

This is a transcript of The Conversation Weekly podcast ‘Underwater soundscapes of seagrass meadows revealed in new recordings’ published on July 4, 2024.

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Issy Key: So I made a little quiz for you Anna, so I'm hoping you can try and work out what might be making these sounds: fish, crab, or human.

Anna Turns: OK. I'll do my best.

Issy Key: OK, first sound.

Gemma Ware: Today on The Conversation Weekly...

Anna Turns: Oh, it's so hard to tell. I'm guessing a kind of fish, but I could also imagine it being a crab smashing its claw against something, maybe.

Gemma Ware: We're speaking with Issy Key, a scientist who spends her time snorkelling off the coast of Scotland, listening to the sounds of fish.

Issy Key: Your instincts are right, it's a fish. That's actually an Atlantic cod. Good start, fish.

Gemma Ware: Here's Issy quizzing my colleague Anna Turns. Issy's been collecting these sounds to measure the health of seagrass habitats.

Issy Key: Next sound

Anna Turns: Um, I'm gonna say a mooring buoy.

Issy Key: Honestly it does sound like a mooring buoy, but no, that's actually a shore crab feeding, so that's, one of the most common species of crab we have in the UK when it's feeding it makes that sound.

Gemma Ware: Besides being quite entertaining to listen to, these gurgles and snaps are the first step towards developing AI tools that can help us better understand the soundscape of the sea, and potentially improve the health of underwater habitats.

I'm Gemma Ware, and this is The Conversation Weekly. The world explained by experts.

Gemma Ware: Helping us tell this story today is the Senior Environment Editor at The Conversation in the UK, Anna Turns. Hi Anna, welcome to the podcast.

Anna Turns: Hi Gemma, thanks for having me.

Gemma Ware: So, Anna, the story we're hearing today came about because of something you told me that you'd been seeing and noticing in Devon, on the south coast of England, where you live. What did you notice ?

Anna Turns: So I often swim in the sea, in the sort of shallow coastal waters around Devon, and I really started noticing differences in the seagrass habitats where I swim. So some places are very sandy and some places have got really amazing seagrass, 3D habitats growing on the seabed, and I started noticing lots of creatures kind of swimming there. And I was really curious about what was going on in terms of the importance of this seagrass, and how in different places it was thriving, and in different places it perhaps wasn't so much because boats were anchoring and, and mooring, that sort of thing.

Gemma Ware: So, when you swim over the top of this seagrass meadow, what does it feel like?

Anna Turns: So, whenever I swim, I swim with my head down, I'm sort of doing front crawl, and I really love the fact that I'm completely immersed in that marine environment, and it sounds really, really different. There's a very different quality when you're underneath the water compared to being on land and being surrounded by air. And I started hearing different. It's really hard to describe, kind of different sort of swishing sounds. Some of it was my breathing, some of it was my movement, but some of it was clinking of mooring chains in the distance or, waves moving underneath the water and things, things like that. And I'm also super conscious of my connection with natural sound as well.

So a couple of years ago, I started losing some of my hearing and, I'm just very appreciative of the fact that I can hear natural things. And I think when I'm swimming, because I'm maybe in a more mindful headspace, I really noticed the quality of sound and the changes in sound as well. And it also struck me that marine creatures use sound as a form of communication so I was just really

interested in this idea of acoustic pollution, like how things are different in seagrass and the sort of diversity of sound, I suppose, underwater.

Gemma Ware: So in your job at the conversation, you've got a great opportunity to go out and find researchers who might be able to answer these questions you had as you were swimming along. How did you find Izzy Key and her research?

Anna Turns: It was quite serendipitous, actually. So I've had this kind of thought process for quite a while, because I swim regularly. It's always at the back of my mind. And I came across, I came across Issy's work on Twitter actually, and when I saw it, I was immediately really fascinated. She is a researcher studying seagrass habitats. She's working on her PhD at the moment at the University of Edinburgh in Scotland as a marine ecologist. And as part of her PhD work, she's heading out into seagrass meadows off the coast of Scotland and listening to the sounds of wildlife and the sounds of those habitats and trying to distinguish what some of those sounds were. So I was just really intrigued by her research and wanted to connect with her and find out more.

Gemma Ware: And you did for this episode and we're going to hear that conversation now.

Anna Turns: Yes and I started out by asking her why study seagrass.

Issy Key: I mean, I'm not one of those people who just fell in love with seagrass at first sight when they were five. But seagrass really caught my attention because it's one of those marine ecosystems which is one of the major ones in the ocean, but hardly anyone has really heard about it. But it's really declined in the UK, so we've lost at least 40 percent of our seagrass cover, possibly up to 90 percent of historical levels. And with that, it's going to have a huge impact on the creatures that live in it, and that's going to have ricocheting effects right up the food chain, so I think for me, I really care about marine life as a whole, and I see protecting and restoring seagrass as one really key part of, restoring marine life.

Anna Turns: So before we go any further, what actually is seagrass?

Issy Key: Seagrass is a marine plant. It's different to seaweed, which I think can be a bit confusing. Seaweed is actually a type of algae, whereas seagrass is related to land plants and it forms meadows just like we get meadows on land.

