

Teuthology with Sarah McAnulty

Ologies Podcast

February 20th, 2018

Hey Ologites, what's up? It's me. It's Alie Ward. Here we are! It's finally time. It's the moment you've been waiting months for: a cephalopodcast [*excited gasping*]. Okay, teuthology comes from "teuth" which is Greek for cuttlefish or squid. What does cephalopod mean? Well, that comes from "cephalo" which means head, and "pod" - feet, because they essentially look like a giant long brain with a mop of feet glued on. So, this week's episode is all about squiiiiiiids, and squids and squids, and octopuses, and cuttlefish. They are adorable, shape shifting, possibly alien, creepy, alive cartoons. I love them even more after recording this. I would hug every one of them if I could.

But first, I wanna say thank you and give all an audio hug to everyone who's bought merch at OlogiesMerch.com. There's pins, and hats, and all kinds of things, and totes. And to all the folks supporting for even 25 cents an episode on Patreon.com/Ologies. That gets you some exclusive content, it gets my undying affection, and also your questions go to the front of the line to the ologists. Thank you for supporting the show!

Also, you can give back for no money, zero dollars, just a little bit of effort, when you rate and review and subscribe. That keeps Ologies up in the iTunes charts so more people see it and say, "what's this shit?" and then listen to it, and then there are more of us out there to delight in primate butts and laughter science, etc. I read each and every review every week, I creep on them so hard. They mean so much to me. Just the fact that I get to make this podcast and you guys listen is like, "aaaaahh!" PeejCWS [phonetic] says:

Fantastic podcast! I recently had a dream that I was an Uber driver, rolling around, and listening to Ologies. I stopped, and Alie Ward got in my car! I got really embarrassed that her show was streaming while she was in the car so I tried to slyly change it without her noticing.

I'll just want to let Peej [ph.] know [*whispering*] that wasn't a dream... What if we actually did that on another astral plane? Anyway, thanks for the reviews!

Okay, back to squid. Ooooh, squid! They look like swimmin' dicks with parrot beaks and they are alive, invisibility cloaks. But are they aliens? How do they change color? Can they kill you? What's a kraken?!

I very excitedly met with a squid scientist that I've been fawning over on Twitter for months, after a post of hers about squid went viral. What happened was multiple jabronis tried to tell her that her squid were cuttlefish and she's like: "ehhh, I'm a squid scientist, aaaaand they're squid." I've become a huge fangirl of her general knowledge and passion about squid, so much that I took a train two hours from New York to Connecticut and back in one day just to spend an hour with her. She picked me up from the train station and told me I'd recognize her car because it had her twitter handle and email, plus the words, "Ever wonder about squid? Ask me anything - octopus too!" written on the back window! Her license plate reads simply: SQUIDS

Alie: It's 39 degrees; I can see my breath. I'm outside. New Haven, Connecticut - first time in Connecticut. I'm looking for a squid car. I'm so nervous! I've been trying to be her friend so hardcore for months online. What if she doesn't like me? Ohmygosh, I think I see her. This is so exciting. *[laughs]* Squids! Oh my gosh!

Hi, it's me! Hi, I'm getting in your car! Ohmygosh, your license plate really says "squids."

Sarah McAnulty: It does!

Aside: We drove around New Haven a little - she's a Ph.D. Candidate and scientist at University of Connecticut - and found a library basement to record in, and we talked about iridescent bioluminescent sea creatures, crafty cuttlefish crossdressing, octopus brains (they're shaped so weird), alien DNA, weird dating stories - both human, our own, and cephalopod-related, and what happens when you blindfold a cuttlefish. Please get ready to become obsessed with quite possibly the world's most charming and impassioned squid nerd, Teuthologist Sarah McAnulty.

[Intro Music]

Alie: Do you know that I, for some reason, every time I want to say your name, I want to say "McNallyty."

Sarah: Most people do. Yeah.

Alie: Why do I do that?

Sarah: I don't know. Phonetics. Irish phonetics make no sense.

Alie: You are a teuthologist?

Sarah: I'm a teuthologist, yes! So glad you know that word. T-E-U-thologist.

Alie: Do you ever say that? Do you ever drop that caj?

Sarah: No one knows what I'm talking about. One time someone asked me if I was a teuthologist, and again I got very excited. But, it rarely comes up. Normally I just say I'm a squid biologist.

Alie: You're kind of boned by phonetics because it sounds like you're an orthodontist.

Sarah: Yeah, it does sound like you studied teeth, and squid don't even have teeth. The poor things, they just have beaks. So yeah, we're hosed there.

Alie: So, you are a squid scientist. How long have you been into squid?

Sarah: I have been interested in squid since I was a little kid, but I started actually working with cephalopods when I was in... right after my sophomore year of college. I found out about this lab in Woods Hole in Massachusetts that was working on cuttlefish camouflage and I thought that was so insane that you could have a career working on the coolest animal there is.

So, I basically followed this scientist around to places that I knew he was giving talks and I was like, "Hi, I'm Sarah, please let me work for you." And he was like, "You're too young." And I was like, "Please though - I would really like to work for you!"

Aside: Sarah sent the lab a very passionate letter, where she basically said, "Look, if you don't hire me this year, you're just going to hear from me next year, and the year after that."

Sarah: And he was like, "Okay, crazy," and gave me an internship.

Aside: Sarah has worked with cephalopods ever since: octopuses (octopi?, more on that later) in college, and now she works with little critters called bobtail squid, which are an evolutionary in between octopuses and cuttlefish. Bobtail squid are little, they have a shorter, rounded mantle, and they can be these beautiful iridescent colors. They're also called dumpling squid or stubby squid because of their shape, and the general consensus is that they are the cutest things on planet earth. I'm sorry, sloths, you've been replaced.

Super side note: if you look at a photo of a bobtail squid and simply cannot even, or you need to scream or punch yourself in the face, this is a something Yale researchers have dubbed: cute aggression. One hypothesis is that the brain simply cannot deal with that much positive stimulation at once, and turns some of it into the opposite, some negative emotion, which for most people ends up being aggression or screaming or squealing or slapping themselves. So, google "bobtail squid" and then bury your face into a couch cushion and shriek with abandon, its fine. It's okay. It'll be helpful.

