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A life submerged in sound: Determining if aquaculture sounds induce stress in fish

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In order of contribution

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Abstract

Fish bioacoustics includes research on sound production and audition in fishes as well as effects of anthropogenic sound on fishes. An environment that is wholly anthropogenic is an aquaculture recirculating system. Fish within this culture system are under unique conditions, as the associated sounds are not ‘natural’, and the fish are completely confined to this soundscape with no option of escape. This environment is poorly understood in relation to how it affects the biology of cultured species. The limited available information on this type of soundscape and the physiological interaction fish have with it, has presented many unknown potentials, which includes the risk to stock productivity and fish welfare. The lack of understanding helped to create the baseline question for this compilation of work, which was ‘are aquaculture sounds, sounds of concern?’

To determine the components of this type of soundscape a survey of an operational recirculating facility was conducted. This evaluation determined the major components of the soundscape (the pump) and the other influences that shape and create this soundscape. Where dominant characteristics (low frequency dominated) and SPLs (min mean SPL of 105 dB re 1μPa^2/Hz and a max SPL 124 dB re 1μPa^2/Hz) at were identified. The information provided by the baseline study created an understanding of acoustic parameters to determine the physiological responses of fish to this type of soundscape.

The acoustic characteristics investigated were further evaluated in combination with information previously published on other species, barramundi was evaluated for physiological stress responses to the introduction of specific sounds at three sound pressure levels (124,130,139 dB re 1μPa^2/Hz, at 187.5Hz). The fish were examined after short-term exposure and long-term exposure to the continuous sounds of an aquaculture soundscape. The results showed a significant correlation between the highest sound level and the initial stress responses of the presence of cortisol which increased over a 24hr period. Due to the increase throughout 24hrs, it was important to determine if this trend continued into the tertiary level of response. Therefore, the fish were evaluated over a long-term duration. The long-term results, displayed high variation among individuals concluding with no significant effect on the growth of the fish across the two-month exposure period. The highest sound level exposure did display the greatest range of variability throughout the treatment.

The last evaluation was determining if transient sounds play a larger role in stress responses of the fish under this type of soundscape. Two interval types were evaluated (random and constant intervals). The data revealed high variability of outcomes between measures of stress concluding that no effect could be determined. Across all physiological evaluations, a limited to no effect was determined, however possible influences associated with the life history of these fish may present levels of pre-adaptation to this type of soundscape. This theory is further investigated and discussed.