So it's got flowers, it's got seeds and pollen, and it has roots that grow underground.

Anna Turns: Issy's ongoing research, which is still unpublished, looks at how seagrass meadows sound different depending on the biodiversity of species that live there.

Issy Key: A really healthy seagrass meadow is going to be home to lots of creatures. So fish, crabs and other animals and lots of those animals will be making sound either accidentally as they're just walking around or deliberately because they want to communicate with each other. So we'd expect that if we hear more different types of sound, then that might mean there are more animals in the seagrass and potentially a more biodiverse and healthy seagrass meadow.

Anna Turns: So Issy set out to start recording coastal seagrass habitats along the west coast of Scotland.

Issy Key: The Scottish coast is beautiful. You have quite jagged rocks and often you have white sand, turquoise water if it's a really sunny day so it can look really stunning. Generally I'm snorkeling. So I'll snorkel around and dive down to do things on the seabed. And then I usually have a friend or a colleague with me on a paddleboard or in a kayak, and they do the navigating and some carrying of equipment and stuff. The water is quite chilly, it's about 12 to 15 degrees c in the summer, but I have a really thick wetsuit, but you really have to limit how much time you're in the water. And I always have someone helping me in the field, this as huge team effort.

Anna Turns: Issy and the team she works with are among the first ecologists to do this sort of audio research in an underwater habitat, partly because the technology they use for recording was prohibitively expensive even just a few years ago.

Issy Key: I take these ditty little microphones called audio moths, which are actually designed to listen to bats on land, but they've been recently developed to have underwater cases, and this is really revolutionized underwater sound science, because these are nice and cheap. So you used to have to spend thousands and thousands of pounds on buying hydrophones and now you can just get a cheap little recorder which has really opened up this field to lots of people.

Anna Turns: These microphones are so small they can fit in the palm of your hand, and Issy and her team use them to monitor the sound in three different seagrass meadows, which are anywhere between 1-7 meters deep.

Anna Turns: So at the moment you're studying seagrass meadows in Scotland, in the UK, It's summertime in the northern hemisphere here right now. What is the seagrass doing at the moment?

Issy Key: So now is a really busy time in seagrass land. It's warm, so there'll be Sea snails feeding on algae, there'll be juvenile fish feeding on zooplankton, crabs might be out defending their territories and having a fight, and there'll be birds and seals which are hunting for fish and crabs to feed their own young, so a really bustling time of year, and of course the seagrass will be flowering, and there'll be pollen moving around either through the water column or invertebrates might move it around in some cases.

Anna Turns: And what sort of things do you hear?

Issy Key: So, we hear fish, so they make kind of grunting noises, or burping or purring noises, which are quite low pitched. They use about the same vocal range of a human speaking, um, or like more around a man's tone of voice. And then I heard a lot of sounds which I think are due to crabs. It's really hard to say everything for sure, but they make a more, kind of, metallic-y, sort of, zzz, kind of sound.

And then occasionally you've got a dolphin coming through. And then you also have, wave sounds, or just like general water movement, occasionally you might have a boat, or some like chinking of chains from a buoy.

Anna Turns: On top of these human-made sounds, Issy also discovered an unexpected source of noise pollution – the seagrass itself.

Issy Key: I got this sound which I wasn't really expecting, or wasn't expecting it to be so loud, so I got lots of popping noises, which I think is due to photosynthesis, and, they were becoming louder during the day, so as the sun is out and it's warmer, plants are photosynthesizing more, and I was getting much more of this popping sound. And that was actually surprisingly loud.

It is known that, plants underwater, so seagrass and algae, make bubbles, so as they photosynthesize, bits of oxygen collect on their surface, and as that moves off the surface, that makes a popping sound. But it can be quite difficult because that, popping sound can mask the fish sounds you're trying to hear, which are

actually quite quiet. So it can be easier to study the fish sounds at night because there isn't as much photosynthesis getting in the way.

Anna Turns: It seems that this sound doesn't bother the marine life. And in fact, this may be part of the attraction for them: Issy explains that the seagrass shields its inhabitants from predators.

Issy Key: So seagrass actually absorbs sound energy as it hits it, and it's been shown that that can protect fish from dolphins that use echolocation to navigate towards their prey. So the clicks of dolphins don't penetrate seagrass very well. So fish are actually safer in seagrass, which is really cool.

Anna Turns: They can actually hide amongst the fronds, basically?

Issy Key: Exactly. Yeah. And you'd think well obviously it's visual protection but you forget that it's actually also acoustic protection.

Anna Turns: So far, Issy has managed to identify 14 different types of animals in the seagrass habitats off the coast of Scotland. Not including dolphins, which can occasionally be heard, but only from a distance.

So how do these marine animals and these marine creatures that you're mentioning actually produce sound?

Issy Key: They can make it in a whole variety of ways, fish have evolved sound production multiple times. Two of the main methods they use are firstly their swim bladder, so that's the gas sack they have which they use to regulate their buoyancy, but they can also squeeze it or hit it like a drum, and that can make all sorts of different noises.