Alie: What's the timeline between octopus and squid and bobtail squid? I know that's a stupid, stupid question, but did one come first and then another? What happened?

Sarah: First we had ammonites, and those are those things that look like nautiluses, those spiral shells. I think a common ancestor of those, we had belemnites, and those are basically squid with shells, like long, skinny, cone shells. And then they brought the shells inside their body instead of outside their body, and then most of them lost the shells completely, and some keep them inside.

So there's squid, like the kind of squid you eat in calamari, still has something called a pen, which is like a clear, bendy version of a shell, and cuttlefish have cuttle bones, and birds eat them for calcium, but they're little buoyancy devices right in the back of the animal. Bobtail squid have absolutely nothing at all.

Octopuses diverged from squid and cuttlefish a long time ago. I don't remember exactly how many millions of years ago. So they're off on their own branch with vampire squid, which are not squid either. They're more like octopuses than squid.

Alie: What is a vampire squid?!

Sarah: Vampire squid are dope! Vampire squid are these deep sea cephalopods that look kind of like a Dumbo octopus if you've seen those, but they're dark maroon red, and at the end of each of their arms they have a little organ that has bioluminescence, so each of the tips of their arms are bioluminescent, and then they have these big spots on either

side of their head that are bioluminescent to give the impression that they have huge eyes, to make other animals think they're way bigger than they actually are.

Aside: I just looked these things up and whooo boy! They're a deep crimson color and their arms are more webbed, kind of like a bloody umbrella with a head. Their Latin genus and species name is *Vampyroteuthis infernalis*, which translates to something that sounds like a title to a grindhouse film: Vampire Squid From Hell. That is what their Latin name means: Vampire Squid From Hell. Do they have knives and a lengthy rap sheets of criminal offenses? Notsomuch.

Sarah: They're non-violent little animals that basically just eat dead shit that falls from above because they lived so deep that when things die above, it just sinks down. That's called marine snow.

Alie: Oh, god!

Sarah: Which is quite a euphemism because it's disgusting. It's just dead stuff.

Alie: They're just called vampire squids because they're maroon?

Sarah: They LOOK really scary. Each of their arms has these little spikes sticking off of it. So they look really intimidating. You would think, "I wouldn't want to run into one of those," but they're just eating dead stuff and floating around. So it's not too bad. I think it's more... they've got more bark than bite.

Alie: When you talk about marine snow, there's poo in there too, right?

Sarah: Oh totally. Yeah. Big time.

Alie: Okay, why squid? I mean, obviously squid are the coolest, but what illuminated you to how cool squid were?

Sarah: When I first realized that squid were awesome, I was about eight and I was watching this National Geographic video that I got from the library.

Aside: It was all about the ocean: fish, coral reefs, dolphins and what have you.

Sarah: But there was this segment about halfway through where they played *Twilight Zone* music, and then they introduced the cuttlefish and I was just like, "What the fuck is that?"

[Twilight-Zone-like music, with spooky male voice: "You are entering another dimension, a watery world between time and space where strange creatures use bizarre powers: The Alien Zone."]

Sarah: And I was like: I need to know more about THAT animal. So, in the video it's doing this like passing cloud maneuver; cuttlefish can change color as quickly as they think about it because each little color changing cell is controlled by neurons. So it's: if you think it, you can change, which is really cool. They're called chromatophores, and they're these little sacs of pigment - little circles, spheres of pigment - that are surrounded by little cellular muscles that can stretch the pigment out like a pancake and then let it release and go back to a little teeny tiny beach ball. They can turn these on in patterns. I saw that and was like, "this is bananas." I had been into dinosaurs but then I switched over

to cephalopods pretty much right then and there, and I checked that video out all the time.

Alie: You're like, "Sorry, dinos. We don't even know what color you were, let alone if you could change like an LED screen."

Aside: That NatGeo video, which Sarah posted on her Tumblr [SquidScientistas.tumblr.com](https://www.tumblr.com/squidscientistas) shows cuttlefish flitting about, doing what's called dynamic displays: blinking and changing colors, with bands of black flashing over their body, like if clouds were overhead zooming past you and threw bands of shadow across you. It looks hypnotic and it confuses their prey. It's bananas! They're like living, squishy disco lights. I get why this video was life changing.

Alie: When you're obsessed with squid, I think that makes other people obsessed with your obsession with squid. Does that make sense?

Sarah: That makes sense, yeah.

Alie: When people are kind of obsessed with cephalopods, do you think it's their huge brains or their dexterity or their instinct camouflage that people are drawn to?

Sarah: It's probably different for everybody, but I think one thing that's really drawing and interesting about cephalopods is that they're really complex animals that diverged so long ago from us that they've come up with all these really wacky, cool ways to get around the same problems that any other organism has to get around, but in a super-different way. Camouflage is the most crazy-different one, but...

Alie: It's nuts! I mean, you watch videos and you're like...

Sarah: It's so fast. It's crazy.

Alie: Are we ever going to develop technology to give us invisibility cloaks in case we see someone we don't want to see at Costco or something?

Sarah: One thing that is really, really hard to figure out is how cephalopods look at their environment and then pick what to do because it's not as though they're saying, "Okay, I bet I could do a pretty good rendition of that rock." They take the whole environment and then they kind of like say, "Okay, I bet this would fit." It's like looking for a new piece of furniture in a room, not to match what you've got, but to kind of go with the flow of the room. There are scientists working on that in Woods Hole in that lab that I used to work for, understanding what cues they're using from the environment to pick what to look like.

Alie: Getting back to that - stretching the pigments out like a pancake and then smooshing them like a beach ball - does that change the way that the light reflects on that pigment? Or how does that change the color?

Sarah: We've got multiple layers of cephalopod skin. On the bottom base layer for some cephalopods like cuttlefish, there's this really, really white cell type called leucophores and these cells never change color. Whatever color you shoot at them is the color that they give back to you, and it's like the purest white in the animal kingdom. There are

grants working to study this to make e-readers better, so that the back of the page is the whitest version so your eyes have more contrast to pick up on words, which is cool.

