disposal sites, linear mixed-effects models (LMM) were performed to define the relationship between the pressure and the BEQI scores for each parameter and ecosystem component. Pressure and habitat were defined as fixed effects, while disposal site and year or period were set as random factors.

According to the BEQI assessment, the highest impact was observed on the macrobenthic community at the disposal site Br&W S1 within the *Abra alba* habitat, where the highest amount of dredged material was disposed yearly. The BEQI scores were also low for epibenthos and fish, probably because of indirect sediment changes and shifts in the macrobenthic community. The impact was lowest at the disposal site with the lowest pressure (Nieuwpoort). At Br&W Zeebrugge and Br&W Oostende, a good similarity between impact and control was observed, although the dumping intensities were high throughout the years at Br&W Zeebrugge. This was probably because the disposed material was similar to the receiving habitat (muddy sediments within the *Macoma balthica* habitat), minimizing the impact, as the sediment has not changed. The impact was evaluated as low at the site Br&W S2 within the sandy *Nephtys cirrosa* habitat, probably because there was an attraction of new species associated with muddy sediments. The epibenthic and fish community was in most cases very similar between impact and control, probably because of the higher mobility of these organisms (except for Br&W S1). The LMMs demonstrated that the impact on the (macro)benthic community significantly increased as function of an increasing pressure, which was not the case for the epibenthic and fish community. Unfortunately, it was statistically not possible to detect a significant different impact for the three habitats based on the current dataset, despite some pressure-response differences in the habitats. To show whether the pressure response differ statistically with habitat type, more data are required, especially in sites with intermediate disposal intensities. Also a more extensive dataset for epibenthos and fish is required in future studies. The present study indicates that the influence of dredge disposal on the seafloor ecosystem varies with pressure intensity, ecosystem component and habitat type. These findings are relevant for a sound management of dredge disposal in the BPNS.

References

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Keywords

Dredge Disposal; Benthic Ecosystem; BEQI; Linear Mixed-Effects Models; BPNS