The other main method they use is rubbing their bones or teeth together, so one of the most common is moving their shoulder girdles, so it's a bit like you clicking your shoulder, which I think is quite cool. And crabs also use a variety of methods, they can rub parts of their body together, or they can hit the hard substrate that they're standing on.

Anna Turns: And Issy is capturing it all on tape.

Issy Key: So I take these microphones and I put them on a stand about 30 centimeters above the seabed. I leave them down for a week, and then every day I'll go and put a camera next to them so I can match up the sound and the video if possible.

Anna Turns: You can work out what's making this sound?

Issy Key: Well, the absolute dream would be to have, a fish swims in front of the camera, you see it kind of moving, it like, it looks like it could be making sound, and you can associate that with the sound you're actually hearing in the sound recording.

Anna Turns: Unfortunately, that's not quite the reality.

Issy Key: This is the catch with acoustic data is that it can be really easy to quickly collect thousands of hours of audio if you want, but then it's not so straightforward to analyze that data. Hopefully in the future it will be, but not quite yet.

Anna Turns: Issy has spent many months wading through the audio recordings she has collected so far.

Issy Key: I use two main methods of analyzing the data. The first is called acoustic indices, which is statistics that summarize the complexity of the soundscape.

Anna Turns: This method might be quick, but the downside is that acoustic indices respond to waves or boats, as well as animal sounds.

Issy Key: The second method I use is phonic richness. Where I just take samples of my audio and I listen to them and I look at it visual depictions of the sound with something called a spectrogram and I actually go and count how many different types of animal sounds I think I can detect and group them into types. So that's very time consuming, but you're actually pulling out real data that you are pretty sure links to animal sounds

Anna Turns: And there's another significant benefit to this method.

Issy Key: That is what can be used in future to train, machine learning algorithms so we can get this analysis working more smoothly.

Anna Turns: The ultimate goal of Issy's research is not just to track what's happening at her three field sites, but to contribute to a machine learning model, a form of artificial intelligence that can analyze other sites as well. But that's at least a few years away.

Studies show that globally, 29 percent of seagrass has been lost since the 18th century, and this decline has accelerated in recent years. So I wonder how these soundscapes can help us learn about how these habitats work.

Issy Key: Humans are just such visual creatures that it's really easy to forget about sound. We all know that birds sing and frogs croak and bees buzz and things, that's kind of natural to us, but I think it's very much not in people's minds that fish and crabs and shrimp make noises and need sound to survive and communicate.

Anna Turns: While Issy hopes eventually to use machine learning to analyze her data and broaden the scope of her research, it turns out artificial intelligence still has a lot to learn about marine life.

Issy Key: A few months ago I asked ChatGPT, some kind of question about fish sounds, and it actually came back at me saying that fish are silent, which was pretty crazy. So that just shows that general awareness has a lot of catching

Anna Turns: Absolutely. Thank you so much, Izzy. That was really fascinating. And I feel like next time I go swimming, I'm going to try and listen in a bit differently to what's happening in the seagrass beneath me.

Issy Key: That's great, well you have to let me know what you hear, I'd love to.

Anna Turns: And good luck with all your research. Thank you so much.

Issy Key: Thank you so much, it's been great to talk to you.

Gemma Ware: This is such a fun story Anna, and what a great conversation you've had with Issy. It sounds like this is something big in the way we understand the sea and the marine environment as well.

Anna Turns: Absolutely. And there's so much that we don't yet know about sound underwater and acoustic pollution and all of the things that, that are going on right now. I really think Izzy is among a sort of group of scientists who are laying the groundwork for understanding so much more about how we can help protect our seas and, and how we can help conserve marine wildlife as well. So for example, like, well, the photosynthesis popping might be a bit of a distraction for her work and there were other scientists studying that in greater detail. It's linking all of those sounds and being able to decipher them and then

judging how that correlates to different seagrass habitats that's really, really fascinating.

Gemma Ware: And what else could be done with this kind of research?

Anna Turns: There's so much untapped potential. Honestly, once, once scientists start creating these really rich sound libraries that can be done all around the world in different types of habitats, in different marine environments, then you've got this AI factor as well. So being able to analyze really quickly what the baselines are, what's changing, how things are progressing or declining perhaps. And another future project Issy and her team are considering getting involved with one day is to perhaps even play the sound of a thriving seagrass habitat in a in an early growth stage seabed, to potentially attract more animals into that area and, and speed up and accelerate that healthy ecosystem. So I think there's a lot of scope for potential future research projects.

Gemma Ware: Brilliant. Well, thanks so much, Anna, for bringing us this story. It's been great chatting with you.

Anna Turns: Thanks so much.

Gemma Ware: That's it for today's show. We'll pop a link to Issy's article, edited by Anna, into our show notes. And thanks to Issy for sharing some of her original sound recordings, and to FishSounds.net for the use of some of their clips of fish. You can find the citations for those in our show notes as well.

This episode was written and produced by Katie Flood, with production assistance by Mend Mariwany. Sound design was by Eloise Stevens, and our theme music is by Neeta Sarl. Stephen Khan is our global executive editor and I'm Gemma Ware the show's executive producer.

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