Above that we have iridophores, and the iridophores are the ones that really change color, but they change color the slowest. They can go from red to blue/purple, and those are changing hormonally. They change a lot slower, but they're kinda sparkly iridescent cells. On top of those is where your chromatophores are, and chromatophores are one color all the time, but you have many different colors of chromatophores all in your palette - like brown ones, and yellow ones, and reddish ones. Which they choose to turn on will determine the pattern that you see. They're using all of these different cell types to amalgamate a pattern.

Alie: Is it like a TV screen or an LED screen? Is it similar to that?

Sarah: That would require me to understand how LED screens work, and I have no idea. [laughs]

Aside: I tried to check to see if this TV screen analogy was whack (I was like, "Maybe that was embarrassing to say"), and then I went down a rabbit hole of LCD, liquid crystal display, backlit by LED light emitting diodes, but also JumboTrons, which is actually a trademarked name and Sony no longer makes them, but LED JumboTrons and if those were like chromatophores. Then I found a published paper called *Dynamic Skin Patterns in Cephalopods* published last year, which said in the opening 'graph: "With parallels to the pixels on a television screen, cephalopod chromatophores..." So boom! I'm sticking with it, don't @ me. Scientists agree. Now, we have more important squid gossip to address.

Alie: I have two pieces of flimflam I need you to debunk straight away.

Sarah: Okay, wonderful.

Alie: I had the amazing Dr. Chris Thacker on - ichthyologist - and she told me that giant squid live, like, five years. Is that true that squid have really short lifespans?

Sarah: Oh yeah, some squid live even shorter lifespans than that.

Alie: Whaaaat?

Sarah: Our bobtail squid, we think, live about nine months in the wild, so really short. And then, we think at the long end of things is about five years.

Alie: If they could live to a hundred years, would they take over the world? Would we be screwed?

Sarah: One would have to assume, yes.

Alie: The other flimflam I have to debunk is: Are octopus and squid possibly alien DNA, and that's why they're so cool?

Sarah: Let's talk about that one. No, [laughs] cephalopods are not aliens. Here's what happened: the octopus genome came out, and there's a lot of weird cool stuff in that genome. They were saying, "Okay, there's all this weird stuff going on. Like it's really different. It's like it's an alien," they said casually to a journalist, and then journalists:

“Cephalopods Are Aliens” and we're like, oh shit, no! That's not what we're saying. Squid did not come from space.

Alie: Talk to me a little bit about your work with bacteria interactions. I know you work with bobtail squid, which are these cute, cute little guys. And you study bioluminescent bacteria that lives on their underside?

Sarah: Right. The bobtail squid has this symbiosis with the bacterium, which is bioluminescent, it's called vibrio fischeri. They have this organ that is appropriately called a light organ, and that's where the bacteria live. It's really cool.

Alie: What a rig!

Sarah: It's an evolutionary... I shouldn't use the word mindfuck, but it's evolutionarily really, really complex and cool.

Aside: So, bobtail squid have these two little crypts where they house one species - one single species - of bioluminescent bacteria, like a bunch of glowing purse chihuahuas but the purse is your skin and the chihuahuas help you live. Because it's just one species of bacteria that they have this relationship with, it's way easier to study and isolate than a microbiome with a bunch of different species. In Sarah's lab, they're looking at the communication between the animal and the bacterium, and how the immune cells influence it: how they recognize their so-called good bacteria. Remember the glycobiology episode (with Michelle Dookwah), where cells use carbohydrate flags to kinda check each other out?

Sarah: We think it's sort of like when the immune cell and the bacterium first stick to each other, the immune cell is kind of like asking the bacterium a couple questions like, “Okay, when it comes to lipopolysaccharide, what do you have going on? Okay, it looks like that. Okay, what do you have going on for this protein over here? Okay. And let me look at this one other thing on your surface and with this information combined, I can identify who you are.”

Alie: Talk to me a little bit about bobtail squid because they do look like a hybrid between a squid and an octopus and a cuttlefish, which is actually how I got to know and gently stalk you: I saw *[laughing]* you tweeted this adorable photo of when you go check on your squids and some of them are totally okay with the checkup and others pretend to be rocks and things. One bobtail squid that had covered herself in rocks and was like, “Nothing to see here!” And then some people tweeted back at you like, “oh, pretty sure that's a cuttlefish.” And everyone's like, “fuck off, she's a squid scientist.”

Sarah: Yeah, this happens to me maybe once a week that someone tries to tell me that my bobtail squid is a cuttlefish. That particular day I had, like, 30 people telling me my bobtail squid was a cuttlefish, but I've just accepted that this is going to be part of my life - having men tell me that my squid is not my squid. And to be fair, there are true squid and I keep calling them calamari squid, but like I think that's where you encounter them the most, the long skinny squid. You know, when I just say, “Look at my squid doing something stupid,” some people will be like, “Well actually it's not a true squid, it's a... you should really be using the term bobtail squid.” I'm like, “Yeah, I guess I should

when I have this many followers and this many people getting all up in my business - I guess I should always use bobtail squid."

And they're definitely not cuttlefish. To be a cuttlefish, you need to have a cuttlebone and the cuttlebone is that buoyant... aragonite is what it's made of - a kind of chalky thing that helps them maintain neutral buoyancy so they don't have to actually put in effort staying up in the water. [*Sarah saying, "in the water," then Sarah's voice slowed down saying, "in the water."*]

Aside: Every time Sarah says "wudder," I die. I die! I texted her afterward to ask where she's from, out of pure linguistic curiosity and it's ... Philly. I love it so much! This accent is called Philadelphia English - that's the proper name for it - and it's heavily influenced by immigrants from Northern Ireland and Scotland. How you pronounce "water" is said to be the defining characteristic of Philadelphia English. I find it SO charming. So please when you hear her say "wudder," take a sip of your beverage, rejoice. It's so endearing. It's like sloth-baby-squid-level cute. Back to cuttlebones.

Sarah: ...and if you don't have that, you are not a cuttlefish. That's basic cuttlefish 101. [*laughs*]

Alie: If anyone's out there that's like, I'm pretty sure I'm a cuttlefish. Check yourself.

