

Listening to underwater noise: impacts of chronic noise exposure on fishes

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The soundscape underwater is never silent, but composed of geophonic and biophonic sounds. Anthropogenic sounds, e.g. sounds generated during exploration of oil and gas deposits, shipping, military operations, and development of offshore wind farms (OWF) have altered the underwater soundscape in the past 50 years. The impacts of anthropogenic noise on underwater animals were depended on the exposure level. Strong noise, such as that from pile driving, military sonar, seismic exploration, and shipping, has been known to cause auditory damage, hearing loss, behavioral change, communication masking in underwater animals. On the other hand, recent studies indicate that continuous noise with lower sound intensity may also induce physiological responses. For examples, milkfish (*Chanos chanos*) and black porgy (*Acanthopagrus schlegelii*) responded significantly on cortisol metabolism or reactive oxygen species / antioxidants balance, when they were exposed to the turbine noise of OWF for long duration. Furthermore, such long-term noise exposure may affect fish behavior as well. Using auditory brainstem response, a preliminary experiment showed that response thresholds of big-head croakers (*Pennahia macrocephalus*) to the intra-specific mating calls were found to be higher under long-duration exposure of OWF noise. The results suggested the increment of anthropogenic noise, will not only shape the underwater soundscape, but also affect both soniferous and non-soniferous fish in various levels. On the basis of Asian Soundscape, now it is possible to study the prominence of underwater noise in different aquatic ecosystems, which serve as the essential baseline information for evaluating the potential impacts of sound-generating human activities on underwater animals.

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