Effectiveness of a sealscarer in deterring harbour porpoises (*Phocoena phocoena*)

and its application as a mitigation measure during offshore pile driving

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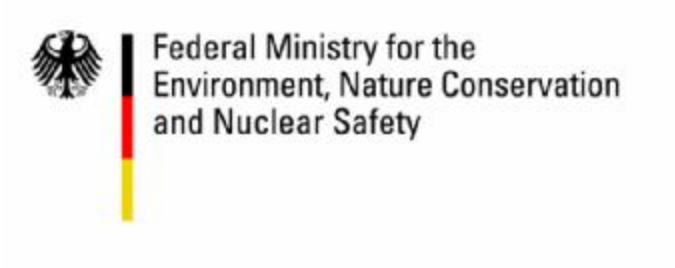

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1. SUMMARY

Offshore pile driving during windfarm construction goes along with substantial noise emissions into the water column, which may harm marine mammals. To avoid injuries from acute sound pulses, low level acoustic deterrent devices (pinger) and high level acoustic harassment devices (sealscarer) are used to keep porpoises and seals out of the danger zone around the construction site. In this study we investigated the response of harbour propoises (*Phocoena phocoena*) to a Lofitech sealscarer by conducting two studies: one based mainly on passive acoustic monitoring (C-PODs) and to some extend aerial surveys in the German North Sea and one applying a combination of visual observations from the top of a cliff and passive acoustic monitoring in the Danish Baltic Sea.

During the study in the German North Sea we deployed 16 C-PODs along three transects running from the deployment location of the sealscarer to a maximum distance of 7.5 km. Ten trials with activated sealscarer could be conducted. During the first trial we also conducted aerial survey flights, one before and one during sealscarer activity in a 990 km² area around the location of the sealscarer. Sealscarer deployment lead to a decrease in porpoise click recordings compared to the time before deployment at all distances studied, but this decrease was only statistically significant in 0 m, 750 m, 3000 m and 7500 m. In 1500 m and 5000 m distance relatively low porpoise activity during the baseline, an outlier and low sample size lead to non-significant effects. At the POD in 0 distance, porpoise activity during sealscarer activity was reduced by 95 % compared to the time before (porpoises were recorded only once), at the PODs in 750 m distance it was reduced by 86 %. An aerial survey revealed a significant decrease in porpoise density within the survey area (covering a maximum distance of 15 km to the sealscarer) from 2.4 porpoises/km² before to 0.3 porpoises/km² during sealscarer operation, thus a reduction in porpoise density by 88 %. The minimal distance to the sealscarer at which a porpoise was sighted increased from 2.5 km before to 6.3 km during sealscarer operation. Results from the aerial survey therefore confirm the reduction in porpoise activity found by POD-recordings and show that this is indeed caused by animals leaving the area around the sealscarer and not only a reduction in acoustic activity.

Three C-PODs deployed at 450 m distance to the sealscarer at the Danish study site in the Baltic Sea, similarly showed a significant reduction in porpoise activity during sealscarer activity. Here not a single porpoise click was recorded during a total of 15 hours when the sealscarer was active and when at least one POD recorded analysable data. Sighting rates significantly decreased during sealscarer activity and dropped down to only 1 % compared to other times. During 28 hours of observations with active sealscarer, only three porpoise observations were obtained within the 1 km radius: one observation at about 1 km distance and two at about 800 m distance. Two more observations were made at distances beyond 1 km. Out of seven cases when porpoises were exposed to sealscarer noise at distances between 300 and 700 m, porpoises immediately disappeared and were not observed again at six times, once the porpoise showed a clear avoidance reaction afterwards. In 15 cases, porpoises were exposed to the sealscarer at distances between 1.1 and 3.3 km. In six cases there was a clear reaction in that porpoises again immediately disappeared (1.1 and 1.7 km) or turned around and swam directly away from the sealscarer (1.6, 1.9, 2.3 and 2.4 km). In two cases there was a possible avoidance reaction: In one case a mother-calf group swam