Sarah: Check your back. Are you stiff? Then you're a cuttlefish.

Aside: Once you've ascertained if you are a cuttlefish, how do you know if you're being a dick on the internet? Sarah has not only a lot of forgiveness and total compassion but also an easy test for this, for anyone:

Sarah: Ask yourself before you correct someone if you're right, and if you are, proceed and say it in a way that's not, "Hey, you're wrong." Just say, "I'm not sure, but I think you're wrong." That goes over better. Also if you get caught out for mansplaining, say sorry. Also if people apologize for mansplaining, let them go. They apologized! Everybody has a douchey moment in their life. Things get so overblown, so fast online; things can really snowball. So just try to be nice to everybody.

Alie: ...they can marine snowball.

Sarah: They can marine snowball. That would be the grossest snowball you've ever seen.

Alie: [*laughing*] Grossest snowball fight ever.

Your position on eating cephalopods - what is it?

Sarah: Okay, so, teuthoid squid I eat. Those would be like your calamari squid. Bobtail squid are so small that you'd have to - that would be like eating stuffed mushrooms. They're so little. So, I don't eat those, partially because it would take a lot of work, and partially because I've raised them from eggs, like from day one. I'm like their squid mom; I can't eat them. I don't eat cuttlefish because I think they're so stinking cute that I couldn't do it. And I've raised those too, and they're like clever and cute and friendly, and when you feed them they know you. They'll normally snuggle next to the seaweed and then if someone that they know comes in that they know will feed them they'll come out of the seaweed and say hi.

I had this one cuttlefish - it was like Cuttlefish #3 or whatever - that anytime I came in the room he wouldn't just come out of the seaweed. He would like bob his head out of the water and it was the cutest! It was the highlight of my day everyday: getting greeted by Cuttlefish #3. When Cuttlefish #3 got sick and died, I cried in the bathroom for 15 minutes. I was so sad because he was just so cute and so friendly.

And so I kind of think having cuttlefish around, it's like having a dog around, like they're wagging their tail and they're happy to see you and you're just like, "Wow, you're just the best." And then octopuses are like the jerk cats that are... some of them are nice, some of them are friendly, but a lot of them are just like, you know, I couldn't give a shit if you lived or died. I've only worked with octopus bimaculoides, the California two-spot octopus; maybe it's just them that are sometimes jerks. I had eight of them in college - not in my dorm room, in the lab [*laughs*]. That would be a cool side project, but not safe. When I would feed them... you feed them crabs or whatever you feed them. I fed them crabs. And they stack their little crab shells in a little pile which is really cute because they want to keep things neat and clean, so I would come in to clean their tank and sometimes they would play with my hands or whatever.

I gave them rubber duckies - they might pull the rubber ducky to the bottom of the tank, let go. Some of them would squirt me in the face every single day and I don't know if they were just playing like, "Hey girl, let me squirt you in the face, you look a little dry, I bet that's uncomfortable. Let me help you." Others would just cower in their tanks when I was around. I was like, "I feed you, I don't touch, you, I don't hurt you. Why are you afraid of me?" But maybe a human out in California before they were caught was mean to them. Or maybe they just have good survival instincts, I don't know.

Alie: Maybe they're plotting a takeover of the world. They might be busy.

Sarah: That's true. There are a lot of stories of octopuses really wreaking havoc in aquaria.

Aside: It didn't strike me until I was editing this: wait what??! The plural of aquarium is aquaria?? WHAAT? WHAAAAT. Aquariums is still considered fine, but aquaria is more correct. Also, JumboTrons are typically located in sports STADIA. Sit with that. Okay, back to how and why an octopus can GTFO your aquarium... aquaria.

Sarah: You basically need to make sure the tank is completely locked down and has no areas that they can escape, that are way smaller than you think they can escape from because they can squeeze through anything the size of their beak, and their beak is way smaller than their head. You gotta watch out for that.

Alie: How do their brains squish?

Sarah: Squid and octopus brains are bizarre. You've got a beak in the middle, surrounded by arms, and tentacles if you're a squid. So, two tentacles and eight arms. Everybody's got eight arms. Then their esophagus goes through their brain, their brain is doughnut shaped...

Alie: Whaaaat? Whaaat?

Sarah: ...and goes around their esophagus. So, things are just squishin' all the time. Some cephalopods you can't squish. You can't squish a cuttlefish because its cuttlebone is big

and you can't squish it. But octopuses can squish through all kinds of stuff. I don't know if it's uncomfortable, because like we can do things that are uncomfortable, like hard yoga positions that we can do...

Alie: Flying coach.

Sarah: Sure, that's really unpleasant, but you can do it, you know, it'll get you from A to B, which is probably what the octopus is trying to do. I don't know, it doesn't hurt them long term, I guess.

Alie: Why do some of these squid say they're totally fine with the checkup and why are others like, "Nah, nothing to see."

Sarah: I think this is just like a personality thing. Just like there are cats that when people come to the house, they hide under the bed and others that are like, "Yo, what up? My name is Rupert, please pet me." I think some of them just are anxious little anchors and others of them are like, "I've been here the whole time. You haven't killed me yet. Let's just do this, whatever."

And when I'm raising the squid, they see me every day. My hands are in their tanks every day, like they get used to the blue nail polish and whatever that comes along with me. Although, I think they're colorblind so they probably don't know that my nail polish is blue

Alie: They're color blind, but they have chromatophores?!

Sarah: Yeah, how whacky is that? I *think* octopus are color blind, but I wouldn't bet my life on that. I'm sure that cuttlefish are. They can only see tones of green, we think, which: how the hell did they figure out what to do? We don't know. There was this proposed experiment where they were thinking "Okay, maybe there's another way for them to see color that we aren't aware of, so we'll just blind them and see if they can change color and match their surroundings." But the scientists didn't want to blind a little baby cuttlefish because that would make you really sad. So it never got done. So the next time people are like, "Scientists are just cold hearted, they'll kill any..." Like, no. Sometimes we feel so bad that we just won't do it and we won't get the answer. Anyway, I digress.

Alie: You couldn't blindfold them and just be like, "Close your eyes, close your eyes."

