HARBOUR PORPOISE PRESENCE NEAR OIL TANKERS

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1 Introduction

Harbour porpoises (*Phocoena phocoena*) are thought to be "shy" animals that are easily disturbed by underwater noises. There is concern that sources of anthropogenic sound, especially those associated with shipping and pile driving, will drive porpoises away from their preferred habitat [1]. A recent study, however, found that harbour porpoises were occasionally present within a few hundred m of a liquefied natural gas (LNG) tanker when it was offloading and departing from the Canaport LNG terminal at Saint John, NB, Canada [2]. The goal of the present study was to obtain more samples of porpoise presence (or absence) when noise levels were high and a tanker was in the immediate vicinity. In addition to measuring the linear (unweighted) noise levels, a weighting function to take the insensitivity of porpoise low frequency hearing into account was used to calculate the likely perceived noise levels [3]. This function is generally analogous to the dB(A) function for humans and is expressed as dB(Pp) where (Pp) represents using the hearing threshold values of *Phocoena phocoena* to calculate the weighting function.

2 Methods

An automated porpoise detector (C-POD, Chelonia Ltd.) and a sound recorder (Song Meter SM2, Wildlife Acoustics Inc., fitted with a 30 m hydrophone cable) were deployed from a trestle, <100 m from the stern of a tanker while docked (Figure 1). The hydrophone and C-POD were 4-5 m above the bottom in 12-20 m of water, depending upon the tide. The C-POD is a data logger that records the time when echolocation click trains are detected. The C-POD operates continuously and porpoise detections were expressed as one or more detections per 10 min. Porpoise presence was determined using the high and moderate certainty levels of the C-POD software. Broadband sound levels (0.1- 16 kHz) of 1 min recordings every 10 min were calculated using 1/3 octave bands measured using NoiseLab 4.0.2, (Delta Danish). The noise levels (1/3 octave band sound pressure levels; SPL) were determined using both linear and threshold-weighted functions [3]. The dB(Pp) weighting subtacted 46.4 – 35.6log(kHz) dB from each 1/3 octave noise band before the broadband levels were calculated [3].

The sound files were time-matched to the presence or absence of porpoises detected by the C-POD and the presence or absence of a tanker was also noted. The arrival and departure times of the tankers were provided by http://www.marinetraffic.com/. Descriptive statistics and a Mann-Whitney U test were used to analyze the data.

Figure 1: The underwater sound recorder and porpoise detector were suspended from a trestle at the location of the arrow.

3 Results

Three oil tankers docked, offloaded cargo and embarked during the study period of 14-25 Nov. 2014. There were high winds and waves >3-4 m for about a week in the middle of the study period. This resulted in an oil tanker having to leave the dock after only unloading 1/3 of the cargo and anchoring offshore for a while before returning to finish the offloading. The high winds also resulted in some high noise levels even when the tankers were not present.

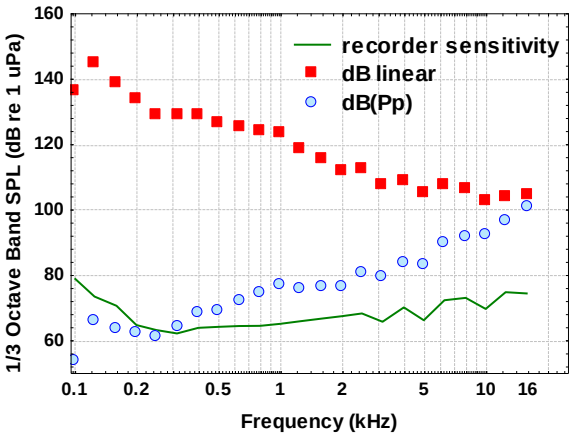

Figure 2: The 1/3 octave band sound pressure levels (SPL: linear and dB(Pp)) of the highest sound level when both a porpoise and a tanker were present.

Porpoise click detections dropped significantly from 49 ± 50 % of the 10 min periods (n = 1134) to 21 ± 41 % (n = 393) (U = 159852, z = -8.36, p<0.0001) when tankers were present. The highest noise level recorded was 119 dB(Pp) re 1 µPa (152 dB re 1 µPa) across a frequency range of 0.1-16 kHz. No porpoises were detected during this ten min period. The highest noise level when a porpoise and a tanker were both present was 107 dB(Pp) re 1 µPa (147 dB re 1 µPa). The 1/3 octave band levels and the impact of using the dB(Pp) weighting function are shown in Figure 2. The porpoise presence (using click detections) was compared to the broadband dB(Pp) noise levels allocated into 5 dB bins (Figure 3).

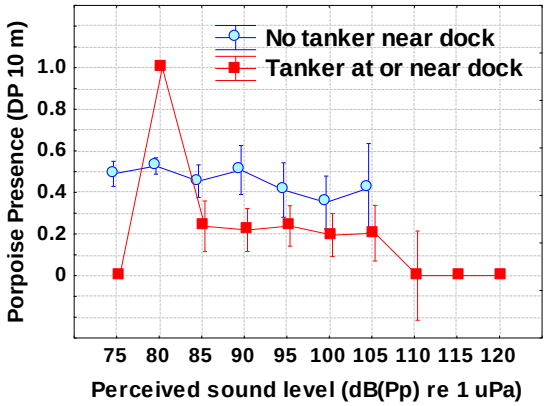

Figure 3: Harbour porpoise click presence (± 2 S.E.) at the Canaport LNG dock in the presence and absence of tankers. The error bars from sample sizes less than 5 have been removed for clarity. DP10m is detection positive 10 min periods.

4 Discussion

When no tankers were present, at least one porpoise was present near the docking site on a regular basis. A high proportion of porpoise presence had been noted at the same location previously [2]. Even when tankers were nearby or docked, porpoises remained in the vicinity for at least 20% of the time. The C-POD will only detect porpoises when they echolocate in the direction of the detector, thus the reported porpoise presence indicates the minimum amount of time that they are present in the area.

When docking or embarking, the oil tankers were accompanied by tugboats and the noise levels were highest then [2]. When offloading cargo, the engines were operating at reduced capacity and the propellor was not turning so the noise levels were lower. Once the tanker was stationary and making less noise, the physical presence of the vessel could constitute a disturbance and it would limit the locations around the porpoise detector where the porpoises could swim. The porpoise detectors have a range of a few hundred m and the ship's hull would block some porpoise detections when they were on the offshore side of the tanker. This may have reduced the number of porpoise detections somewhat.

Porpoise detections inceased once the tankers had left the area. Harbour porpoises have been observed to return to areas, often within a few minutes of the cessation of a disturbance [4].

The hearing sensitivity of the porpoises is poor at low frequencies where the highest tanker noise occurs. Thus, the possible disturbance associated with the sound levels of the tankers would be lessened due to the lower audibility of the low frequency noises. Although the sample sizes are small, the data suggest that the porpoises were displaced, or reduced echolocation activity, by noise levels above ~110 dB(Pp) re 1 µPa. The porpoises appear to tolerate low to moderate noise levels but not necessarily higher noise levels. It is not possible to determine if the porpoises simply habituated to the disturbances or if they remained there, while possibly being physiologically stressed, because it was an important feeding area.

It will not be appropriate to extrapolate dB(Pp) adjusted noise levels to assess the potential impact of noise levels on baleen whales because they have much better lower frequency sensitivity. Linear noise levels do not reflect the likely perceived noise levels by different species and thus should not be used when assessing potential noise disturbances.

5 Conclusion

The regular, although reduced, presence of porpoises when tankers are present suggests that they will tolerate moderate noise levels and related disturbances without being displaced from a location for long times.

Acknowledgements

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