Interview with Dr. Alyssa Gehman by Shelby Deglan and Erin Cox

Topic of Interview: Sea Stars in the Anthropocene

[00:00:00] AG: My name is Alyssa Gehman, and I am a postdoctoral researcher here at the University of British Columbia in the Biodiversity Research Centre, and I work for the Hakai Institute as well, and I study sea stars.

[00:00:15] AG: So I personally don't mind between sea star and starfish. "Sea star" does make it more clear that they are, in fact, not fish. They are found in the ocean, but they are not the same as a fish. But if you want to call it a starfish I'm fine with that as well.

[00:00:32] AG: Sea Stars generally have five arms, and they live in the ocean. So we find them all over in the ocean. The ones I study here in the Northwest are generally found either from the intertidal which is just as you go into the ocean all the way down to the deep sea.

[00:00:49] AG: And they have these things called tube feet which are on the bottom. And the tube feet have—are just a whole bunch of little,tiny suction cups. And amazingly on the end of the suction cups they actually have glue as well. So they both suction and glue to attach themselves to the bottom. And they move around on these tiny, little tube feet.

[00:01:11] AG: So while they mostly have five arms, they can actually have six or many. So there is a variety of arm numbers. They are generally fairly flat to the surface. They actually have a mouth on the—on the underside of them, so the part that is aimed toward the ground, sort of surrounded by their feet, is where their mouth is. They come in all the colours. So you can find blue sea stars, and pink, and reds, and greens, and just any, any colour you can think of there's probably a sea star that is that colour.

[00:01:45] AG: I think they would spend a lot of their day eating. And what they eat is mussels. And so, if you recall, we have sort of, this mouth that's on the bottom side of the sea star. And in order to eat a mussel, what they have to do is find one first. So find the mussel. And then they're going to get on top of the mussel, and put their tube feet on either side of the mussel, and actually pry open the mussel. And this is where it gets even weirder. They don't have to open it completely because their stomach comes out of their mouth. And so they pry open the mussel, and drop their stomach out into this mussel, and dissolve the tissue on the inside of the mussel, and then just pull that all back in—into the sea star, and digest it. It's really an amazing way to eat.

[00:02:45] AG: I would imagine they might eat one or two a day. There are a lot of these stars, and so they can devour an entire mussel bed if they can get to it. And so they are this really important predator. If there's no other reason for the sea star to not be able to eat, so for—there's a variety of

things that might make it hard for a sea star to get to the mussels. But if that isn't in place then they will eat all the mussels, and there will be none left.

[00:03:13] AG: So the things that keep a pisaster away are really high wave action. So if the waves are too—hit them too hard they will fall off. Or low salinity. So that's how much salt is in the water. If there's not enough salt in the water they have trouble with their bodies, and so they won't go there. So sometimes mussels can live in places that sea stars can't, and then they can't get to their food because it's in this sort of uncomfortable location for them. Let's see—if there's sand. They don't particularly like sand. They like to be more on rocky shores. That's another thing that can keep them away. Another thing they might do, if maybe another sea star were to come too near them, they—on their skin, they have these tiny, little things called pediselaria, which you won't be able to see without a microscope, but they're teeny, tiny little pinchers. And so if another sea star comes and puts its arm on top of their arm, their little skin pinchers will come out and pinch off their tube feet. So they'll actually cut their tube feet off as they're trying to walk on eachother. So, they have sort of little skin battles essentially. That's another thing that might happen on an average day.

[00:04:31] AG: And then, amazingly, something that happens to them—especially these intertidal ones—so they'll be underwater, and while they're underwater they'll be moving around trying to eat. And about once or twice a day, depending on where they are, the water goes away. And so during that period of time, that's low tide, that's when we can see them. You're actually just going to have them attached to the rock trying to keep all their water inside them and not dry out. So hopefully they've found some sort of a crack or a crevice. And they're in the shade ideally, so they're keeping all—as much of their water as possible during this time period while the water, the ocean, is away.