Sarah: We thought about doing that, but as we mentioned, cephalopods are real squishy. So we were like, what would happen if we took those goggles that you put on when people go tanning and just stick them on a cuttlefish? So we tried; they basically reached their arms back and pulled it off their face. If you think it's hard to blindfold a dog, this is a squishy-headed dog that has opposable everything. So, they can just yoink stuff right out.

Alie: And multiples of arms.

Sarah: Yeah, like eight of them.

Aside: Sidenote: arms vs tentacles. It's a thing. Octopuses have eight arms. Squid and cuttlefish have eight arms PLUS two tentacles: and the tentacles are the two longer stretchy ones with the grippy clubs on the end of 'em. The clubs have circular, serrated

rings, kind of like teeth, so they can whip out and catch stuff, which would be so handy if you were sitting on a couch and your bag of Cheetos was across the room and you were like wha-pa! wha-pa! [*whipping sounds*] Or if you wanted to make sensual love to someone but didn't want to walk over to them, tentacles – also helpful

Alie: What about for sexing? I heard that an octopus will just use the end of an arm, like a paddle covered in sperms and then be like, "Hey, I sent you something," and send it swimming over to a lady. Like, "Use this, and make some babies."

Sarah: Yeah, cephalopod sex is varied and wacky. Let's just talk about it cause there's a lot to talk about here. I don't even know where to begin. So, in deep sea squid - not all deep sea squid - but this one deep sea squid whose genus and species name obviously is not coming to me right now.

Aside: Googled: octopoteuthis deletron, for those taking notes.

Sarah: They see each other so rarely that when they see another squid, they don't care if it's male squid, they don't care if it's a female squid, when the male squid sees another squid they will punch through the body cavity and just stick sperm somewhere in there. So, like if you think you've had a bad date, I'm sure you have, but at least no one literally punched sperm through your abs.

Alie: And they don't even verify...?

Sarah: They don't even verify, they're just like, "Oh, THAT could be a squid!" [*ka-plooffff*] So, there are male squid getting sperm stuck in their insides, and female squid getting sperm... It just sounds like a terrible approach, but...

Alie: Do they survive it?

Sarah: Yeah.

Alie: I would change myself into an invisibility cloak all the time. No wonder! I'd be like, "Yeah, there's no squid here."

Sarah: "I gotta get outta here. This is the pits." Yeah, the dating scene in the deep sea is no good.

Let's talk about something better. So we've got the giant Australian cuttlefish. This is my favorite cephalopod tale out there. These cuttlefish are a meter long, they're huge and beautiful. The males are like... if you can picture a cuttlefish... If you've never seen a cuttlefish before, picture a rugby ball with a bed skirt around the outside and then a little stupid face, with eight arms, okay? So, you're there, we're there. And now the males have these two big arms that kind of are flopping down on either side. They're really big and kind of billowy. They kind of look like someone put on a shirt that's way too big for them and that's their skin, and they're purple and blue and beautiful and ruffley.

Aside: Honestly, with their arms right in front of their eyes, they look like heavily mustachioed Ron Swanson types, or like a bristle-lipped cop from an old movie. Now, the female of the species is much smaller and they tend to put on more maroon splotchy patterns. So, they're easily distinguished from males by the size and the color. Well,

most males. And there are a lot of males in the breeding frenzies, which I propose we call cuttle parties. Haaay!

Sarah: It's quite a battle because there's, like, ten males to every one female out there. So, yeah, it's a tough...

Alie: Sausage party.

Sarah: It's a sausage fest, yeah. The big males will basically battle each other. They'll wrestle, and the winner of the wrestling match, which is hilarious 'cause watching two [laughs] comforters, battle is pretty funny. So, there's floofy tentacles everywhere - or arms rather - everywhere. The winner gets access to the female for at least a bit of time, mates with her. And then the female's, meanwhile mating with many males throughout this time period and storing the sperm from each male in these little pockets that she's got in her arms and she's like, just keeping her Rolodex of sperm ready to go. Then when she actually lays her eggs, she gets to kind of pick who she liked and who she didn't like.

Alie: Does she remember? Because that sounds like the season premiere of *The Bachelor*.

Sarah: Basically. I guess she does. How does she do it? I don't know. They're very organized. Okay, that's already pretty cool. But then you have these little males and they know they don't stand a chance against the big males. If they get in a battle they're going to lose. So they've got to think of something else to do. So, they will cross-dress, basically. They take those two big billowy arms on the side and they just tuck them, à la *Ru Paul's Drag Race*...

Alie: [incredulously] No...

Sarah: They do. And then they put on this model-pattern of the female, and then they just swim on over to the female and they're like, "Heyyy girl." Then when the male is like, "I'm killing it, I got two ladies, this is the best day ever. Yo Joe." And then while he goes to talk to his friend, the little male is like, "P.S, I'm a dude," mates with the female, leaves really fast so that he doesn't get his ass kicked by the big male. Then when the female goes to lay her eggs - so she's got her eggs all back up in the mantle and she fertilizes them one by one and puts them in a little egg clutch on the bottom of the ocean. When she goes to do that, like I said before, she can choose who she liked. And those males, the little males that cross-dress - they get a bigger proportion of the eggs than the big males.

Alie: Why?!

Sarah: I guess they want to... Maybe the females liked intelligence. Like, "Hey, that was pretty smart." So if we're ever like: how did those cephalopods get so smart? Well here's one way they're choosing for it.

Alie: It sounds like the worst romcom plot ever. They're able to change their pattern to look like a lady?

Sarah: Yeah. I might get yelled at for this, but like we talk about gender being, obviously, different from sex and you only have gender when there's society, you know, so normally we're, "Well, gender is only true in humans because only humans have society." And yet, if you can cross dress and put on different cultural patterns and signals of being a male or female: do cuttlefish kind of have gender? Maybe, I don't

know, I'm not a gender and sexuality scientist. I'm a squid scientist, but food for thought for us to all think about as we go about our day.

Alie: I mean, it's kind of like how us ladies like funny, ugly guys, you know what I mean?

Sarah: Totally. Yeah.

Alie: You're like: You've got a good brain; I don't need a jaw line. That's so fascinating.

