THE CONTRIBUTION TO ANTHROPOGENIC NOISE FROM MARINE AGGREGATE EXTRACTION OPERATION IN UK WATERS

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1 INTRODUCTION

As of 2009, there were 75 licensed areas within UK waters for marine aggregate extraction. Each year, around 20 million tonnes of sand and gravel are extracted from these areas for use in the construction and building industry[1]. Extraction of marine aggregate has the potential to generate noise, and if at sufficient levels, this could have a negative impact on marine species in or around the dredging area. However, measurement of the noise generated during marine aggregate extraction has been limited, particularly in UK waters. The most extensive measurements were undertaken in the Beaufort Sea during oil exploration in the 1980s[2,3]. Other measurements around Sakhalin Island have been reported in the literature, which were compared by Ainslie et al[4] to other vessels including the Overseas Harriette[5].

This paper presents the results of underwater noise measurements for six different dredgers measured in three locations around the UK, with aggregate type varying from sand to coarse gravel. From the measurements of radiated noise for dredgers under normal operation an estimate is made of the long term contributions to ambient noise levels from typical dredgers under normal operation, the contribution to the overall ambient noise budget, and the cumulative Sound Exposure Level for receptors in the vicinity.

2 MARINE AGGREGATE EXTRACTION OPERATIONS

The type of vessel used for marine aggregate extraction in UK waters is the trailing suction hopper dredger (TSHD). This type of dredger lowers a drag head and suction pipe to the sea floor to extract the sand or gravel, depositing it in a hopper on the vessel and returning any unwanted material and water over the side. During the dredging process the vessel travels up and down the same lane, typically around 1 – 1.5 km in length, at a slow speed of around 1.5 knots, lifting the drag head to turn at the end of the track. A single dredging operation can take anything from as little as 3 hours up to 12 hours to complete.

3 MEASUREMENT METHODOLOGY

Noise measurements were performed on six of the TSHD vessels from the UK fleet in three dredging areas, with one of the vessels, the Sand Falcon, measured in two separate locations. For each dredger, hydrophone measurements were performed as a function of range from the vessel at up to 4 positions along a transect normal to the centre point of the dredging track. These ranges varied for each vessel measured but typically did not exceed 1 km, with ranges of less than 100 m not used for the estimation of source level (although shorter ranges were measured for source characterisation purposes). Measurements were obtained using a combination of static, bottom-mounted recording systems and hydrophones deployed from an anchored survey vessel. The use of multiple measurement positions provided range-dependent measurement points without the time-dependent variability introduced by the use of a single mobile survey vessel.

4 MEASUREMENT RESULTS

The source levels for each vessel were calculated for each receiver position using a propagation loss model based on the source-image, which models the sound field of a source as the sum of the acoustic radiation from the source and a series of images of the source reflected in the medium boundaries: in this case, the water surface and seabed[6]. The third-octave band dipole source levels for each vessel measured are shown in Figure 1. These are compared to those of the cargo vessel, Overseas Harriette, while travelling at 8 knots and 16 knots.

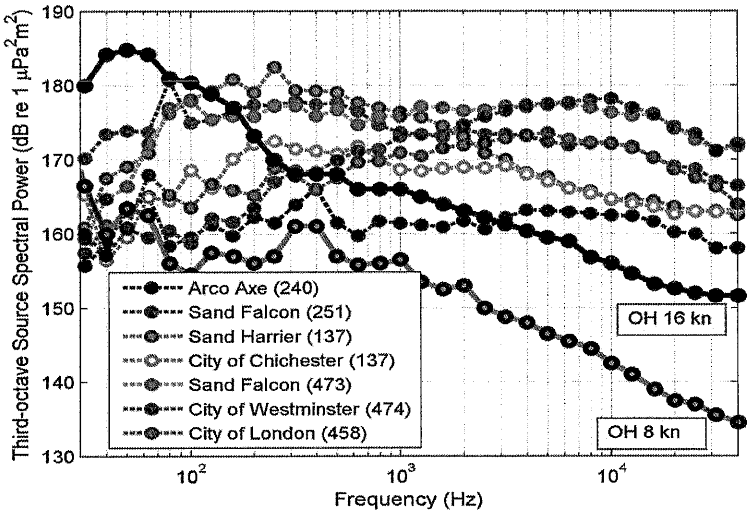

Figure 1: Dipole third-octave band source levels calculated for all vessels measured.

5 SOUND EXPOSURE LEVEL

Sound exposure level (SEL) from the dredging operations was estimated using the measured source level in figure 1 and an image source model[6] over an area in which marine life might be affected. It was assumed the total time of operation was 4 hours and the dredger followed the same straight track of fixed length. Both the noise source and receiver were at the mid water and the source was assumed to be omnidirectional. The seabed was flat within the area of interest. Figure 2 shows the results for the dredger City of Chichester over a track length 1 km. It may be noticed that, for this exposure time, the cumulative SEL can reach values towards 190 dB re 1 $\mu Pa^2 \cdot s$ within a few tens of metres of the dredging track.

6 CONCLUSIONS

A comprehensive set of measurements of the underwater noise produced by six TSHD vessels during dredging operations has been made in three areas. One vessel was measured twice, once in an area dredging sand and once in an area dredging gravel. The measurements show that source levels at frequencies below 500 Hz are generally in line with those expected for a cargo ship travelling at modest speed, while those at frequencies above 1 kHz show elevated levels of broadband noise generated by the aggregate extraction process. By comparing measurements from different dredging areas it was found that the elevated broadband noise is dependent on the aggregate type being extracted – coarse gravel generating higher noise levels than sand.

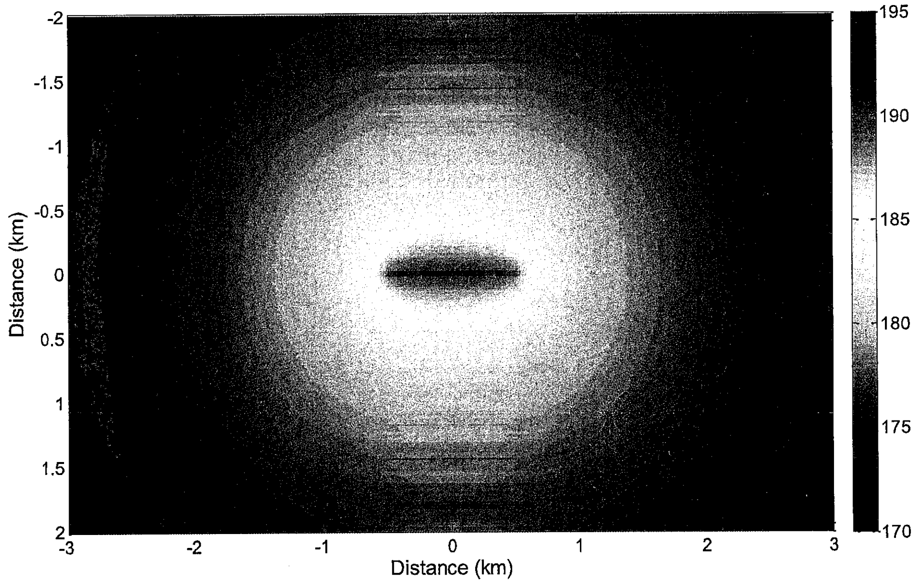

Figure 2: Cumulative Sound Exposure Level for City of Chichester for a typical dredging operation.

7 ACKNOWLEDGEMENTS

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