Source level measurements for harbor seals and their implications for estimating communication space

Casey, C.[1], Sills, J.M.[2], and Reichmuth, C.[2]

[1]Department of Ecology and Evolutionary Biology, Long Marine Laboratory, University of California Santa Cruz, 115 McAllister Way, Santa Cruz, CA, 95060, USA
[2]Institute of Marine Sciences, Long Marine Laboratory, University of California Santa Cruz, 115 McAllister Way, Santa Cruz, CA, 95060, USA

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, as source levels can be used to estimate the communication range of a signal in a given noise background. Here, we describe source characteristics for underwater roars produced by male harbor seals **(Phoca vitulina)** during the breeding season. Spontaneous calls were recorded at close range (< 4 m) from one captive adult male harbor seal over multiple years. Similar to wild harbor seals, these calls were predominantly low-frequency, guttural vocalizations that lasted 5 to 10 s, with most energy between 100 and 800 Hz. Taking transmission loss into consideration, sound pressure level over the 90% duration of the call was ~140 dB re 1**µ**Pa at 1 m. To estimate the range over which these underwater roars could be detected in different representative noise environments (a slough, harbor, and coastal area), we paired these source level measurements with frequency-dependent signal propagation estimates, measurements of ambient noise, and published auditory data available for harbor seals. We confirmed that background noise constrains the active space of harbor seal roar vocalizations: the loudest frequency component of these signals would likely be detectable by other seals at ranges of ~ 700 m in the quietest environment of the slough, and limited to ~ 290 m in the louder ambient conditions of the harbor environment. These findings inform our understanding of how wild seals communicate in natural noise conditions, and enable predictions of the effects of anthropogenic sound on communication space in this species.