Measurement of Auditory Temporal Resolution in the California Sea Lion (Zalophus califlorum) Using Auditory Evoked Potentials

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In contrast to studies of temporal auditory processing in odontocete cetaceans, the ability of non-echolocating marine mammals to resolve acoustic stimuli in time has received little attention. However, temporal resolution likely plays an important role in the ability of sea lions and other animals to distinguish relevant features of acoustic signals. We measured the temporal resolution abilities of the California sea lion (Zalophus califlorum) using auditory evoked potentials. The auditory brainstem responses (ABRs) and rate following responses of two anesthetized California sea lions were recorded at the Marine Mammal Center in Sausalito, California. Stimuli were 20 ms click trains consisting of 70 is biphasic clicks presented at repetition rates between 125-1500 Hz. ABRs were measured from three subcutaneous electrodes and a customized amplification and averaging system connected to a PC laptop. At click presentation rates below 500 Hz, distinct individual brainstem responses were clearly visible following each click in a train. As presentation rates increased, responses to the initial click in a train remained relatively large with a typical ABR form while responses to subsequent clicks decreased in amplitude and became more sinusoidal. Rate following responses remained evident for click rates up to 1000 Hz. The results suggest that the temporal resolution capabilities of sea lions are better than previously suspected. These findings improve our understanding of auditory processing in sea lions, motivate additional comparative research with other pinnipeds, and provide guidance in the application of electrophysiologic methods to the study of sea lion hearing.

Passive Acoustic Research on North Pacific Right Whales (Eubalaena japonica) in Alaskan Waters

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We used two types of passive, underwater acoustic instrumentation to provide information on critically endangered North Pacific right whales (Eubalaena japonica) in the Bering Sea and western Gulf of Alaska. We deployed Directional Frequency Analysis and Ranging (DFAR) sonobuoys during vessel-based cetacean surveys in Alaska in summers of 2002 and 2004 to detect and localize calling right whales and provide data on right whale acoustic repertoire and behavior. The most common call type (75%) among analyzed calls (n = 385) was an upswept tonal call, on average from 88 Hz to 159 Hz and 0.82 s in duration. Real-time acoustic detection and localization of right whale calls preceded right whale sightings on most occasions, guiding the vessel to whales at unprecedented ranges (up to 100 km) and enabling researchers to conduct more detailed studies. We also deployed autonomous, seafloor-mounted hydrophones in three study areas; the southeast Bering Sea middle-shelf domain (in years 2000-2002 and 2004-2005), the Bering Sea shelf break (2004-2005), and the western Gulf of Alaska (2003). The seafloor packages recorded continuously at an effective bandwidth encompassing the most common North Pacific right whale calls. Automated detection software was configured to detect upswept calls, and detections were reviewed by an analyst, who also browsed data surrounding positive detections to find additional calls. In the southeast Bering Sea 2000-2002 seafloor hydrophone data, over 1000 right whale calls were detected, occurring seasonally as early as May and as late as November. Peaks in calling were observed during late winter when the right whale is migrating off the coast of Alaska.