farm is strongly comparable to the one carried out for the Offshore Wind Farm Egmond aan Zee (OWEZ).

Contact: Arjen Boon, Deltares Research Institute

Belgium: Six years of Belgian research on the environmental impact of offshore wind farms, was compiled in a concluding report and presented by Belgian scientists at an international scientific symposium (26, 27 and 28 November 2013), organised by the Royal Belgian Institute of Natural Sciences, Operational Directorate Natural Environment. The research executed by ILVO takes part of this monitoring project and focusses on the wind farm effects on epibenthos and demersal fish of soft substrates and on the effects of pile driving on fish larvae and eggs.

For the baseline monitoring, epibenthos and fish were investigated within a BACI design. Samples were taken before and after wind farm construction, in impact and control areas. Several significant results were observed within the BACI design and within a certain year, for several parameters. At the Thorntonbank for example, the length of dab was significantly lower at the sand bank top in autumn 2012 as a result of the wind farm presence. Similarly at the Bligh Bank, significant results were noted: possible edge effects for sole density in spring 2012 and wind farm effects for ophiuroids in 2009.

One of the targeted monitoring topics is the investigation of any changes in fisheries activities in the vicinity of the wind farms. Vessel Monitoring System data indicated three zones with an increase and one zone with a decrease in fisheries activity in areas surrounding the wind farms. This might be a redistribution effect or it may indicate a local change in availability of commercially interesting fish species. Results on the presence of demersal fish in the vicinity of the wind farms showed no major differences concerning species of commercial interest. So, the observed changes are likely due to a redistribution process. Data on recreational fisheries (from ship based survey observations) indicated a concentration of angler activity around the Gravity Based Foundations in 2008/2009. The year after, that concentration was mostly gone. Two hypotheses are suggested: there was less fish than expected or the wind farms were too far for day trips. Extra research is needed to see what happens with recreational fishing effort.

Another targeted monitoring topic is the investigation of the feeding guild structure of several fish species by stomach analysis. Data from a small-scale pilot study at the Thorntonbank in 2010 showed little differences in the diet of dab originating from inside and outside the wind farm. The most abundant hard substrate species present on the turbines could not be found in the stomachs of dab. This may be linked with the small sampling size, the sampling distance or the prey preferences of dab.

The effects of pile driving noise on sea bass have mainly been studied in the lab. The first field experiments close to the pile driving activity were performed in 2013. The experiment was performed on board of a piling vessel exposing young European sea bass to a complete piling event as close as 45 m from the pile driving activity. The young sea bass did not die immediately or during the following two weeks after exposure. No abnormalities were found in the skeleton. The stress level of the fish was assessed by measuring the oxygen consumption during exposure. A depressed respiration during exposure indicates a certain level of stress. The growth and condition of the fish was monitored over one month and was not affected by this rather short-term exposure. This suggests that pile driving has no long-term impact on the fitness of sea bass.

To answer the research question 'Are wind farms functioning as spawning and nursery areas?' data still have to be analysed.

Contact: Jozefien Derweduwen, Institute for Agricultural and Fisheries research (ILVO), Animal Sciences, Aquatic Environment and Quality, Bio-environmental Research, Ankerstraat 1, 8400 Oostend, Belgium.

5.3 Scale issues

Tom Wilding gave a brief introduction to the aspect of scales in relation to assessing interactions between benthos and offshore renewables: scales are different from local, single device testing to commercial deployment, this will have important consequences to how the benthos responds and also how we determine the level of change and ultimately whether there are any impacts. The scale of change is already happening for offshore wind as plans for much larger developments and more developments in adjacent areas of the sea are in place with construction already occurring (e.g. southern North Sea). The cumulative effects on the benthos are much related to the scale aspect.

TW suggested that it is relatively straightforward to consider scales of meters. Near-field effects are going to occur and we have the knowledge with which to determine the changes. People tend to draw impact halos around devices. But who cares about changes at this scale? What about further afield? Devices are usually part of an array, London Array is 100 km2, but an effect at 50m distance, is small compared to total footprint. We need to think from single devices to arrays to superstructures: clusters of OWF. Reckon on 100–500 wind farms. What happens at this scale? We also need to consider linked questions such as what about invasive species at this scale, important for distribution.

We should also consider other human activities (i.e. MREDs as part of coastal modification): shipping, aquaculture, fishing: scale-based connectivity and gradients are visible here, as are temporal scale aspects such as seasonal, annual and long-term variability. National boundaries do not make things easier. All these things are part of the EIA. But there is no consistent guidance on scale related and cumulative effects, and there are no 'significant thresholds identified'. Decision makers use the term 'reasonable foreseeable future' however this is impossible to define. We need identification of relevant receptors, however there is currently no consideration for benthos except for designated features such as *Sabelleria* reefs.

Critical Q: what does society want from seas and oceans, why is benthos is important?

Some receptors are protected (e.g *Sabellaria*, *Lophelia*, *Modiolus*): but we need to understand what scale these receptors operate at.

In relation to benthos: important questions are raised, such as 'can we define a population, reproductive dispersal strategy, rarity, critical mass, baselines'.

Environmental positives – negatives: connectivity, habitat restorations/constructions etc. what is weighed and how?

Biodiversity, biogeochemical cycling, food production is key to why we should care about benthos. How we are going to 'sell' this? Scales relate to system functioning (production). It was agreed that this was important and Steven Degraer highlighted that a new PhD student is researching the changes in food web structure and the relationships with organic matter input.