I always like to ask: is there a movie about cephalopods that you hate or love?

Sarah: *Twenty Thousand Leagues Under the Sea* HAS a giant squid. There are certainly no movies about squid biologists that I'm aware of.

Alie: Are there any sea creatures like giant squid in any of the *Pirates of the Caribbean*?

Sarah: Yeah, there is! The kraken is in one of them. We can talk about that because that kraken upsets me.

Like we've said, cephalopods have beaks and this kraken, when it comes out... Of course, the kraken is a mythological creature, but the kraken that was the mythological creature we've shown is probably a giant squid. So, I denounce the fact that it's mythological - it's real. So, let's stick with what's real. The kraken in that movie has rings of teeth, like a shark, sort of? But there's no beak in there. It's just rings of teeth. And I'm like, come on man, we have access to what those animals look like. Beaks are scary enough! We don't need rings of teeth.

Alie: What do the beaks look like? And where did those come from? From an evolutionary standpoint?

Sarah: I don't know where they came from, from an evolutionary standpoint. But they look like sharp parrot beaks, kind of. They're like brown parrot beaks. I should have brought them because I have a collection of squid beaks, which is something that we don't mention on the first date. I'm going to tell you a story that I've never told on a podcast before.

So once upon a time I was going on a date with a dude whose name I shouldn't mention. We were hanging out and talking about raccoons and stuff, as you do on a first date. Things were going pretty well. So, we were back at my apartment and then we went in my room to hang out. And then he found a box [*laughs*] under my bed... It was, like, pretty close to the... It wasn't, like, deep under my bed. It was pretty close to the outside of my bed. And he was like, "what's in the box?" thinking it would be something that would be fun for him, but I knew that that box had squid beaks in it. Squid beaks, octopus beaks, cuttlebones, dried flowers, and snake skins and stuff.

I was like, "Oh no, you don't want to go in there, that's maybe not the best idea." So, he was like, "Oh that means I should DEFINITELY go in there." So, he opens it up and okay, maybe recently I had gotten some squid and maybe I was still working on getting some of the squid chunks off of them. I had soaked them in this ethanol. So he was like, "wait, what is THIS?" And the look on his face went from "This is going to be a great night," to "What the fuck did I get myself into?" I was like, "Oh, well, those are just squid beaks. And I also have some octopus and cuttlefish too, and errrr..." He opened it... he opened

it and then he just closed the jar, put it back in the box, put the box under my bed, walked out and never talked to me again.

Alie: No!! Oh, I was hoping that you'd say that you're engaged or something.

Aside: After hanging out in a basement with this chick for one hour, I can very much say: his loss.

Alie: Are you ready for some rapid fire?

Sarah: I am so ready for some rapid fire.

Alie: Lily Masa wants to know: What's the deal with squid ink?

Sarah: What's the deal with squid ink? This is a good question because I can go anywhere I want with it. So, squid ink is, it's a pigment that they store in their ink sac and they primarily use it to get away from predators. They have two options. They can either make this poofy cloud, like a smoke bomb and then they disappear and confuse everybody, and potentially it tastes bad to some fish.

Aside: So the inky "Aaaah, you can't see me leave!" is one tactic.

Sarah: Another approach is what's called a pseudomorph. That's a blob that they incorporate mucus in to the...

Alie: [*heaving sounds*]

Sarah: No, it's great. It's okay. I've had it all over my face before, because I was working with the squid and it woke up - in the middle of me trying to wake it up - really violently, and just inked me right in the face. It was dripping off my face and I was like, "Man, I deserved it." They'll shoot pseudomorph where they were, jet away from where they are, leave the blob where they were, so the shark or the big fish is like, "Oh, there it is," and then attacks the blob and just gets a mouthful of mucousy ink.

Alie: How pissed would you be if you were eating a sandwich, you blink for a second, you put the sandwich to your mouth and it's an inky blob of mucus?

Sarah: That would be a real bummer, a stone-cold bummer.

Alie: Your sandwich is like, "wamp wamp," and it's hiding behind a bush. Pissed!

I didn't know that that's what they used them for. I thought they only produced it for pasta.

Sarah: That's true. They also used it for pasta. [*laughs*]

Alie: Al Martinez wants to know: How many giant squids are there, and is there any truth to the old tales of giant squids attacking ships?

Sarah: Okay, that's a question I can answer. There are most likely a shit ton of giant squid, because we find a lot of giant squid beaks in sperm whales. We've tried to back-of-the-envelope calculate how many giant squid there are, and I don't have that exact number in my head, but they live pretty much everywhere in the deep ocean.

Now, the reason there's this myth about them attacking ships is that these animals are full of ammonia, which is a part of dealing with buoyancy, basically. When they die,

instead of sinking like other squid and cuttlefish and octopus do, they float. So, when they're starting to feel like crap and start to die, they tend to go near the top of the water. Yeah, we think there are a lot, a lot, a lot of giant squid. And, they get to the top of the water when they're sick, and ships - maybe they'll just touch the side of the ship because they're like, "What, what year is it? Who are you? Are you gonna help me?" [laughs] Then the sailors think, "Oh my God, it's attacking." Meanwhile it's just on its deathbed and feeling like garbage. So, it's not going to hurt you.

Alie: [pitifully] "Tell my family I love them."

Sarah: Exactly.

Alie: John Worster wants to know: How intelligent is an octopus? Would its intelligence level compare it to a four or five-year-old child, or is it more intelligent than that?

Sarah: The short answer is: Lord knows how smart any given animal is; it's a harder question than you think it is. When you are assessing how smart an animal is and you're not an animal intelligence scientist, you might think... you're kind of judging the animal based on how you judge human intelligence. How smart is an octopus compared to an age of human? I don't know. Maybe like a dog. I don't know.

Alie: I guess it also depends on how dumb your children are.

Sarah: That's very true. I never had a child or watched one develop firsthand.

Alie: As a four-year-old, I got my whole arm stuck in an escalator and they had to invent the emergency stop button for me and another kid whose foot got eaten off. So, it really depends on whose kid you're...

Sarah: That definitely wouldn't happen to an octopus.

