COSEE NOW Podcast
Episode 2: Heidi Sosik & Rob Olson

<cue up music>

Ari: Hello! This is Ocean Gazing, the podcast where we observe and explore the oceans on our planet. I'm Ari Daniel Shapiro. This time we'll hear about a special underwater camera that takes pictures of tiny cells in the ocean.

<fade down music>

Sosik: We literally had *millions* of cell images. We were just absolutely overwhelmed with the amount of data that we got. It was exciting, but kind of intimidating.

<fade up music>

Ari: That's Heidi Sosik. She and Rob Olson are both biologists at the Woods Hole Oceanographic Institution. They'll describe how a shared frustration led them to develop a tool that has revolutionized how the ecology of the ocean is studied.

In addition, we'll tell you the answer to our last sonic stumper, give you a new one, and answer some of your questions. Stay tuned!

<fade music up>

Ari: Ever pull an all-nighter? What about 4 in a row, while at sea? Rob Olson and Heidi Sosik used to do just that.

Olson: We were doing a lot of cruises where we would sample 24 hours a day for several days at a time sometimes. It was just exhausting, very frustrating because we couldn't keep up.

Sosik: Not only that but we couldn't even do what we wanted to. We got a point every 2 hours. Every time we'd analyzed the data, we wished we had a point every hour or a point every half hour.

Ari: Sosik and Olson were participating in these research cruises to collect phytoplankton – microscopic plant-like cells living in the ocean. They may be small but there are lots of them and they play a rather big role in photosynthesis. That is, they use energy from sunlight to consume carbon dioxide as food. They also produce about half the planet's breathable oxygen.

And Sosik and Olson had a specific interest when it came to the phytoplankton.

Sosik: The kinds of basic ecology questions that we're trying to ask in the ocean are how many of a certain type of organism are there and what are their vital rates: how fast are they growing, to understand how they're responding to the environment, how they might be changing over time. And for plankton, growth rates are extremely difficult to quantify.

Ari: And it's that difficulty that led to those exhausting all-nighters of looking through a microscope and counting different types of phytoplankton. Getting their data meant working around-the-clock. So they began to consider a different approach.

Sosik: The idea of trying to automate it and have it go by itself so you'd have very high-resolution observations while you were asleep had a lot of appeal. We were inspired to go down that road of trying to build an automated microscope by the capabilities of the Martha's Vineyard Coastal Observatory.

Ari: This observatory is anchored to the seafloor a mile south of Martha's Vineyard. It extends upwards through the overlying water and into the air. Cables run between the observatory and the Vineyard, which supply both power and a network connection to transfer data.

Such a setup was crucial because any automated camera would be very demanding.

Sosik: They take a lot of power and they generate a lot of data.

Ari: And so, over the course of several years, Sosik and Olson turned their imaginings into reality, and built an automated underwater microscopic camera.

Sosik: Yeah!

Ari: They wanted to take pictures of individual phytoplankton cells, like this one.

Ghinwa: Hello, I'm a phytoplankton cell.

Ari: Or this one.

Evan: Hello.

Ari: Or these.

Amanda: Thank you.

Kerry: Don't worry.

Ari: Phytoplankton tend to be mixed in with lots of small debris, and they're spread out.

Ghinwa: Over here.

Evan: Hello, over there.

Ari: But Sosik and Olson were up to the challenge, and their eventual design for the camera was elegant.

Sosik: You take the seawater sample in, and then it's flowing through the instrument and it's drawn out into a very thin stream.

Olson: We take a syringe full of water – 5 ml – and then we slowly inject that into the center of this stream so that the cells get funneled down.

Sosik: And the cells are in the water, and you draw it out thin enough so that the cells are essentially going single-file —

Evan: Excuse me.

Amanda: I'm sorry, sorry, sir.

Evan: Coming through.

Olson: One at a time

Ghinwa: I beg your pardon.

Kerry: Oh, no, you go ahead.

Ghinwa: No, no, please, after you.

Olson: through a laser beam. <soft laser noise>

Amanda: Oh, man, what's that?

Sosik: As soon as a cell goes through the laser beam, it scatters light.

Olson: Which tells you something about how big they are.

Ari: The bigger the cell, the more light it scatters, or deflects.

