Ocean Gazing: Episode 45
MBARI: A seaside sequel

<intro music>

Ari: This is Ocean Gazing, the podcast where we shake off the barnacles and the kelp, and go for a deep dip in the big blue salty sea. I'm Ari Daniel Shapiro.

Everlove: Arm dot grab 4. Arm dot 2 flush. <sounds of ESP>

Ari: That's Cheri Everlove. When we spoke, she was a mechatronic engineer at the Monterey Bay Aquarium Research Institute, or MBARI.

Everlove: Forearm seek retract.

Ari: And she's reading off the commands she uses to control a special robot in the ocean.

Everlove: Elbow seek flush.

Ari: This is the second episode of a two-part visit to MBARI. We'll learn about this robot, anchovies, and how high school teachers are using MBARI data right in their classrooms. Stay tuned.

Everlove: Forearm seek garage.

<fade up music and sustain>

Ari: Hello!

Fulton-Bennett: This is Jim Birch, Ari.

Birch: Hi, how ya doin'? I don't know what you wanna…

Ari: Yeah, do you want to tell me your name and what you do?

Birch: So, my name's Jim Birch. Technically, I run the Surf Center here within MBARI that deals with this instrument that we call the ESP, which stands for Environmental Sample Processor.

Ari: ESP, usually I think of extrasensory percep—, I mean is there any…?

Birch: <laughs> I don't know, do you know why ESP was selected? I don't know. The idea, I think, is that this lab sits in the environment and it samples where it sits. And that's really, really unusual. There is nothing else like this in the world right now.

Ari: So the ESP – it's about the size of a trash can?

Birch: It is.

Ari: And it's got all sorts of colorful little cables in there, and boards. What does all that stuff do?

Birch: Yeah, well, what it really is: it's a microbiology lab that has taken all the steps that a human would do when they would receive a sample of water, and automated it. So it's a robot in essence. What the ESP does is it filters seawater, and it looks for either different microorganisms in the seawater, or it looks for the products that these organisms might make and slough off into the ocean.

Ari: What sorts of life are you on the hunt for?

Birch: So the ESP can detect bacteria, different kinds of algae, very small larvae.

Ari: The ESP can be used to monitor water quality, and it can survey for red tides – that is, dangerous blooms of dinoflagellates that can be poisonous or deadly for humans and other sealife. These little robots are usually stationed in the waters off Monterey. They can plug into MARS, the ocean observatory that MBARI runs. MARS offers two benefits: one, a power cord that provides the ESPs with a constant supply of electricity, and two:

Birch: The really, really nice thing is it has high-speed Internet. So we can plug this in out in MARS, and sit at a computer terminal here at MBARI, and talk to it as though it were in the lab down the hall.

Ari: So you could write these commands to it while it's out at sea.

Birch: Oh yeah, we have, we have.

Ari: The Internet cable also allows Birch and his team to receive data from the ESP in real time. Cheri Everlove was one of the engineers on the project, and built the ESPs from scratch. Now she's commercializing the ESP at McLane Research Laboratories on Cape Cod. But when I interviewed her, she was still at MBARI.

Everlove: I love to tinker. I build things all the time. One of my earliest memories is being, like, 2 years old and taking apart my grandfather's fishing reel. And not quite knowing how to put it back together but, you know, interested in how things work. So working on this system that involves so many different kinds of engineering is so much fun.

Ari: Each of the ESPs has a different name. So this, I see a label, it says Betty?

Everlove: Yes, each of our instruments that we've built so far have been named. <fade up Matrix music> The first one we called Neo – he was the one…

Ari: Wait, wait, is that a pop culture reference?

Everlove: It is, it is to the Matrix.

Ari: Wait, I know Morpheus. Who's Neo? <"He is the one."> Was that Keanu Reeves?

Everlove: Neo was…Keanu Reeves. Yes, exactly.

Birch: That's not exactly why it was called that. It was NASA Earth Observatory cause NASA helped fund it! So we have two good reasons why we named it that.

Ari: Then came Bruce…

Everlove: Named after a colleague…

Ari: Mack…

Everlove: Strong like a Mack truck, you know…

Ari: And MOE….

Everlove: Somebody wanted, like, the three stooges names. And we nixed the other two but MOE got to stay because it could be the Monterey Ocean Observing Experiment.

Ari: You guys are really good with acronyms.

Everlove: We specialize in acronyms here!

Ari: Why do you go to the trouble of naming them?

