Qualia

Noise pollution also threatens fish

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Fish, like this school in the Maldives, actually live in a very loud world. (Image: Jim and Becca Wicks, Flickr)

Man-made noise is a growing threat to wildlife. Sounds produced by traffic, urban sprawl, and industry interfere with the way many animals communicate, mate, and find food. A recent review study found even animals living in protected National Parks are exposed to disturbing levels of noise.

The effect of man-made noise on marine mammals, many of which depend upon echolocation to find and catch prey, has also garnered a lot of attention. But what about other underwater wildlife? For years, it was assumed that fish lived in a largely silent world. In fact, 'The Silent World' is the title of the 1956 Jacques Cousteau documentary that introduced the public to vibrant undersea ecosystems with ground-breaking underwater cinematography.

AAAS Fellow and University of Maryland Professor of Biology Arthur Popper remembers seeing this movie and wondering, even as a child, if the underwater world really was silent. In his talk at the International Congress of Neuroethology, held in August in College Park, Maryland, Popper discussed his decades of research on fish bioacoustics and his recent investigations of how man-made noise can affect fish. He has learned the underwater world is, in fact, a rather noisy place.

Popper studied under William Tavolga, who founded the field of marine bioacoustics. Popper, Tavolga, and many collaborators demonstrated the importance of sound to fish. Most fish hear well and sound plays an active role in their lives. Light does not travel very far in water, so sound gives fish a large expanse over which they can detect predators and prey, communicate, and learn about their environment.

Different fish species vary in their hearing sensitivity. Most fish hear best within the range of 30-1000 Hz, though there are exceptions. The European eel, a freshwater species that spawns at sea, is sensitive to infrasound, while some herrings can hear ultrasound. The latter is thought to be an

adaptation to help herrings detect the ultrasonic echolocation clicks of dolphins, one of their major predators.

Fishes also vary in the ways they produce sound. Thus far, over 800 species of fish from 109 families are known to produce sounds. Fish make sounds in a variety of circumstances: when fighting over territories or food sources, within spawning aggregations, and when attacked by predators.

In 2010, Popper, along with colleagues in The Netherlands, Germany, and Belgium, reviewed the impact of man-made noises on fish around the world. Over the last century, noises made by oil and gas rigs, ships, construction, and sonar have increased, and these noises have the potential to affect the distribution of fish and their ability to communicate, reproduce, and avoid predators. There is some evidence that fish school less coherently in noisy environments and avoid areas where man-made noise levels are high. The presence of noise could keep fish away from preferred spawning sites and change their migration routes. It could also mask natural sounds that are important to the fish, such as communication sounds from other fish, and sounds produced by prey and approaching predators.

There are also physiological consequences of noise pollution. Continuous loud noises cause stress responses in endocrine and other systems that can have long term health effects. Proximity to extremely loud sound sources can result in hearing loss, bleeding, tissue damage, and even death.

Over the last few years, Popper's research has focused on the effects of human-generated sound on fishes, measuring both the behavioral and the physiological consequences. His lab has investigated the effects of seismic air guns (used for oil exploration), high-intensity sonar, and pile driving (as used in construction of bridges, piers, and wind farms) on fish hearing, health and behavior.

Popper ended his talk at the International Congress of Neuroethology by summarizing what is known and what scientists still need to figure out. "We know that hearing, and sound communication, is crucial to fish behavior," he said. "Humans are adding tremendous amounts of sound to the environment right now and understanding the impact of these sounds is becoming more critical. Sounds have the potential to harm fish physiologically. They have the potential to mask biological sounds and alter behavior." Popper said the behavioral and physiological effects on fish may depend on sound intensity and duration and a range of factors that scientists are only beginning to learn about. To fully understand the ecological impact of man-made noise on fish, a two-pronged approach is needed. One, more basic science research on how, what and why fish hear is necessary. At the same time, scientists must look at how the increase in intense man-made sounds can affect fish, and how to evaluate and mitigate those effects.

Related Links:

- The costs of chronic noise exposure for terrestrial organisms
- A noisy spring: The impact of globally rising underwater sound levels on fish
- Tenth International Congress of Neuroethology

- A Clupeid fish can detect ultrasound
- Effects of mid-frequency active sonar on hearing in fish
- Effects of exposure to seismic airgun use on hearing of three fish species
- Barotrauma effects on fishes in response to impulsive pile driving stimuli