Fish and their billions of "friends"

Hayley Rutger: Hi I'm Hayley Rutger.

Joe Nickelson: And I'm Joe Nickelson

Hayley: And this is another episode of "Two Sea Fans at Mote Marine Laboratory."

Joe: And today, Hayley, we are going to talk to…

Hayley: Well, Dr. Andrea Tarnecki. And Joe let me just say, last episode you were badgering me about why we collect fish poop. I promised you an episode that includes the fish poop, and I have delivered.

Joe: And?

Hayley: This is about fish and bacteria.

Joe: Where's the poop?

Hayley: The bacteria are in poop, Joe.

Joe: Oh, okay.

Hayley: And other places too. They're kind of everywhere. But anyway, Dr. Tarnecki has a very fascinating job here studying all of the tiny bacteria that live on fish and just why that matters for their health, for our seafood, for everything. So, we hope you enjoy.

Joe: And I'll bet you I can get her to say poop at least twice.

Hayley: Okay, bet taken.

Joe: Alright.

Hayley: A dollar.

Joe: Heh, so we hope you enjoy the interview.

Hayley: So well, we are here with Dr. Andrea Tarnecki.

Joe: Scientist supreme, is that her title? What is your title?

Dr. Andrea Tarnecki: Ah, my title is Mote Postdoctoral Research Fellow.

Joe: Oooh. Fancy.

Hayley: That does sound fancy. But that means that, like Mote provides a certain amount of support for you to do your work?

Andrea: Yeah so a post-doctoral fellowship, basically after you get your PhD, you go into a place where you work for two or three years and they give you some start-up money and kind of gives you an opportunity to establish a research program.

Hayley: And you have a really interesting one. You're studying the bacteria in fish.

Andrea: Yes.

Hayley: So, I don't know. Why should -

Joe: Well, yeah shouldn't we like step back a bit first for people that may not even know what bacteria are? Like what are bacteria?

Andrea: Bacteria are single-celled organisms that are microscopic. So you can't see them with the naked eye but there are everywhere.

Hayley: Including, like, all over us?

Andrea: Including all over us, on our skin and also inside our bodies, in our stomach and intestine.

Joe: Well and I understand the etymology of the word bacteria is the plural of the new Latin *bacterium*, which is the Latinization of the Greek *bakterion* which is the diminutive of bacteria, meaning staff or cane, because the first ones to be discovered were rod-shaped.

Hayley: Ah.

Joe: Is that right?

Andrea: That sounds right.

Hayley: It sounds like Wikipedia to me. So now that we know what they are, you study them in fish. Why should people be interested? What's that all about?

Andrea: Well, whether you like to eat fish or catch fish or go to the aquarium or buy fish from the store, all those fish have bacteria on them. And bacteria's in the water and it's everywhere and most people think that they're bad, but they actually do a lot of really good things. They help the fish with digestion and they produce nutrients that the fish use. And they compete against bad bacteria or harmful bacteria that are found in the environment.

Hayley: Wow, so like most people you meet, do they know that bacteria are helpful?

Andrea: You know what, Activia commercials have really helped!

Joe: I'll bet, yeah. Jamie Lee Curtis.

Andrea: Jamie Lee Curtis is doing a great job with that. Probably five or 10 years ago I would've said no, most people thought bacteria were bad. But with commercials for probiotics I think people are beginning to understand that that's not entirely true.

Joe: It's helpful and healthy for the body, yeah.

Andrea: And there are bacteria that can cause disease, but bacteria that are found on our bodies - about 99 percent of them are not disease-causing bacteria. So they're doing other things and a lot of those things are really beneficial to our health.

Joe: And you know I've been dying to ask you this question.

Andrea: Uh oh.

Joe: Where do you get this bacteria from?

Andrea: Ah, I get the bacteria from a lot of places.

Joe: Say it.

Andrea: Including fish poop.

Joe: Yes!

Andrea: I do, I sample a lot of fish poop, which is not as disgusting as it sounds.

Joe: Ahh.

Hayley: Oh my goodness. So where do you get, where do you get the poop, where are the fish? Like what fish are you working with?

Andrea: I work with a number of different fish species and I catch them both in the wild and then I also work at Mote's Aquaculture Park which is in Sarasota, Florida also, where we have three species in house: Florida pompano, red drum and common snook. And those are three common recreational fish species in Florida and also targets for stock enhancement and for food fish also.

Hayley: Cool. I've been to Mote Aquaculture Park, we all have, it is very, very, very cool. It's one of the largest recirculating aquaculture research facilities around the country. And so they study all the ways to farm fish in a more eco-friendly manner, and you're kind of adding a new, new angle to it by looking at these probiotic bacteria, maybe?

Andrea: Yeah I'd say that's true. The system is really unique because it does recycle all of the water instead of using water from out in the environment, it's all contained in our aquaculture systems, which is really good in terms of environmentally fish farming. But we do get problems

with some of those harmful bacteria in those systems because they are adding food to the water which not only fish eat, but the bacteria eat them also. Also you have a large number of fish in a small area and the bacteria can take advantage of that situation also. So we do have some problems with bacterial pathogens in those systems. So what I'm trying to do is look for good bacteria that we can add to those systems out-compete the bad ones.