In order to photosynthesize, phytoplankton rely on chlorophyll. It's the pigment that captures sunlight and makes plants green. When the camera's laser beam hits chlorophyll in the phytoplankton, the chlorophyll fluoresces or glows.

Olson: The laser beam excites chlorophyll fluorescence.

Sosik: And then we have a series of detectors that are looking for this scattered light and fluorescence.

Olson: If it's above a certain threshold,

Sosik: That triggers the camera to grab a picture a fraction of a second later. And then the next cell comes along behind it.

Evan: Excuse me, yeah, excuse me.

Ari: And so on. Here's what one of the cameras sounds like. <fade up camera noise> This one doesn't just take photos. We're hearing the apparatus that collects particular cell types of interest and stores them for future analysis. This is also the answer to last week's sonic stumper. <fade out camera noise>

Every day, hundreds of images come streaming through those cables that originate at the observatory. Sosik and Olson – dry and alert in their labs – download pictures of the phytoplankton cruising by their camera in real time. It can be mesmerizing.

Sosik: As soon as the images start flashing by, it's hard to drag yourself away, and we'll get caught up.

Olson: Because you see new things. I mean, we still see species that we haven't seen before. It's just always different. And the pictures are – they're just pretty. Those cells are very interesting to look at. <cue up keyboard typing>

Ari: Those pictures contain many, many different kinds, or species of phytoplankton.

Sosik: Every time you hit return, something new pops up.

Olson: This is a chain diatom, chaetoceros. And here's another diatom that grows in chains…

Sosik: These are really amazing…

Olson: Detritus.

Sosik: That's, uh…

Olson: Guinardia.

Sosik: Phaeocystis. Looks like catanella or something.

Olson: No, that's a colony of Ditylum. Dinobrium.

Sosik: Oh, look this is a ciliate.

Olson: This is made up of …

Sosik: Gelatinous matrix…

Olson: 8 or 10 cells…

Sosik: Gooey, mucousy almost – yeah, there's the edge of it.

Ari: Given the millions of photographs documenting all this diversity, Sosik created software that automatically classifies the kind of phytoplankton in the photographs. Together, the automated camera and automatic classifier …

Sosik: … give us this really exciting tool for doing ecology.

Ari: And this tool has led to some interesting discoveries. In February of 2008, it allowed collaborator Lisa Campbell to detect an unforeseen bloom of toxic algae in the Gulf of Mexico. Her discovery led to a recall on Texan shellfish and a temporary closure of the fishery.

In addition, the camera catches life in action.

Sosik: So you'll see an image of some cells attacking a different kind of cell. And we've found things like this that seem to be revealing of patterns of interactions between organisms that we didn't anticipate.

Ari: Each photograph offers a chance to turn on its head one conventional idea or another. So there's a lot of excitement about what the future holds.

Sosik: It's very exploratory. We never know what we're going to see. And it's not all driven by a specific hypothesis that we're going out to test.

Ari: Sometimes science is about developing a really good tool, and making sure you're well rested enough to appreciate the results.

Olson: Wow, what's that? What's that? Look at that. <as music fades up>

Ari: And now, to one of your questions. On our last podcast, we spoke with oceanographer John Delaney about the eventual availability over the Internet of data collected in the ocean. Here's a question from Laura Dunbar, a middle school science teacher in Sea Girt, New Jersey.

Dunbar: I'm excited that information will now be available in real-time but do you anticipate that changing the current structure of scientific research?

Delaney: This is John Delaney. Laura, that's an excellent question. Inevitably, it will change the structure of scientific research. This new observatory will deliver vast amounts of information to millions of folks across the world. Anyone who has new insights based on the new data that they receive – scientists and non-scientists – it would be appropriate for them to share their results. And as a society, we will learn new ways of conducting science in real-time over large volumes of the ocean with many, many different people combing the data for new insights. Scientists will rapidly distill this collective effort into even more powerful scientific results than when individuals work alone.

Ari: It's time for this episode's sonic stumper. What's this sound?

<fade up goliath grouper sound; at some point, transition to outro music>

To submit your guess, visit us online at www.coseenow.net/category/ocean. You'll find a short video about just how small and big phytoplankton can be, additional audio clips and photographs, and information on how to ask Rob Olson and Heidi Sosik your question. You can also email us at podcast@coseenow.net.

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<outro music ends>