Everlove: When we have a bunch of them out in the ocean at the same time, we wanna look at the data that's coming back from it. We want to know where it's coming from. And so you gotta call them something, and names are just – they make it a lot more fun.

Ari: My visit to MBARI was full of conversations with people doing important work. Before stopping by the ESP group, I dropped by Francisco Chavez's office. He's a biological oceanographer with an incredible view of the Pacific Ocean from his office window. Chavez studies how and why the numbers of different species in the ocean fluctuate.

Chavez: A student of climate and how it impacts ocean ecosystems.

Ari: And he uses moorings to monitor the level of carbon dioxide, or CO_2, in the waters off Monterey.

Chavez: At the surface here, we see these very large changes in CO_2 that are driven by this natural upwelling process.

Ari: Upwelling is a process is where the ocean is kind of, like, pushes up water from below. And this water, it's rich with all this organic stuff.

Chavez: No, inorganic.

Ari: Inorganic.

Chavez: It's been decomposed: it's like Miracle Gro. We have a whole bunch of Miracle Gro, and we've also gassed it with CO_2 gas like we have in soda pop. So we have CO_2 and Miracle Gro together that's brought up to the surface by this upwelling.

Ari: And it's that that's kind of a good food surface for a lot of critters at the surface.

Chavez: And that drives these critters…makes the ecosystem productive.

Ari: So upwelling, it's not constant, but when it happens periodically, then you get these bursts in CO_2 drawdown?

Chavez: Yes, so you have…the upwelling will show up as a spike up in CO_2. That'll last for 3-7 days. Plants are stimulated, they suck it down. So we see this continuous spikiness.

Ari: And that spikiness from CO_2 getting upwelled and then drawn down by the phytoplankton or tiny marine plants…that spikiness is overlaid on a trend over the last 50 years. A trend of increasing CO_2 in the ocean due to human activities…deforestation, burning of fossil fuels…the usual culprits.

Chavez: It's happening because of something we've done. The big question now is what are the impacts of that. And that's where we don't have the answers.

Ari: And on top of that, Chavez is taking into account El Niño and La Niña – natural changes in climate that happen every 3-8 years, and El Viejo and La Vieja – that happen every 25-40 years. Chavez uses all this information to predict how certain fisheries – like sardines and anchovies – are being impacted, and what's gonna happen to them in the future.

It's an important message, and one that Chavez shares beyond MBARI. I found that out when I asked him about a drawing of some corals lying on his desk.

Chavez: This one? I often go to schools and give invited talks. This was a little thing that a – I think it was a third grade class – did for me…as a thank you. They all signed it. I've kept it.

Ari: Increasingly, Chavez doesn't even have to show up in person for his science to be used in a classroom. For example, John Cary - a science teacher at Malibu High School in California – has his students work with Chavez's data showing the relationships between climate and the anchovy fishery. Cary says his students get a lot out of it.

Cary: They need to understand what's going on in the world. You can't make suppositions. You have to have data, which is what scientists use, to create models that give us an idea of what might happen. So this gives them an idea that we have to gather real data to see what's happening into the future.

Ari: And how do you feel that this impacts their relationship with science? Or does it?

Cary: I think that when students understand the importance of science and how we can show what is happening, or what may happen, or what has happened in the past, then they have a better understanding of the environment.

Ari: Cary's just one example of teachers connecting to the science at MBARI. And that's a top priority for George Matsumoto. He's the Senior Education and Research Specialist here, and he runs a program for teachers called EARTH, which stands for Education and Research: Testing Hypotheses. I'm tellin' ya, the folks at MBARI, they sure know their way around an acronym.

Matsumoto: So the general notion of the EARTH workshop is to get real data into the classrooms. A lot of this comes about because the teachers have gotten tired of textbooks, and some schools can't afford textbooks period. But they've also found that the students are very eager to learn but the students want to learn material that is current and relevant. And that comes down to real data. In particular, real time data is something that is perfect for students cause they get very excited about that. And the teachers are the ones who are gonna have to motivate the students and interest the students in these issues. But it's gonna be the students of today that're gonna make the difference tomorrow.

<fade up transition music>

Ari: Check out our website – oceangazing.org – to hear about another application of the ESP that involved a big flush, and to learn about a lesson plan using Chavez's data that came out of an EARTH workshop. You can also send a note or a question to any of the scientists and educators featured in this episode. Oceangazing.org.

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