Q&A: Does noisy construction of offshore wind farms disturb marine animals?

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The former Tappan Zee Bridge (left) was replaced by a new bridge (right) in 2017. Credit: SteveStrummer/Wikimedia Commons. CC BY-SA 4.0.

Offshore wind farms can be an energy boon, but does their noisy construction bother marine animals? UMD's Arthur N. Popper, who

studies underwater sounds and their ecological impacts, weighs in.

When listening to the gentle lapping of waves, the ocean may seem like a calm and quiet place. Below the surface, however, marine animals can be subjected to a cacophony of sounds.

Marine life and natural phenomena produce some of this noise, but a growing amount comes from human activities like shipping, recreational boating, fossil fuel extraction and infrastructure projects. One of the most clamorous sources in some parts of the world is pile driving, a construction method that involves pounding piles—long cylinders—into the seabed to support a structure, such as a bridge or wind farm.

Arthur N. Popper, a professor emeritus in the University of Maryland's Department of Biology, worries that the use of pile driving to construct offshore wind turbines could potentially harm fishes. Only two offshore wind farms are operational in the United States, but many more are in the works, including two projects planned for Maryland's waters and a third project approved for construction off the coast of Virginia. Across the U.S., interest in wind farms is growing, but Popper noted that researchers still don't know much about their effect on marine life.

Popper has studied the effects of human-generated underwater sound on fishes and invertebrates for more than 30 years and has advised companies and governmental agencies around the world on best practices to protect marine life. In a recent interview with UMD's College of Computer, Mathematical, and Natural Sciences, he discussed how fishes use sound to mate and communicate, the opportunities and risks associated with offshore wind farms, and the challenges of studying a vast sea of sounds.

This interview has been edited for length and clarity.

To what extent do marine animals, and fishes in particular, depend on sound?

Marine animals depend heavily on sound. Sound is one of the few communication signals that travel quickly across long distances in the oceans and are not stopped by low light levels or objects in the environment. One of my colleagues and I have argued—and it's reasonably accepted now—that hearing evolved in fishes to give them a bigger worldview than they would get from any other sense. Vision has a limited range and is useless in the dark, and chemical signals travel slowly and are subject to currents. To get a long-distance, 360-degree view of what's going on around them, sound is the best form of communication.

You often hear about underwater noise as it relates to marine mammals like dolphins and whales. Why is there so little research on how sounds affect fish?

Marine mammals are cute, interesting and smart, and people relate to them. They fall in love with Flipper and Free Willy, but tuna? That's what comes out of a can. Marine mammals are important, but we should be much more concerned about fishes and invertebrates because we depend on them. According to the Food and Agriculture Organization of the United Nations, aquaculture and fisheries provide 17% of the animal protein consumed worldwide. As food supplies become narrower in the future, they're going to become even more important.

Studying fishes in the open water is also extraordinarily hard. Marine mammals surface every few minutes so you can put tracker devices on them, but you can't do that with most fishes. Plus, there's never enough funding to work on fishes and marine invertebrates. I was collaborating with a researcher in Canada on a project to understand the impact of

seismic air guns—a device used to study marine geology and seek underwater oil and gas—on fishes, and the price for just two experiments was going to be $10 million. The challenge is: How do you get the funds to do very expensive and very difficult work?

How does underwater noise affect fishes and invertebrates?

Human-generated sounds can potentially interfere with the ability of fishes and invertebrates to hear sounds of biological importance to them, such as the sounds of potential mates or predators. There are data, for example, showing that male Atlantic cod and haddock congregate and make sounds, and the females hear the sounds and come to the males to spawn. If the females can't hear the males because there's so much noise in the environment, you've harmed a generation of animals. Anything we're doing in the ocean—from pile driving to shipping to wind farms—has a potential impact on vast populations of animals and their reproductive capabilities.

What sparked your interest in the noise generated by offshore wind farms, and what are your concerns?

Wind farms are becoming a big thing on the East Coast of the United States, and I'm consulting with different groups that are involved in developing and regulating wind farms. The construction of wind farms is a big issue because it is a source of considerable noise. In some places in Europe, they don't drive piles into the substrate to support the wind farms. They let them float and use big weights and cables to keep them in place. But in the United States, at least on the East Coast, I haven't heard of that happening.

There have been few observations of fishes during the operation of wind

turbines, and these studies have been in Europe. In fact, it turns out that fishes are attracted to wind farms because they produce shadows. Shadows provide coverage and can be attractive breeding grounds for fish. There's reason to think that fish might like wind farms in the same way that they like coral reefs, but there are not enough data to say how true that is or whether it affects reproduction or other aspects of behavior.

In past presentations, you have said that the sound of pile driving can exceed 225 underwater decibels. How loud is that exactly?

Imagine being at an airport with a Boeing 747 at full power and you put your head near the engine. That's how loud it is. There is concern that if fish are very near piles being driven into the sediment, the sound may be loud enough to kill, or at least severely damage, them. However, there is no reason to think that fishes further away would be physically harmed, and waters are much quieter during operations of the wind farm.

The main issue, though, is that sound can spread large distances and affect fish behavior. Sounds may mask a fish's ability to communicate or scare them away from a feeding site. We did a study several years ago on the Hudson River when the former Tappan Zee Bridge in New York was replaced. We looked at Atlantic sturgeon, which are highly endangered, to see how they responded to pile driving noise. It turns out that the fish seemed to skirt around the noise, so the good news is that if there's enough room, the fish will avoid the sounds.

Is it possible to have the best of both worlds: to promote sustainable energy while also protecting marine life?

My guess is that it is totally possible. Wind farms are useful sources of power. They don't cause pollution, they're not taking up space on shore and they produce a good deal of energy. There are some real advantages, but we need to learn a lot more about their impact on marine life.

What needs to be done to learn more?

A couple of years ago, colleagues and I argued in a paper that the way in which human-made sound is evaluated and mitigated is backward. For most projects, people install devices to mitigate sound in the water, but they never stop to ask, "Do the fish care? Can they even hear the sounds?" In effect, people doing pile driving put in a solution without asking if it is effective or useful.

Considering that this may not protect animals—or that the animals may not need protection—we argued that we should learn more about how fishes deal with sounds and then design devices to specifically protect them. The point we're getting at is that the right questions have not been asked.

Provided by University of Maryland

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