

UNDERWATER TEMPORARY THRESHOLD SHIFT (TTS) IN PINNIPEDS: THE EFFECTS OF MODERATE NOISE LEVELS

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Low frequency noise from man-made sources represents an increasing portion of the total noise in the ocean. Such noise may adversely impact diving pinnipeds, which hear relatively well at low frequencies. Our research program investigates the effects of relatively low frequency (under 3 kHz) octave bands of noise on the underwater hearing of three species of pinnipeds (*Zalophus californianus*, *Phoca vitulina*, *Mirounga angustirostris*). These studies involve obtaining behavioral thresholds before noise exposure, immediately after exposure, and 24 hours later. Initially, we found that exposure to noise below 60 dB sensation level (SL) for 20-22 minutes had no reliable effects on hearing sensitivity. Next, we documented (Kastak et al., 1999, *JASA*, 106) that temporary thresholds shifts (TTS) of almost 5 dB occurred at the center frequency of the noise band following exposure to moderate noise levels (60-75 dB SL for 20-22 min). New research using slightly higher levels of noise exposure (69-80 dB SL for 22 min) has generated the following results: 1) Mean threshold shifts for all subjects ranged from 2.9-4.9 dB at the center frequency of the noise band; 2) Maximum hearing loss occurred at center frequency and not one-half octave above center frequency; 3) There was no definitive relationship between the level of noise exposure and the degree of TTS when noise exposure was between 60 and 80 dB SL; and 4) Complete recovery of sensitivity occurred within 24 hours of exposure for all noise levels. Further experiments using noise of longer duration and higher exposure level will be required for a more thorough evaluation of the degree to which pinniped underwater hearing is temporarily affected by exposure to continuous noise. By using a systematic method of experimentation, we are attempting to develop models to predict potential hearing losses and define critical zones of noise impacts for pinnipeds.