Pile driving is perceived as an acoustic stressor by juvenile European sea bass (Dicentrarchus labrax)

Blom, E; Bolle, LJ; Botteldooren, D; De Boeck, G;De Coensel, B; De Jong, C; Hostens, K; Sinha, A; Vandendriessche, S; Vincx, M; Wessels, P; Degraer, S

Elisabeth Debusschere
elisabeth.debusschere@ilvo.vlaanderen.be

"Institute for agricultural and fisheries research, Ghent University"
Ankerstraat 1, 8400 Oostende, Belgium

An increasing amount of anthropogenic underwater sound is induced in the marine environment. Consequently, a better understanding of the impact on marine life of underwater sound, and especially of impulsive sound, is needed. This particular study tackles the impact of impulsive sound related to pile-driving activities for offshore wind energy development, on the mortality, stress and condition of post-larval and juvenile European sea bass Dicentrarchus labrax.
A 'worst-case scenario' field experiment was carried out on board of a piling vessel, exposing 68 and 115 days post hatching (dph) fish (< 2 g wet weight) to the sound generated during 1.5 hours of pile-driving. The number of strikes ranged from 1740 to 3070, with a single strike sound exposure level ranging between 181 and 188 dB re 1µPa².s, resulting in cumulative sound exposure levels ranging between 215 and 222dB re 1µPa².s. Immediate and long-term survival of the exposed fish was high and comparable to the control groups. Although not significant, control fish had elevated whole-body cortisol levels (31.7± 12 ng/g fish) compared to unhandled fish (5±3.7 ng/g fish) which reflects the impact of handling and transport onto the piling vessel. Fish exposed to pile driving had high whole-body cortisol levels (87±50 ng/g fish), which confirms that pile driving is perceived as an acoustic stressor. Additionally, a 50 % reduction in the oxygen consumption rates was observed in the exposed fish compared to the control fish. Lactate levels were similar in exposed, control and unhandled fish. Together these results suggest a reduction in movement. Whether this is involuntary immobility or strategic freezing is unclear. Back in the lab, the fish were held under optimal lab conditions over a 30-day period. In this period, no differences were observed in length, weight and condition.
Overall, a strong stress response was observed during the pile driving exposure but no long term detrimental effects were seen, at least not under laboratory conditions. During the sound exposure, the lower energy levels might negatively affect the general alertness, anti-predator response and activity levels, making the fish more vulnerable. Laboratory experiments performed with a SIG Sparker, used in seismic research and the larvaebrator, were used to compare the stress responses with the in situ experiment. Both sound sources produce impulsive sound but the larvaebrator is limited to the lower frequency range whilst the SIG Sparker covers mid and high frequencies. At the moment, the stress indicators are under analysis. A second goal is to distinguish the sound metrics which excited the stress responses.