

Noise-induced Temporary Threshold Shift in Pinnipeds: Effects of Exposure Medium, Intermittence, Duration, and Intensity

- (1) David Kastak
- (2) Brandon Southall
- (3) Ronald J. Schusterman
- (4) Marla Holt
- (5) Colleen Reichmuth-Kastak

(1-5) University of California; Long Marine Laboratory, 100 Shaffer Rd., Santa Cruz, CA 95060

(1) Kastak@cats.ucsc.edu

We assessed noise-induced temporary threshold shift using behavioral psychophysics in individuals representing three pinniped species: California sea lion, harbor seal, and northern elephant seal. The fatiguing stimulus was an octave band of noise centered at 2500 Hz. Noise and tones were presented aurally (continuous exposure), or under water (intermittent exposure). Exposure levels ranged from 137 to 174 dB re: 1 μ Pa under water and 68 to 124 dB re: 20 μ Pa in air. Maximum threshold shifts ranged from 12 to 28 dB. There were no differences between threshold shifts measured in air vs. under water, when intermittency was equated. For two subjects, there were significant positive relationships between threshold shifts and noise energy flux density and log of exposure duration. These relationships were consistent for both intermittent and continuous exposure conditions. Based on these results, we conclude that 1) growth of threshold shift in pinnipeds should be modeled using the sound energy of the fatiguing stimulus as a factor; 2) noise exposures sufficient to induce TTS are approximated by a 5-dB exchange rate (intensity per doubling of exposure time); 3) in-air TTS testing is a robust method for assessing the harmful effects of underwater and airborne noise on amphibious animals.

Temporary Threshold Shift (TTS) Measurements in Bottlenose Dolphins (*Tursiops Truncatus*), Belugas (*Delphinapterus Leucas*), and California Sea Lions (*Zalophus Californianus*)

- (1) James J. Finneran
- (2) Donald A. Carder
- (3) Sam H. Ridgway

(1-3) Space and Naval Warfare Systems Center - San Diego; 53560 Hull St., Code 2351, San Diego, CA 92152

(1) Finneran@spawar.navy.mil

Intense anthropogenic underwater sound may adversely affect the hearing and behavior of many marine mammals. Exposure to intense sound may produce an elevated hearing threshold, also known as a threshold shift (TS). If the threshold returns to the pre-exposure level after a period of time, the TS is known as a temporary threshold shift (TTS). Marine mammal TTS studies at SSC San Diego have examined the effects of pure tones and underwater impulsive waveforms on bottlenose dolphins, belugas, and California sea lions. In these studies, a behavioral response paradigm is used to measure hearing thresholds before and immediately after exposure to high-intensity underwater sound. This paper reviews the TTS studies conducted at SSC San Diego, including the test methodology, sound exposure parameters, and the results. Particular attention will be given to current efforts, which are focused on the effects of mid-frequency tones on bottlenose dolphins. Preliminary data will be presented for the growth of TTS as a function of SPL and duration for single frequency tones.