

Evolution of noise exposure criteria for fishes

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The first noise exposure criterion for fish was proposed in 1990 for a Navy test facility at Lake Pend Oreille in Idaho. Based on a study showing that goldfish had temporary threshold shift (TTS) after 4-hours exposure to pure tones with 149 dB re 1 μ Pa sound pressure level (SPL) (Popper & Clarke 1976), the recommendation for 'no harm' to fish was to limit SPL to 150 dB re 1 μ Pa (Hastings 1990). As concern about effects of human-generated sound in the ocean grew, damage to auditory tissue in fish was examined. Studies indicated that exposure to an SPL of 180 dB re 1 μ Pa for 1-2 hours could cause hair cell damage (Hastings 1995; Hastings et al. 1996). The site and extent of damage depended on species and sound frequency. The latest recommendation for direct injury is a sound exposure level (SEL) from 183 to 213 dB re 1 μ Pa²-s, depending on fish body mass. These end points are based on data from a blast study on juvenile fish (Govoni et al. 2003) and a low frequency active sonar study on larger fish (Popper et al. 2007), respectively. Moreover dual criteria consisting of peak SPL and cumulative SEL are recommended for TTS based on the results of a riverine airgun study (Popper et al. 2005). These data indicate that some species will experience TTS of 20-25 dB at an SEL of 185 dB re 1 μ Pa²-s that recovers within approximately 18 hours, whereas other species show no hearing loss.

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