Alie: Even if it did, it's like, "I have seven extra arms!"

Sarah: "I'm just gonna eat this off. We're good."

Alie: Okay, Krista Evampato [phonetic] says: Are squid likely to be more impacted by climate change than other sea animals? Or will they be one of the species that's best able to adapt?

Sarah: Squid are doing really well right now, but we think that's more to do with the fact that we don't overfish them. We have overfished the hell out of most fish populations. We started with the biggest fish and then we've been working our way down ever since. The really small prey fish are doing the best. The one thing that cephalopods generally have to worry about with climate change is ocean acidification.

Basically, when the ocean is acidic, it's harder to build a shell, so that's going to be a problem for all crustaceans and clams, bivalves, whatever. Now, when they're looking at populations in the last five, ten years, all of the cephalopods that I know of are doing really well, but we don't have really good records of fisheries information for squid, because back then you wouldn't need to eat a squid because you had cod coming out your ears. We think they're doing all right. We don't think they're endangered. The other nice thing is that they have really short life spans - for the purposes of adapting quickly, that's great. When you produce a lot of your species, it gives you more

opportunity to adapt quickly and evolve quickly, compared to an animal that needs to live 50 years before it reproduces.

Alie: They have more iterations to tweak and see...

Sarah: To play with. Yeah, exactly.

Alie: Oh, that's interesting. I hadn't ever thought about it.

Jennifer Overbye wants to know: Are squid social creatures? I think we just talked about how they were loners. She said: I've only ever seen them alone, but they must get busy every once in a while. So, with how intelligent they are, do they have a complicated social structure?

Sarah: It depends on the species. Some, like Sepioteuthis which are these really, really beautiful squid that have the bedskirt that goes all the way around, the fin that goes all the way around, they will generally travel in groups of, I don't know, three to seven-ish. They're always hanging out together. Humboldt squid travel in huge packs. Humboldt squid are up there with some of the coolest cephalopods. They're human sized, length wise. They're like thick and big and scary and some people have said that they killed people swimming, which I wouldn't put it past them, but I don't know if there are recorded deaths from Humboldt squid, but I would believe it.

Aside: Humboldt squid, FYI, also called red devils, and they're known to be very intelligent, very curious, aaaand aggressive. Those beaks they have that look like bird beaks have more bite force than an African lion, which is a fact I did not need to know. And I kind of wish I didn't. I'm sorry.

Sarah: They live off Baja California, and I think in 2010 they were coming up through, up to San Francisco. They're huge, travel in packs, they flash red and white to communicate with each other, we think, and they will pack hunt, which is sooo scary. Like, as if ONE Humboldt squid isn't scary enough. People will sometimes dive with them literally wear chain mail because they don't want to get bit.

Alie: Could they eat a human?

Sarah: Sure. Why not? Yeah. The bummer about getting eaten by a squid is that they don't care if you're living or dead while they're eating you. They will... they have so many arms to grab onto you, that they'll grab on and start chomping away while you're still alive. So, big squid are very scary.

Alie: It seems like with the Humboldt squid, if they're the size of a human, it would just be like getting into a big skin sleeping bag. Like, you would just fill their whole guts.

Sarah: They might eat part of you and then drop you.

Alie: To share the wealth.

Sarah: Yeah, absolutely.

Alie: Like, "Anyone want some of this?"

Sarah: You're going to become marine snow. [*multiple DJ air horn blasts*]

Alie: Mike Ramsey wants to know: Every once in a while, a strange creature washes up on a beach somewhere and may often be described as squid-like, but of unknown classification. Is anyone maintaining a database of unknown sea creatures? If there's no immediate obvious classification and no easy way to find living specimens, does anyone research these things?

Sarah: I think a lot of times when things wash up that could be cephalopods but we don't really know... cephalopods degrade really fast. They don't have... For example, if one of my squid dies in the tank, the next morning it'll already start to come apart. If I leave it 'til the afternoon, its body parts will start falling off. This is a tank where there's not a lot of wave action. By the next morning if I pick it up, it will fall through my fingers, liquid. So, identifying positively, a lot of this stuff is really hard to do. That's probably why they're saying, "Unidentified. Yeah, it was a cephalopod but what was it? Lord knows."

Alie: Brian Edge wants to know: How threatened are the nautiloid populations? They've always been one of my favorite cephalopods.

Sarah: Great choice. The nautiloids are in bad shape right now because we keep collecting them for their shells. Their shells are gorgeous, and if you cut them in half, you see these different chambers that the animal used to live in. They reproduce pretty slowly, and they don't produce as many offspring per nautilus as the squid do. Go online and look up the Nautilus Breeding Program at the Monterey Bay Aquarium because you have these little baby nautilus videos and they're all so cute.

Cuttlefish look like tiny fully formed cuttlefish, which are so cute that it hurts a little bit. Nautilus is the same way. They come out pretty big they look like fully formed nautilus. but small.

Alie: With a shell?

Sarah: With a shell.

Alie: Aww, little babies!

Sarah: It's really just so cute. So, DON'T buy nautilus shells, because you're depleting the population and we got to cool it.

Alie: Yeah, let's 3D print some. Are there enough people studying squid and octopus and cuttlefish?

Sarah: There's not enough government money to fund people studying cephalopods. There should be more, because they're so dope. And we can learn so much from them. Understanding how they're doing this stuff is really important for engineering purposes down the line. What my work is doing is really more about understanding how your microbiome stays healthy. There's a lot to learn from these animals. It's super cool.

Alie: Also, octopuses...

Sarah: Octopuses! I know you want it to be octopi. We all do!

Alie: We all do.

Sarah: Octopi sounds nice. Octopuses – you have to say “pusses.”

Alie: I know, I don't want to say "pusses."

Sarah: It's a stone-cold bummer but it's a fact of life, so you just gotta get up in the mirror, look at yourself, and just say, "octopuses," and keep a straight face. When you can do it, you've made it. Then you can apply to be a cephalopod biologist... if you can say "octopuses."

Alie: I've got a way to go.

So, what about your job sucks the most? What do you haaaaaate? Is it cleaning tanks? Is it forms?

