**Hearing Thresholds and the Impact of Anthropogenic Noise in Four Invasive Carp Species**

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Abstract:

 Due to extensive ecological impacts, aggressive range expansion, and their potential to enter the Laurentian Great Lakes, silver (*Hypophthalmichthys molitrix*) and bighead (*H. nobilis*) carp are primary targets for fisheries management. One promising measure to prevent their further dispersal is the use of acoustic deterrents because carp exhibit negative responses to sound. However, for an acoustic deterrent to be effective the sound level emitted needs to be above the hearing sensitivity for any target species, yet not too high to be detrimental to fish hearing. In this study, auditory evoked potentials (AEPs) were used to determine the impacts of exposure to high intensity sound on the hearing of silver and bighead carp. Auditory temporary threshold shifts (TTS) of up to 32 dB re 1 μPa SPLrms following sound exposure were observed between 0.2 – 2 kHz for both silver and bighead carp and sensitivity to some frequencies remained elevated up to 96-hrs following exposure. As there is often overlap of detectable frequency ranges among different species, there is the potential for acoustic deterrent signals to effectively target multiple fishes. Therefore, auditory thresholds were also determined for the invasive grass (*Ctenopharyngodon idella*)and black (*Mylopharyngodon piceus*) carp. Auditory thresholds were measured from 0.2 - 4 kHz with the greatest sensitivity between 0.3 - 0.4 kHz for both species. This study indicates that acoustic deterrents could impact carp hearing and that such deterrents may also be detectable by other invasive fishes in the area, such as grass and black carp. These findings will be used to increase the long-term efficacy of acoustic deterrents aimed at preventing the range expansion of invasive carps.