Joe: Oh, so you've got a little war going on.

Andrea: It is, it's a tiny little war.

Joe: It's a tiny microscopic war.

Andrea: Yeah.

Joe: Cool.

Hayley: Microbes have been fighting it out since the dawn of time.

Andrea: That's true.

Joe: Yes, yes. Bacteria were the first living organisms on the planet if I'm not mistaken.

Andrea: That's correct.

Hayley: Very good Joe!

Joe: Thank you. Joe smart.

Hayley: Yes, he is.

Andrea: Joe get cookie.

Joe: Oh yay, cookies.

Hayley: Oh my goodness. So in all your research with bacteria and fish, what has been one of your favorite moments or discoveries, like what's been one of the most "Aha"?

Joe: Oh, like yeah you went, "Oh wow I can't believe that's really going on."

Andrea: Yeah, so actually that happened during my Ph.D. work and it's kind of what got me here to Mote doing what I'm doing now. I designed a project that allowed me to go catch my own fish to sample my own fish, so -

Joe: Nice, doing something you enjoy doing anyway.

Andrea: Yeah, so I at Auburn at the time which is inland, of course, they do a lot of freshwater fish research. But I was more interested in marine fish so I designed a study where I could go catch fish and sample their mucus, their external skin mucus and look at the bacteria there. And basically the goal of this study was to figure out what it is that influences the bacteria that are

found on fish, whether it's an environmental influence, something like salinity or temperature, whether it has to do with different geographical locations, or whether different fish species have different bacteria. And what we found was that all of those impact the bacteria found in fish mucus, but fish species actually exerted the most influence. So we saw more differences in the bacteria on fish between different species than we did, say, in different seasons or different locations. And so that really got me curious as to how the bacteria were interacting with the fish, specifically the fish immune system.

Joe: Yeah.

Andrea: And what it was that was leading to those species-specific bacterial communities. So common snook are one of my favorite fish species because they're really fun to catch and they're really delicious to eat.

Joe: Yes they are.

Andrea: And they're very well-managed in Florida, so there's a lot of rules if you wanna go out and catch a snook for dinner, you can only do it a couple times a year, they have to be a certain size, you have to buy a snook tag, which the snook tag all that money goes back into snook research, so that's a really interesting, cool system. But they are one of the species, like I mentioned earlier, that we raise at the aquaculture park, and we raise them for stock enhancement purposes. So we can raise them up from little larvae until they're juvenile size, and then we release then into the environment and we can see how they survive and what they're doing to the snook population in the wild. One of the problems that we have with them, and it's a problem that's shared across a lot of marine fish species that are grown in aquaculture, is that they die. We see up to 98 percent mortality in these larvae. And a lot of that happens before they're even 14 days old.

Joe: Why is that?

Andrea: Not sure. So it's a really interesting situation where, you know, the work that they've been doing at the aquaculture park, they've really been looking at nutritional issues and genetic issues.
Joe: Could it be a bacterial issue?

Andrea: Looking at rearing conditions, and there are some ideas out there that it might be a bacterial issue.

Joe: Bacterial issue.

Hayley: Now but let me ask, in the wild, like do they produce like thousands of larvae and a lot of them die normally?

Andrea: Yes, they do. But in the wild it's an uncontrolled system essentially. You have much larger variations in environmental conditions, you have predators -

Joe: Predation, yeah.

Andrea: You have all sorts of things that can affect them in the wild, and the idea being that if you have them in these controlled systems, you should be able to do better.

Hayley: Hmm okay.

Joe: So have you been able to sample, for instance, larval snook in the wild, at all?

Andrea: Unfortunately no they are very difficult to find. When they hatch, they're about two millimeters long, so they're very tiny. And larval fish can be very difficult to identify in terms of -

Joe: What species…

Andrea: Telling whether it's a common snook, or whether it's another species of snook, or whether it's something different. So unfortunately, no I haven't had that opportunity yet but maybe one day.

Joe: And does the mortality rate change as the snook get older?

Andrea: It does. And in most fish species, mortality is really high when they're young because they're small, they're getting eaten. And it reduces as they get older. With these guys, even though we've tested all that in the lab, we still see some spawns where we have really high mortality and so I'm kind of taking a bacterial management strategy going in seeing if that some of the problems are due to some of that harmful bacteria that are found in our aquaculture systems.

Hayley: I liked to call this "microbe-management." like micro-management with a B.

Joe: Microbe-management.

Hayley: Microbe-management.

Joe: Microbe-management.

Andrea: Ah, that's clever.

Hayley: Yeah, I'm a pun machine. It's not good.

Andrea: I like it.

Joe: We need to get her a t-shirt.

Hayley: Maybe, pun machine. So, I mean, how do you do this? Like even in the controlled setting, it can't be easy or is it easy to get the bacteria and identify them and…?