Sarah: Probably dead shrimp is the worst part of my job because they turn pink and get goopy and smell pretty bad. So that's the one of the worst parts of my job. That's normally what I say, but also the worst part of being a squid biologist specifically, is people - and you can cut this if you want - but people will, no joke, send me tentacle porn on the internet. People will be like, "You're into tentacle porn." In college, I'd be like, "I'm really not!" That really upsets me because these squids are these nice, lovely little animals. Like, whyyyy?

Alie: But also: don't send it to someone unless they request it.

Sarah: YEAH! Especially someone that really cares about the welfare of cephalopods! Like, gawwwd! That happens to me more than I... that's probably the worst part. I can pick up 30 dead shrimp and be like, "I had a really good day today," but like any day that somebody sends me squid porn is a BAD day, at least a bad afternoon. I'm like, Report, like no! Please, don't!

Alie: What is the best thing about your job?

Sarah: The best thing about my job right now is watching baby squid. When they first hatch, they're the size of the head of a pen, and they'll take down these shrimp called mysids which are about four times as big as them, and that's very cute. But when they transition from little shrimp to big shrimp, it's hilarious because these little squid that are maybe a quarter of a marble in size, will tackle these big shrimp and it's hilarious because they've got this huge shrimp in their mouth and they're trying to swim and control where this big shrimp goes, AND that means that I can now pay a little less money to feed them, which is great.

And it means that they're going to make it because that's the hardest part of raising a squid - getting it to transition to bigger shrimp. If they make that transition, it's like: I've done it. That's like sending your kid to college. Like, you did it, you didn't screw it up, everything's good. And it's just so stupid cute. I can't handle it.

Alie: It reminds me of when a tiny poodle is carrying a huge stick.

Sarah: Right! It's exactly like that, it's just like that.

Alie: [*cooing voice*] But with more arms.

Sarah: Yeah, and they'll stretch all their stupid little arms around the shrimp body, and it cracks me up.

Alie: I forgot to ask you entirely: How can people get involved with Skype a Scientist?

Sarah: Basically, it's a program where we match up scientists and either classrooms or groups of adults that like learning, so that they can have these 30 to 60-minute question and answer sessions with a scientist.

Aside: Skype a Scientist isn't just for schoolkids; they just expanded to adults. So, if you are a book club or a library group, you can sign up, and you can gather, and you can chat with one of the over 1,500 scientists who have already signed up. Go to SkypeaScientist.com for more info – if you're a scientist or you're someone who wants to talk to one, click the Teacher button. It's also not just for Skype: you can Facetime or video Hangout. But let's be honest, Google Plus Hangout a Scientist just does not have a ring to it, so they just call it Skype a Scientist.

Sarah: Every scientist loves answering questions about their work. They're spending their whole life working on it, so just tweet at them. Probably they're going to be happy that somebody talks to them and cares about their science.

Alie: That's such solid advice. I think so many people figure that if you were to tap the shoulder of a working scientist, they would rear back in a lab and say, "How dare you!" It's nice to know that they're like, "Oh, sweet, I'm just like walking through the mall and I can totally answer that right now, waiting for a smoothie."

Sarah: Yeah, totally. I think the movies and TV give scientists such a bad rep. We're friendly and we like talking to other people most of the time. There's no reason to not talk to us. A lot of times like if we're studying some weird thing like bobtail squid symbiosis, or whatever, we probably don't think people care some of the time. So, when people do care, it's awesome! Let's talk about my favorite thing! Of COURSE I want to talk about this! So yeah, don't be afraid of us.

Alie: Okay. Thank you so, so much for being on. I'm so excited!! I mean, it was only several months of mildly stalking you. I'm such a creep.

Sarah: You're welcome!

It should be noted that during this interview we also paused for a moment and we did our best impressions of squid and cuttlefish dances for each other. Hers was amazing. If you ever see her out in Connecticut, she says you have to buy her a beer to see it performed, which is fair. Also, we got locked in this library basement for like 5 or 10 minutes after the interview, which was scary, but honestly I wouldn't have changed it for the world. It was a good time.

To internet-befriend Sarah MacAnulty, you can follow her on Twitter or Instagram at SarahMackAttack.

She also gives advice to anyone wanting to get involved with squid. She says just start working with animals in general as soon as you can, in any capacity, and don't be afraid to do disgusting work. You can also volunteer at one of the many aquaria in the nation and just ask people questions, ask scientists questions. If you're living in Connecticut and want to work with her, if you're a big squid nerd, like "This is my jam!" - reach out. She also thanked her squid squad who help her with research in the lab: Zack, Elise, Hope, Courtney and Lydia [phonetic].

Thank you from me to Steven Ray Morris for editing this cephalopodcast; to Boni Dutch and Shannon Feltus for handling all the Ologies merch at OlogiesMerch.com. Thank you Erin Talbert and Hannah Lipow for being admins and wonderful friends. The Ologies Facebook group that they admin is great. It's full of curious, hilarious people, I love going in there and saying hi to everyone. Thank you to all the Patrons for financially making this podcast possible. Thank you. You are really the engine behind this; that's at Patreon.com/Ologies if you want to support. Even a quarter an episode helps. Thank you so much, Nick Thorburn of the band *Islands*, who did the music.

I always give you guys a little secret at the very end of the podcast, [*sing-song voice*] as a thank-you for listening. I'm very much NOT a redhead, and on top of that, I dye my hair with stuff out of a box from the grocery store. In the shower it looks like Carrie, but it costs about ten dollars, and it usually turns out the right color. So there you go, that's your secret.

Okay, ask smart people dumb questions.

Next week, I think it's gonna be mythology. What do you think? It's gonna be good. Berbye.

Transcribed by Bailey Olfert

Links:

[NatGeo video that Sara Loves](#)

[Humboldt Squid](#)

[Dynamic Skin Patterns in Cephalopods](#)

[Marine Bio Basics](#)

[Why Cute Things Make You Want to Punch Things](#)

[Squid Camouflage](#)

[LED vs. LCD](#)

[Deep Sea Bisexual Squid](#)

[Man eating squid](#)

For comments and inquires on this or other transcripts, please contact OlogiteEmily@gmail.com