



## Source-Level Estimates for Harbor Seals and Implications for Estimating Communication Space

**Caroline Casey**

University of California, Santa Cruz, [cbc Casey@ucsc.edu](mailto:cbc Casey@ucsc.edu)

**Jillian Sills**

University of California, Santa Cruz, [jmsills@ucsc.edu](mailto:jmsills@ucsc.edu)

**Colleen Reichmuth**

University of California, Santa Cruz, [coll@ucsc.edu](mailto:coll@ucsc.edu)

Acoustic signaling plays an important role in marine mammal communication because sound transmission characteristics of the underwater environment allow signalers and receivers to remain in contact over relatively large distances. Determining the range over which a signal can be detected can clarify the relationship between a signal's structure and its function. This is especially true when considering the spatial and social dynamics of breeding populations. Source levels can be used to estimate the communicate range of a signal in a given noise background. Despite the importance of this metric, estimates of source levels for free-ranging marine mammals are often difficult to obtain because the location and distance of vocalizing individuals may be challenging to accurately determine. Furthermore, signal detectability is limited by the auditory sensitivity of the receiver, but quantitative hearing data are lacking for many species. This study provides the first source levels for the underwater roars produced by male harbor seals (*Phoca vitulina*) during the breeding season. Calls with high signal-to-noise ratios were obtained over multiple years from one captive adult male harbor seal of known age. Spontaneous roars were opportunistically recorded at distances ranging from 1 to 5 m, with caller orientation of 0° to 90°, using calibrated receivers. The calls were low-frequency, guttural vocalizations that lasted 5-10 s, with most energy between 200 and 500 Hz. These calls had similar features to the vocalizations produced by wild seals during the breeding season. Taking transmission loss into consideration, we determined the sound pressure level at 1 m over the entire call duration. The RMS level of these roars was ~145 dB re 1  $\mu$ Pa at 1 m. To predict the range of these calls in typical coastal ambient-noise conditions, we paired these source level data with low-frequency absolute detection thresholds published for the same individual. The findings from this captive study inform our understanding of how wild seals and other marine mammals communicate in natural noise and enable predictions of the effects of anthropogenic sound on communication space. (This study was supported in part by the Office of Naval Research.)