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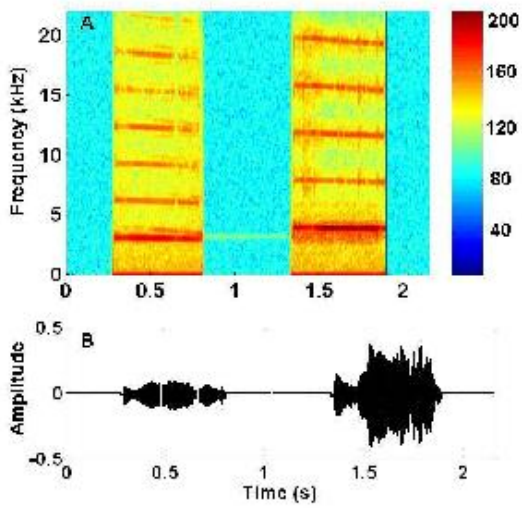
T. Aran Mooney: Marine Mammals and Noise

I have investigated how noise impacts marine mammal hearing. This includes demonstrating sonar induces temporary hearing loss (temporary threshold shifts - TTS) and the relationship of sound duration and intensity (short duration sound must be of very high amplitude to induce TTS).

Sonar induced TTS



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Sonar induced temporary hearing loss in dolphins

There is increasing concern that human-produced ocean noise is adversely affecting marine mammals, as several recent cetacean mass strandings may have been caused by animals' interactions with naval "mid-frequency" sonar. However, it has yet to be empirically demonstrated how sonar could induce these strandings or cause physiological effects. In controlled experimental studies, we show that mid-frequency sonar can induce temporary hearing loss in a bottlenose dolphin (*Tursiops truncatus*). Mild behavioural alterations were also associated with the exposures. The auditory effects were only induced by repeated exposures to intense sonar pings with total sound exposure levels of 214 dB re: 1 ?Pa^2?s. Data support an increasing energy model to predict temporary noise-induced hearing loss and indicate that odontocete noise exposure effects bear trends similar to terrestrial mammals. Thus, sonar can induce physiological and behavioural effects in at least one species of odontocete; however, exposures must be of prolonged, high sound exposures levels to generate these effects.

Mooney, TA, Nachtigall, PE, Vlachos, S. 2009. Sonar-induced temporary hearing loss in dolphins. 5: 565-567. Biology Letters.

Predicting temporary hearing loss

Predicting temporary threshold shifts in a bottlenose dolphin (*Tursiops truncatus*): the effects of noise level and duration

Noise levels in the ocean are increasing and are expected to affect marine mammals. To examine the auditory effects of noise on odontocetes, a bottlenose dolphin (*Tursiops truncatus*) was exposed to octave-band noise (4-8 kHz) of varying durations (<2-30 min) and sound pressure (130-178 dB re: 1 ?Pa). Temporary threshold shift (TTS) occurrence was quantified in an effort to: (i) determine the sound exposure levels (SELs; dB re: 1 ?Pa^2?s) that induce TTS and (ii) develop a model to predict TTS onset. Hearing thresholds were measured using auditory evoked potentials. If SEL was kept constant, significant shifts were induced by longer duration exposures but not for shorter exposures. Higher SELs were required to induce shifts in shorter duration exposures. The results did not support an equal-energy model to predict TTS onset. Rather, a logarithmic algorithm which increased in sound energy as exposure duration decreased was a better predictor of TTS. Recovery to baseline hearing thresholds was also logarithmic (approximately -1.8 dB/doubling of time) but indicated variability including faster recovery rates after greater shifts and longer recoveries necessary after longer duration exposures. The data reflected the complexity of TTS in mammals that should be taken into account when predicting odontocete TTS.

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