Andrea: Yeah, no, it's really not simple, and the reason for that is there are so many different species of bacteria. In one study that I did, we found over 400 different species of bacteria in fish poop.

Joe: Nice! Oh that's twice.

Hayley: Good job.

Andrea: So, so yeah there's a lot of them in there and the problem is that we can't grow all of them in the lab. With the techniques that we have available, we can get sometimes up to 50 percent of them to grow in the lab, but normally it's more around 90 percent that don't grow. So I am approaching this research from a different standpoint where I'm looking at the DNA of the bacteria. We can tell bacteria apart based on their DNA sequences and that gives us a much more thorough picture of the bacteria that are there.

Hayley: Very cool. So with the snook are you getting a good sense of what they have, and what the might need in terms of bacteria?

Andrea: We're starting to and every spawn's a little different because we restart the recirculating system every time so there are changes. But there are definitely consistencies between spawns too so we're starting to get an idea of what the larvae are supposed to have. And we have the opportunity where we can sample them every time we spawn them and if one spawn does well and another does not do so well, we can look for differences in the bacteria between those two spawns.

Hayley: I remember you saying with your snook work that there's at least a little bit of work on giving them a probiotic, didn't you did that and saw an effect?

Andrea: We did, actually we did it twice. We did it in the fall of 2014 and experienced one of those mass mortalities that I was telling you about. So that gave us a unique opportunity to look at the bacteria as those larvae were not doing so well. And then we repeated in summer of 2015 and we were able to successfully raise those guys.

Hayley: Oh. Nice.

Andrea: So we have the interesting differences there between the two different spawns. But in our probiotic study in the summer, we did see that we were able to increase snook survival with addition of the probiotics. And fish are really interesting because you can give them probiotics in two different ways: you can give it to them through the feed; and you can put it in the water. And the probiotic can interact with the fish through its skin and through its gastrointestinal tract.

Joe: Wow, yeah.

Andrea: We tried both ways and we found that both ways seemed to work for these guys. So it was a really interesting study and now we're following it up with more studies trying to figure out exactly how those probiotics are working.

Hayley: Okay so I'm curious, like, why can't, why don't humans ever try probiotic products on our skin? Why is it just about our gut so much?

Andrea: So the human skin is built different. It has that keratinized layer on it; it's more for protection against the external environment. The fish, their skin is actually a mucosal tissue, so -

Joe: Okay so when you say keratinized do you mean we have like a harder -

Andrea: Yes, yes we have a harder -

Joe: A less permeable, if you will -

Andrea: Yes, less permeable that's a perfect word for it.

Joe: Surface, compared to a fish.

Andrea: Compared to a fish. So the fish, they have a mucosal layer so it's a much more active tissue. It's really interesting tissue where they actually did a study and they found that the immune function of fish skin is very similar to its function in the gastrointestinal tract.

Hayley: So we can an idea of how fish are a little different from us in their microbial happenings, but there are a lot of similarities too. And sometimes fish are even models for human health, you know, discussions and research. Like, what do they share with us?

Joe: That's a visual - a fish model.

Hayley: A fish model, she's -

Andrea: With a bikini?

Hayley: Yeah, she's beautiful. Fish model. Andrea, what do I mean?

Andrea: Yes! So what you mean is that fish, if we study fish we can learn things about people. The reason for that is that we share 70 percent of our genes with some species of fish. So 70 percent of our genetic makeup is the same as, specifically zebrafish, the little guys that they sell at aquarium stores.

Joe: Really?

Andrea: Yeah, zebrafish are a very common model for human disease because we have similarities in development, physiology, immune function, and also there's a number of genetic disorders in humans that can be reflected in zebrafish. So the genes are similar in those disorders and we can go into the zebrafish and make a mutation similar to what we find in humans and sometimes we can duplicate what we see in people in terms of the, the effects of that mutation.

Joe: That's very cool.

Hayley: Joe are you in touch with your inner zebrafish.

Joe: I try not to touch my inner zebrafish.

Hayley: Okay, that's one way to answer that question. You know, I'm running out of questions because you've given us so much cool information, but I did wanna ask if there is a particular type of bacteria or a particular fish host that you find super cool for any reason?

Andrea: You know, that's a really good question. I find all bacteria cool, so I can't discriminate there. I can discriminate in the fish category. Of course I already said that I really love common snook. I love Florida pompano. I love red drum, although I've never caught one, that's something that -

Joe: You caught a black drum recently though, didn't you?

Andrea: I have caught a few black drum, yes, that's true. But never a red drum, so I'm working on that. That's on my bucket list.

Joe: Well I'd really like to thank you for spending some time with us and explaining more about bacteria and probiotics and for telling me that you get bacteria from fish poop. And -

Hayley: See, now what are you gonna obsess about?

Joe: I don't know, we'll have to think of that.

Hayley: But yeah this has been a really awesome chat, so thanks a lot.

Andrea: Well thanks for having me, it was fun.

Hayley: See ya later, from Two Sea Fans at Mote!