Sound Levels of Participating Vessels during the 2021 Vessel Speed Reduction Program in the Santa Barbara Channel

Vanessa M. ZoBell, Kaitlin E. Frasier, John A. Hildebrand
Marine Physical Laboratory
Scripps Institution of Oceanography
University of California, San Diego
La Jolla, CA 92037

MPL TM – 659

Suggested Citation

ZoBell VM, Frasier KE, Hildebrand JA. Sound Levels of Participating Vessels during the 2021 Vessel Speed Reduction Program in the Santa Barbara Channel. Final Report. Marine Physical Laboratory Technical Memorandum 659. April 2022.

Background

In 2014, the Channel Islands National Marine Sanctuary (CINMS) partnered with the Santa Barbara County Air Pollution Control District, Ventura County Air Pollution Control District, National Marine Sanctuary Foundation, and the Environmental Defense Center to implement a voluntary, incentive-based vessel speed reduction (VSR) initiative known as the Protecting Blue Whales and Blue Skies Program (hereafter VSR program). Enrollment was made available to companies operating container ships or vehicle carriers within the VSR zone, which extends approximately from Point Conception southeast to the Long Beach Harbor. In addition to its original goals of reducing the risk of ship strikes on endangered whales and decreasing air pollution emissions, the VSR program also recognized the opportunity to address underwater noise pollution in the Santa Barbara Channel (SBC). The potential for reducing noise pollution from commercial shipping by reducing vessel speeds may allow the VSR program to address an even more comprehensive conservation initiative than originally anticipated (ZoBell et al. 2021).

In 2018, the VSR program changed from a transit-by-transit approach to a fleet-based approach to incentivize slow speeds across all transits taking place in the VSR zone. In the fleet approach, container ship and vehicle carrier companies that cooperated in the program were rewarded based on the percentage of nautical miles that all vessels in their fleets traveled at 10 knots or less during the 2018 program season in the VSR zone. Companies with fleets that demonstrated higher percentages of cooperating transit miles were awarded with financial rewards and positive press. The fleet-based program was also utilized in 2019, 2020, and is in effect presently. The program was active May 15 through November 15. The three awards tiers were Sapphire, Gold, and Blue Sky, which had cooperation of 85%, 60% and 35%, respectively.

Key message: There was a **5 dB/transit** reduction when comparing baseline source levels to source levels measured from participating vessels in the 2021 VSR program. From this result, we assume that there was also a **5 dB/transit** reduction when comparing received levels of baseline transits to VSR 2021 transits.

Methods and Results

In this report, baseline source levels of participating vessels were compared to source levels of participating vessels while the VSR program was active in 2021. In order to account for any differences in distance from the source to the receiver between hydrophone deployments, reductions in received levels were assumed from reductions in source levels. Baseline source levels were determined from transits of participating vessels during the first year the fleet-based VSR program was in effect while the program was inactive (2018). The first year of the program was used in order to minimize any bias the program had on vessel speed during the program's inactive months in 2021.

Source levels were determined by applying the propagation loss between the recording device and the source at the closest point of approach (CPA) to the received levels for each vessel transit. Received levels for each vessel transit were averaged over the data window period that equaled the time it took the ship to travel its length, as defined by ANSI/ASA (2009). Received levels were calculated for each ship passage by dividing the time series into 1 s non-overlapping segments. For each 1 s interval, a fast-Fourier transform (FFT) and Hanning window with FFT length of 10,000 samples and no overlap provided the power spectral density (PSD) in 1 Hz bins. Ten times the base-10 logarithm of the PSD in 1 Hz bins was used to convert to sound pressure received levels in decibels (dB) referenced to a unit pressure density (1 μPa^2). The hydrophone calibration was then applied to achieve the calibrated RL in dB re 1 μPa^2. Propagation loss was calculated using a modified Lloyd's mirror propagation loss model and was applied to the received level to estimate the source level of each transit (Gassmann et al. 2017).

The average baseline source levels while the program was inactive in 2018 was **195 dB re 1μPa^2 @ 1m.** The average source level of the participating vessels in 2021 while the program was active was **190 dB re 1μPa^2 @ 1m.** This result concludes that there was a **5 dB / transit** reduction when comparing baseline source levels to the 2021 VSR source levels. Because source levels are calculated from received levels, we can assume that there was a **5 dB / transit** reduction in received levels when comparing the baseline received levels and the 2021 VSR received levels.

ANSI/ASA. (2009). ANSI S12.64-2009, Quantities and Procedures for Description and Measurement of Underwater Sound from Ships–Part 1: General Requirements (American National Standards Institute/Acoustical Society of America, New York).

Gassmann, M., Wiggins, S. M., & Hildebrand, J. A. (2017). Deep-water measurements of container ship radiated noise signatures and directionality. *The Journal of the Acoustical Society of America, 142*(3), 1563-1574.

ZoBell, V. M., Frasier, K. E., Morten, J. A., Hastings, S. P., Peavey Reeves, L. E., Wiggins, S. M., & Hildebrand, J. A. (2021). Underwater noise mitigation in the Santa Barbara Channel through incentive-based vessel speed reduction. *Scientific Reports*, 11(1), 1-12.