Suitability of echosounders to study zooplankton and pelagic fish in shallow water of the North Sea

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The Belgian part of the North Sea (BPNS) is shallow and highly dynamic, characterized by strong currents and high turbidity. Consequently, vision is not the most important cue for marine fauna, most of them rely heavily on sound. The area is heavily exploited and is subjected to various kinds of anthropogenic noise. Most of the effects of anthropogenic sound have been found in demersal and mesopelagic fish. However, a lot of the fauna residing in wind farms is pelagic, a group of species that has received relatively little attention. North Sea pelagic fauna includes economically important species, such as commercially-caught fish species, like herring (*Clupea harengus*) and Atlantic mackerel (*Scomber scombrus*), and might harbor ecologically important zooplankton layers. Therefore, it is important to understand how pelagic fauna will respond to sound from anthropogenic activities. The ideal way to study behavioural responses is at sea with anthropogenic activities and wild fish.

The first aim of this project was to determine the suitability of bottom-moored echosounders in turbid shallow waters to study pelagic fish schooling behaviour and presence of zooplankton layers in time and space. Secondly, we wanted to know how pelagic fish respond to a seismic survey and pile driving activity and if their response varies with the sound source. Paired echosounders were placed over the course of a month within and at the edge of an offshore wind farm (OWF) in three OWFs, with either a seismic survey, pile driving activity or just operational turbine noise (control). Four frequencies were used in order to capture images of both fish and zooplankton at high resolution. The resulting echograms were processed with Echoview.

The bottom-moored echo sounders were successful in detecting variation in the behaviour of pelagic fish in the wind farms, e.g. school size, depth and biomass estimates. However, due to floating particles and turbulent water, it was not possible to detect zooplankton with this method. The influence of abiotic parameters, e.g. time of day, sea state, tides and temperature was substantial on most measured response variables. Patterns of behaviour and detection of fish schools were significantly different during sound exposure compared to before, but also varied significantly in the control site. This shows the need for thorough replication when investigating responses of pelagic fish to sound exposure. We conclude that bottom-moored echosounders are a good tool to study pelagic fish fluctuations at high temporal resolution in shallow water. Ground truthing is also recommended to obtain insights in the species composition of the observed schools. Although the tool was not sufficient for zooplankton monitoring, it may be useful to monitor sediment transport.

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