Ocean Gazing: Episode 14
Dungeons and Darwins
Mick Follows: MIT

<begin music>

Ari: Greetings. I'm Ari Daniel Shapiro. This is Ocean Gazing where we plunge underwater and take a look around, with our ears. Mick Follows is a research scientist at MIT. He uses his computer to model the ocean. He asks himself how all the little pieces – the life, the water, the chemicals – fit together. Or, to use a metaphor:

Follows: When I write down the recipe and stir it up, does the cake come out like I expected it to?

Ari: We'll follow Mick Follows into his virtual world and hear about how it relates to one of the most popular fantasy role-playing games ever created. And we'll visit an education tool of his that's the size of a moving truck. Stay tuned.

<fade up music and sustain until it ends>

Ari: We've talked about phytoplankton before.

Ghinwa: Hello, I'm a phytoplankton cell.

Ari: Phytoplankton are the microscopic plants of the ocean –

Follows: The tiny plants of the ocean.

Ari: – that take the energy from sunlight and the carbon from carbon dioxide to grow and build their bodies. They're gobbled up by lots of other critters, which get eaten by still other critters. Just like plants on land, they're the base of the food web in the ocean. It's no exaggeration to say that most marine life depends on phytoplankton. So it's kinda important to understand how they behave, what they're vulnerable to, what they really like in the ocean, and what they despise. One way of doing this is coming up with computer models. And for 8 decades, it's pretty much been done the same way.

Follows: One writes down a mathematical formula that kind of represents the growth of one type of phytoplankton.

Ari: A formula like this one.

Follows: dp/dt, if p is the biomass of the phytoplankton, equals μ, which is a growth rate, times p.

Ari: And although that might sound complex, it's actually pretty basic. Because the ocean's not made up of just one type of phytoplankton. Rather, it's better to ex–

Follows: –tend that to represent many types of phytoplankton. So, the recipe becomes more complicated because each type of phytoplankton now has its own recipe in some sense. And you wanna put them all together and see what comes out.

Ari: You talking about making a salad?

Follows: <laughs> Something like that, yeah, I guess, yeah. <fade up salad munching sounds>

Ari: This is our last sonic stumper, the sound of me eating salad. <swallow> And swallowing. For Follows, modeling this microscopic salad with all these phytoplankton mixed together means chewing on a basic idea.

Follows: Nature has explored lots of possible ingredients but a few are successful in the sense of fitness in the environment. And so the few things that dominate nature's salad are actually the result of the exploration of lots of possibilities.

Ari: You know, for someone who's never kind of seen a model before, can you kind of explain – like, how are you describing each of these little phytoplankton?

Follows: Could I – there's a great analogy. Video games and Dungeons and Dragons games are a great analogy to what we've been doing. And for anybody who's played a Dungeons and Dragons game, you have a virtual world, a virtual environment that's full of dangers <blade sharpening clangs> or different places you can find treasure or whatever. And you populate that virtual world with characters who have different attributes. Some are good fighters <fighter noises> and some are good healers <healer noises> or whatever. And then, as you play the game, the attributes that make the world good for you to live in – you know, that you're well adapted to that world, you'll continue and you'll be in the game at the end of the game. Whereas the attributes that weren't very helpful will lead to those characters kind of dying off.

So a computer game of a Dungeons and Dragons world is kind of quite a good analogy to what we've been trying to do. We've been trying to give different phytoplankton different attributes. But instead of being fighters or healers, they're: can I use nitrate as a source of nitrogen? Am I good at gathering light energy in low light conditions? Or do I need to be in a nice, beautiful stream of sunlight? Then we put them into a description of a virtual world, which looks like the ocean. It's got nutrients in or light in or some representation of them. And then we're letting them interact with that world and with each other to determine the outcome of the population.

Ari: How do you win as a phytoplankton?

Follows: You know, I guess winning or losing isn't perhaps the word. But being successful just means that you don't go extinct, I guess.

Ari: Just staying alive.

Follows: Staying alive. <fade up "Staying Alive" music> That's one measure of fitness, isn't it. If you become extinct, you kind of lost your edge somewhere. <laughs> Somebody else took over. <fade down music>

Ari: To figure out if and how these phytoplankton are staying alive <fade up music quickly, and then down again>, Follows is peering even deeper into these cells. He's considering their DNA and their genes.

Follows: The detailed understanding of what happens in a cell should inform a crude description of how a cell responds to its environment.

Ari: Rather than thinking of a phytoplankton cell as a single unit, it's almost like they're little factories. Filled with lots of little parts that tell you about what they do in the ocean. Follows is taking the very, very tiny – you know, the genetic machinery and DNA of the cells – and mapping it at a very large level – the world's oceans. All the while being guided by a very basic question.

Follows: Is the system that pops out of that something that does look like what we see in the world?

Ari: One way that Follows is looking at all this information is through a public outreach tool called the vis wall, or visualization wall. <fade up walking sounds> We walked from his office to another building on the MIT campus that gets a lot of foot traffic from students, faculty and the public. That's where Follows showed me the vis wall.

Follows: What we're looking at is an array of sixty 30" LCD computer monitors. So we're looking at a screen that's, you know, maybe 10 feet high by 25 feet wide.

Ari: About as big as a good-sized moving truck.

Follows: We could put an image or a movie into that system and have it distribute the image across the whole set of panels or we could have a different image on each panel.

Ari: They've got a whole bunch of images and movies to draw from.

Follows: Depictions of the currents in the global ocean. The phytoplankton distribution that the model's predicting. We have some kind of more fun movies.

Glaciers calving in the Arctic somewhere. Imagery of the Earth from space from NASA – so this blue marble – with very high resolution composite images of the planet.

Ari: This vis wall's meant for both the scientists –

Follows: It's fun to come over here and look at some of your model results and perhaps try and get a different perspective.

Ari: – and the unsuspecting public just passing by and witnessing movies of a swirling and breathing ocean dancing across this massive array of screens. You can stand pretty far away and take in the whole image. Or you can step right up to one of the screens and follow the path of a tiny squirt of water. In fact, it's exactly the way Follows contemplates the ocean: the enormous and the miniscule at once <fade up "We're at the Top of the World" music>, each informing the other, painting a portrait of our ocean.

<fade down music>

Ari: Here's this week's sonic stumper. <fade up sonic stumper> Find us on Facebook to send in your guess for the stumper and your comments and questions. Just search for Ocean Gazing. <fade up outro music>

This podcast's brought to you by the Centers for Ocean Sciences Education Excellence, and it's funded by the National Science Foundation. Thanks to Janice McDonnell, Jim Yoder, and Sage Lichtenwalner. And to my family – Mom, Dad and Taan – who helped make the fighter and healer sounds. See you in two weeks!

<sustain outro music until it concludes>