COSEE NOW Podcast
Episode 3: Chris Martens

<intro music begins, and then fades down under narration>

Ari: You've found your way to Ocean Gazing, the podcast where we journey underwater to discover the ocean. My name's Ari Daniel Shapiro. This episode features Chris Martens. He's a marine chemist at the University of North Carolina at Chapel Hill. He does his science by living at the bottom of the ocean for up to 2 weeks at a time.

Martens: It's not at all like what I dreamed about when I was 7 or 8 years old in South Florida. I dreamed that someday I was certainly gonna go out there and live in a little house under the ocean. I'm getting to do it but it's slightly different than I was expecting.

Ari: Martens will also reveal the answer to our last sonic stumper and we'll hand you another one. Stay tuned!

<fade up intro music until it ends>

Ari: Chris Martens is concerned.

Martens: I grew up in the Florida Keys and when I was a boy, all of the areas that I'm diving around now were covering with branching corals – big, luxurious corals that you always had to worry about getting poked by. Now that area is relatively hard-ground, exposed rock and lots of visible sponges. It's like having a forest that once had a canopy that's been reduced to bushes. Corals provide an amazing amount of cover that make it possible to have a really high diversity of life on coral reef ecosystems. So it's the loss of diversity that we fear because of the loss of coral cover and all the structure that's provided. Worldwide it appears that coral cover has dropped from something around 50% or greater down to an average of about 22%. It's very alarming. However, it's turned out to be very difficult to understand exactly what's going on.

Ari: One of the difficulties for Martens and his collaborators was not having enough time on the coral reefs to gather the information they needed.

Martens: As we began to realize that we had to work 24 hours a day and for longer periods of time than just a few hours, it became obvious that we needed to stay.

Ari: Stay, that is, on the coral reef itself. The answer was Aquarius. It's the only underwater observatory in the world that you can live on, and it's located on Conch Reef off of Key Largo, Florida.

Martens: Let's describe the Aquarius habitat itself. It's about the size of a schoolbus and it's painted yellow so I like to call it the schoolbus. The lab is actually made of 2

components: a 116-ton baseplate with 4 legs and the Aquarius lab itself is a big cylinder that's placed on those 4 legs. At one end of it, there's an airlock – basically a 4" thick door that you can seal against the ocean if you want to – that opens into what we call the wet porch. Think of the wet porch as an upside-down bucket. And the way you swim in and out of Aquarius is by maintaining air inside the upside-down bucket. There's a little science laboratory inside Aquarius. There's a little kitchen. And then there's a bunkroom at the far end of the habitat – 3 bunks to a wall just like in a submarine. After the full 10-day mission, you go through a decompression phase. It takes 17 hours to decompress. At the end of the decompression phase, you're still on the bottom and what we do is open the door and you swim out. And it's just as if you were on a regular 30-minute dive from the surface. You just swim up to the surface and go back to shore.

Ari: Aquarius is stationary and it sits about 50 feet underwater. From there, Martens and his team can make their two scuba dives each day right out onto the reef and then return to Aquarius. And it's allowing them to study coral reefs up close and without interruption. One of their projects focuses on what could be a major threat to coral reefs. It's called ocean acidification.

Martens: It appears that all of the fossil fuel CO_2 – carbon dioxide – that we've been releasing into the atmosphere has other effects than just global warming. And one of those is that it dissolves into seawater and creates carbonic acid. Since about 1950, we've acidified the ocean by about 10%.

Ari: And given our current rates of carbon dioxide production due to burning fossil fuels, it's predicted that ocean acidity may double by the year 2100.

Martens: It's a huge change. There's some concern that we're going to begin to dissolve away coral reef ecosystems. They're in very shallow water, in close contact with the atmosphere where all the CO_2 is.

Ari: Martens and his colleagues are examining the connections between coral reefs and ocean acidification. One of these connections involves respiration, whereby animals breathe oxygen in and carbon dioxide out. The specific question about ocean acidification that Martens is asking is:

Martens: How do you distinguish this global scale effect from local animal respiration?

