Offshore pile-driving and young fish, a destructive marriage?

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Given the increasing amount of anthropogenic impulsive underwater sound introduced into the marine environment, a wide-ranging coverage of impacts on marine life is needed. The strongest and acute impact can be expected in the close vicinity of the sound source while more subtle, long term effects can act on a larger scale. This study tackles the impact of pile-driving on post-larval and juvenile European sea bass. First, a 'worst-case scenario' field experiment on board of a piling vessel was carried out with 68 and 115 days old fish, both weighing less than 2 g. Fish were exposed to strikes with a single strike sound exposure level between 181 and 188dB re 1µPa²s. The number of strikes ranged from 1,739 to 3,067, resulting in a cumulative sound exposure level ranging from 215 to 222dB re 1µPa²s. Immediate and long-term survival of the exposed groups was high and similar to the control groups. The fish showed a depressed respiration during the sound exposure, indicating an elevated stress level.

To assess effects further away from the sound source, we studied changes in fish behavior and physiology in a laboratory setup featuring a sound system that plays recorded piling sound. In the aquaria, single strike sound levels reached 162 dB re 1 µPa²s and 2400 strikes led to a cumulative sound exposure level of 196 dB re 1 µPa²s. Under these conditions, we observed that normal behavior was disturbed, with an increase in startle responses and stationary behavior at the beginning of the sound exposure, but was re-established shortly after the cessation of the sound. Feeding and respiration were not affected and accordingly, feeding conversion efficiency, Fulton's condition index, length and weight over 15 days were no different than in the "silent" treatment. The specific growth rate, however, was significantly different between treatments, indicating that food assimilation was decreased due to increased stress levels after exposure.

These results indicate that short-term exposure to impulsive sound creates sound pressure levels at the sound source that are below the lethal sound threshold for fish, but above the stress sound threshold, at least for sea bass smaller than 2 g. Furthermore, the sound levels at a wider range can disturb fish behavior. This disturbance, however, was short-lived and little impact on growth and condition was seen in the conducted experiments.