



Loud and clear!

Can you hear me?

By Emily Cambias

MICHELLE FOURNET

MARINE ECOLOGIST

Michelle Fournet is a scientist who studies marine mammals and their sounds. She conducts research for the K. Lisa Yang Center for Conservation Bioacoustics at Cornell University in Ithaca, New York. Fournet is featured in the recent Apple+ documentary *Fathom*, which shows her collecting and examining humpback whale vocalizations. She began by telling us: “My job means that I get to listen to the voices of whales, and seals, and also fish in order to understand how they’re talking to each other, what they may be saying, and how human activity changed the way that animals underwater communicate with each other.”



I WAS EXPECTING THE WHALES AND THE SEALS, BUT I WAS NOT EXPECTING THE FISH!

That's very common! I think that there is a misconception that fish don't make sound. But as it turns out, almost all fishes rely on sound for survival, either through their hearing or through sound production. And some fish make amazing sounds—they sound like French horns, or drummers.

HOW DOES A FISH MAKE SOUND? DOES IT HAVE VOCAL CORDS?

They don't have vocal cords. Fish use their swim bladders to both hear and produce sound. They can make vibrations by moving their muscles around the swim bladder. Some fish, like the parrot fish, flap their jaws together to make sound, and in other fish we're not entirely sure what they're moving to make sounds. Toadfish have some extraordinary vocalizations, sort of a *bup-buuup-bup-buuup* sound. Male toadfish make that sound during breeding. They use that sound to defend their territory and to attract mates.



Toadfish

HOW DO YOU HEAR SOUNDS UNDERWATER? DO YOU JUST STICK A MICROPHONE IN THE WATER AND LISTEN?

Well, it depends. I work in Alaska, doing the bulk of my research on humpback whales. I've been studying in Alaska for a little over a decade now. I go to a small island, and I drop hydrophones under the water and leave them there. They collect sound around that island. And I watch the whales from shore and try to document all their behavior. Then we go back afterwards and get the sounds [that the hydrophone picked up] from the bottom of the ocean, and we line up what we saw with what we hear. Or sometimes, I'll go out in a boat, and I will set a hydrophone adrift in the water. Then I put a speaker in the water, and I play a sound to the whales. I'll play it several times, and then retrieve my hydrophone and see how the whales reacted to the sound.



Hydrophone

SO, IN OTHER WORDS, YOU'RE PUTTING THE HYDROPHONE IN THE WATER AND PLAYING WHAT YOU THINK MIGHT BE A "HELLO" TO SEE IF THEY SAY "HELLO" BACK.

Exactly. I'm playing a call that I think is a "contact call." In human language, "hello" is a contact call; if you hear someone say "hello," you respond with "hello" back. If I walk into an empty room and I'm not sure if somebody's there, I might say, "Hello, hello?" to see if someone says "hi" back. That's a human contact call. There's one call that humpback whales make that I think is a whale contact call. That call is called a *whup*. It sounds kind of like *brrrrrrup-pop*. I play that contact call in the ocean, and see whether I get a reply. So, right now what that means is I play that call 10 times, and then I check to see whether or not the number of whups per minute that the whale is making goes up. Do I get more whups when I play a contact call versus when I play something else?

AND DO THEY SAY HELLO BACK?

Yeah, they do! What we found in our pilot study in 2019 was that 100 percent of the time that we said "hello" to a group of whales, the number of "hellos" they were saying increased. So, we got more hellos when we said hello than we did when we said something else.

ARE THERE ANY OTHER CALLS THAT YOU'VE IDENTIFIED?

We are working on that. That is much harder. The other call that we have played in the past is a feeding call, that means there are fish around. Herring will run away from this sound, and for whales, it's like the dinner bell—if they hear other whales making this call they'll come over to check and see if there's fish. And so

ultimately, we didn't do too many playbacks of that call because we didn't want to deceive the animals. But that's another really good one for testing hypotheses. So, we know that whales make contact with each other using one call and we know that they use this other call when they're foraging on fish.

Sea lions live in the same waters as whales and eat many of the same fish.



YOU ALSO MENTIONED SEALS—ARE YOU PLAYING ANYTHING TO THEM?

I'm not actually trying to play anything to seals, but because there are seals and sea lions in the same area sometimes, when I'm playing sounds to a whale, sea lions will respond. When we were out on the boat in Alaska, we played a feeding call to see what the whales would do, and a whole group of sea lions came over and checked out our boat. In fact, we had to pull in our equipment, because sea lions are really curious, and they explore the world with their mouths. We had to get our speaker out of the water before a sea lion bit it! In one past project I did, we had a hydrophone in water and a sea lion got really, really curious about it, and ripped it off with its mouth and carried it away. We had to get a new hydrophone!

Animals have been in the ocean for a very long time. And animals that live underwater rely on sound, because light doesn't travel very far through water. When you're underwater, you can't see very far, but you can hear over really long distances. So, as a result, the underwater sounds, or the acoustic habitat, that whales, dolphins, and seals and fish inhabit is very rich. If an ecosystem is healthy, you should be able to hear the voices of fish and shrimp, and whale songs. There should be kind of a lovely underwater cacophony when you put your hydrophone into the water. That's an indication that things are going well. When the ocean starts to get quieter than it was, that's an indication that something's changing.