Ari: In other words, they want to know where the carbon dioxide responsible for ocean acidification is coming from. How much is coming from human pollution? And how much comes from marine organisms that exhale carbon dioxide as they breathe, or respire?

Using Aquarius as a base, Martens is able to remain underwater and track the CO_2 produced by respiration continuously, 24 hours a day for multiple days at a time. This is highly desirable because –

Martens: – there's a day/night cycle. You have both photosynthesis and respiration going in the water column of a coral reef ecosystem. In other words, by day there's lots of organisms in the water column. We call them phytoplankton –

Ghinwa: Hello, I'm a phytoplankton cell.

Martens: – that are consuming CO_2 and converting it into organic carbon, using sunlight energy to do it – photosynthesis. By night, those organisms also respire but in addition, there's no sunlight, photosynthesis shuts down, and you have primarily respiration going on.

Ari: Martens is also able to continuously measure the acidity at different locations on the reef.

Martens: It's in that layer right next to the animals that live on the seafloor that we see our greatest effects of local respiration. CO_2 that's coming out from a sponge, for example, and is not transported immediately up into the water column. It sort of hangs there next to the bottom, at least for tens of minutes during nighttime still conditions.

Ari: This means that the acidity is somewhat higher right next to the seafloor, right next to where the corals live. Martens' work on ocean acidification is only just beginning. And it turns out that Aquarius is invaluable as a home base for finding out what's threatening the coral reefs of our oceans.

<gradually fade up audio of Martens underwater video>

But Aquarius also gives Martens the chance to marvel at and listen to this reef habitat when he's out on his extended dives.

Martens: The primary noises are going to be of my breathing. And it sounds like a Star Wars movie with Darth Vader breathing. < breathing sound > But once you get away from that part of the sound, what you begin to hear is an amazing amount of clicking. The clicking sounds that are often animals that make a living by snapping a claw together – snapping shrimp are among the more famous.

Ari: This was part of the answer to last podcast's sonic stumper. Connor Walsh from Brussels, Belgium left us a message on our Skype voicemail and he got it right!

Connor: I think it's the sound of snapping shrimp. It reminds me of the sounds I recorded myself in New Zealand when I was there last year, a place called Kaikoura. So that's my guess; I think it's snapping shrimp.

Ari: There was another sound in our stumper as well, best heard with a subwoofer. Let me let Martens explain.

Martens: When you're around Aquarius, you're also surrounded by a lot of very big fish. So one of the more interesting sounds that you can hear are those that come from super groupers or goliath groupers. The ones that are around Aquarius are more like 3 or 400 pounds at the max, maybe an occasional 500 pounder. We give them names. The big one that's presently hanging around Aquarius, we named Earl. His way of fishing, of collecting his food is to suddenly lunge forward and at the same time, open his mouth. Any fish too close to him will be sucked right in. When the goliath groupers do that, they make a 'thump' sound that's very distinctive. It sounds like a small underwater explosion. My guess is that there's a lot of noise on the reef. If you could dial down the noise level from your own breathing apparatus, you'd hear a lot more. <fade up breathing sounds, then down>

Ari: Let's move right into this episode's sonic stumper.

<fade up new sonic stumper>

Any guesses? <fade out sonic stumper> Or maybe you have a question for Chris Martens?

Martens: We always welcome both questions and comments from people who would like to get involved.

<fade up outro music>

Ari: Leave us your answer to the sonic stumper and your questions for Chris Martens by visiting us online at coseenow.net and clicking the podcast link. That's c-o-s-e-e-n-o-w dot net. You'll also find pictures of Aquarius, links to videos featuring the science described in this podcast, and additional audio about a day in the life of an aquanaut.

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See you in two weeks!

Martens: Ok, Ari. Goodbye.

<music ends>