By listening to these soundscapes, and listening to the acoustic community—which means all the sound-producing animals that are in one area—we can begin to figure out whether or not our ecosystem is healthy, or whether or not our ecosystem is struggling. This is something that we're listening for; to understand climate change, to understand how animals are interacting with the warming ocean, and how these animals are feeling about human activity nearby. And by doing this, we can figure out what animals are doing, when they're there, and where they're going. That gives us a lot of information about the health of our oceans.



Michelle Fournet and her furry first mate, Vista.

YOU MUST ALSO BE PICKING UP A LOT OF HUMAN NOISE LIKE SHIPS AND SIGNALS.

Humans have only really been making noise in the ocean for the past 250 years. Anthropogenic noise—any noise that is produced by humans or human activities—on the scale of the entire ocean is really new. Animals haven't had much time to adapt or evolve to this changing underwater soundscape. Humpback whales have been in the ocean for millions of years. Anthropogenic noise has only been in the ocean for hundreds of years—that means that it's only been a handful of generations—maybe three generations—of whales that have had to deal with our sounds.

You can drop a hydrophone almost anywhere on Earth and still hear humans. They put a hydrophone to the bottom of the Marianas Trench, the deepest point of the ocean, and they could still hear boats. If we can hear them everywhere that we are listening, it means that whales, seals, and the fish can hear them, too. Part of my research is trying to understand animals' resilience to our noise. Are humpback whales capable of having a conversation when we're around? Or do they stop talking altogether? If we understand the relationship between the sounds that we



make and the sounds whales make, we might be able to improve our technologies to not be so noisy. We can change when and where we make ocean noise, so that if we have to make noise, we might do it at a time when there's fewer animal noises around. There need to be responsible choices about human activities so that we don't infringe on the lives of these animals that have been in these waters for millions of years.

THAT REMINDS ME OF A STUDY IN WHICH THEY FOUND THAT CITY BIRDS SANG MUCH LOUDER THAN BIRDS OUT IN THE COUNTRYSIDE, BECAUSE OF ALL THE HUMAN NOISE AROUND THEM. HAVE WHALES CHANGED THE WAY THAT THEY CALL TO EACH OTHER BECAUSE OF HUMAN ACTIVITY?

Yes, they have. Similar to the birds, when it gets noisy humpback whales will call louder. But unlike birds, when humans make a lot of noise, humpbacks don't just call louder—they'll also call less. If it's raining on the water, the whales might call a little less because it's harder to hear each other. But if there's a boat in the area, we see about a 30 percent reduction in the probability of a whale calling, just because the noise is manmade. They will actually stop calling when a

boat passes by. They seem to respond more strongly to humans than they do to rain or wind or other animals.

We have a new hypothesis that we're testing right now. We were able to test this because of the COVID-19 pandemic. During the start of the pandemic, it was really quiet in the ocean because so many boats stopped going out. We think that humpback whales change what they say in a quiet ocean versus a noisy one. When the ocean is noisy, humpback whales are more likely to make contact calls; they call back and forth more than they do when the ocean is quiet. And what we're testing right now is this hypothesis that when the oceans are quiet, the quality of the conversation gets more complex. They talk to each other in different ways, when the ocean is quiet.



IT SEEMS ALMOST LIKE BEING IN A CROWDED ROOM AND SHOUTING YOUR FRIEND'S NAME TO GET THEIR ATTENTION, VERSUS BEING IN AN EMPTY ROOM WHERE YOU CAN HAVE A LONGER CONVERSATION WITH YOUR FRIEND IN A NORMAL VOICE.

Yes, that's exactly right. Like if you're at a birthday party, and it's really noisy, you might just say things like "Hi," or "Can I have a piece of cake?" But if you're sitting down just two people, let's say that you're on a park bench, you might have a whole conversation about how you feel about something; what kind of cake you like, what you did this morning. When it's quieter, there's an opportunity to share more information. And when you're shouting, it's harder to share more information.

COULD YOU TREAT US TO A WHALE ENCOUNTER THAT YOU REMEMBER?

When I do my work in Alaska, we often will camp for long stretches of time, several months on an uninhabited island. The whales in Alaska forage right by the shore. From my tent at night I can hear the whales breathing. You know they're right next to the shore. One evening when I was in my sleeping bag, and I heard an explosive breath closeby. I slid out of my tent and went down to the water. And sure enough, there was a whale foraging maybe 20 feet (six meters) offshore. I stepped into the water, in my rubber boots. This whale took a breath right as I stepped into the water. And my whole body vibrated, just from the breath of this whale. The simple act of it breathing was enough to move every bone in my body. That's one of my favorite experiences I've ever had.

Emily Cambias is an assistant editor for *Muse*. She has seen whales from a distance, but has only ever heard their songs in her dreams.