[00:05:12] AG: So the effect of climate change on sea stars is really quite nuanced. And it depends on which species you're looking at. So I guess there's two different things to think about. There's temperature, and there is ocean acidification. And there are many other things to think about, but those are the two main things we're really worried about for most of the things in the ocean. For example, pisaster. Pisaster eats these mussels. Mussels are calcifying organisms, so they are organisms that make their own hard shell. And one of the things we know is that with ocean acidification it becomes harder to make your own hard shell. And so for pisaster, for this ochre star, some of our experiments have shown that they can actually get more food under ocean acidification conditions—assuming the mussels continue to survive on their own. They can actually eat them easier because of—because the mussel is weakened by the ocean acidification conditions. So their food suddenly becomes a little easier to eat. And a little bit easier to eat food means you get to eat more of it on a given day. And so, sort of,

temporarily there might actually be some moments where it's actually good for the ochre stars.

[00:06:25] AG: However, when you add in the temperature question—one of the things we've found is that there—as we have increased temperatures, we have these anomalous temperatures. That's correlated with this outbreak of a disease called Sea Star Wasting Disease. Or Asteroid Idiopathic Wasting Syndrome is another word that people have started using. And that has been devastating for sea stars, and for many of the species in the area. So the wasting outbreak killed millions of stars from Mexico all the way to Alaska, across all the species.

[00:07:08] AG: And a wasting sea star, when you see it, it starts as a small lesion on the skin. So it starts as sort of a small white spot on the skin. And it's interesting because there actually are lots of white spots on a normal healthy sea star. So the key to the start of wasting disease is that it's sort of gooey. So it's a white gooey spot in the earlier stages. And what happens is that white gooey sort of lesion will grow on the sea star.

[00:07:40] AG: And it's just a really upsetting disease because what happens—the further stages of the disease cause enough large lesions that you can actually end up with arms falling off. And because of aspects of sea star biology sometimes those arms might actually walk away from the main body of the sea star. So you just sort of see these disintegrating stars. And at the very, very last stages of the disease you might just see sort of a white sea star shaped area where the sea star used to be. So they really just dissolve away. It's very gross actually.

[00:08:21] AG: An interesting thing about sea star wasting disease is that we don't actually yet know what causes the disease specifically. There was a time where we thought we'd found the virus that caused the disease. We've since figured out it is a virus that can cause the disease symptoms we see, but it doesn't—it isn't in all systems where we find the disease. So it remains a bit of a scientific puzzle that we're hoping to solve.

[00:08:55] AG: Pisaster is one of the species that was pretty badly hit by this wasting outbreak. The one that was hit the most is one called pycnopodia. There—we have, you know, twenty different species, and this one species pycnopodia is just massive. The Individuals, you know, used to be— huge. You'd go up to it and it would be, you know, wider than your arm span. You might have trouble picking up one, because they were so large. And they were plentiful. They used to be everywhere. And they—you used to be able to see them in the intertidal. There were certainly more in the subtidal, but you could go to a beach in Seattle or Vancouver at low tide and find a sea star. Um—and you don't—you can't, at this point, go to the intertidal and find a sea star.

[00:09:52] AG: So what's really interesting is that sea stars, specifically in pisaster specifically, are—they're the original keystone species. So pisaster—. A keystone species is a species that has a—much higher effect on its ecosystem and its community than other individual species. So it's sort of an outsized effect on its community. And the pisaster were the original keystone species. And the way they did the experiment was actually to remove the sea star from areas. So they would go out and collect them. They didn't kill them, they just moved them to some other location in the ocean. And what they found was when they removed sea stars from an area we get these huge mussel beds, and that it really changed the ecosystem. It changed what was present in a location.

[00:10:47] AG: And so—of all the species in the intertidal specifically, but also in the ocean—we probably have—we had a pretty good idea of what we thought would happen if there was a large decline in those species. And so, as we discussed, there actually has been a large decline in that last several years. And there have been many studies out there now evaluating how—how the ecosystem has responded. And in many cases we did see increases in mussels. And we saw increases in species they compete with. So sea star species have suddenly disappeared, and that is not an experiment that anybody wanted to happen. But it is something we are studying actively right now.

[00:11:40] AG: I would like future generations to know about the diversity in species and sizes that we currently have. And that we had of sea stars before—before the rest of climate change happened. There's no indication that the warm water is temporary. Most of the patterns, and most of the predictions show that we're actually going to have more and more marine heat waves going into the future. So that does not bode well for many of the sea stars.

[00:12:11] AG: It is an interesting thinking about all the different species. And how each of them is going to respond is a more varied picture. So for example the pycnopodia—that one. It will take a fair amount of work. I hope we can recover them to their full glory, but I also hope we remember how many there used to be.

[0012:35] AG: How many sea stars were lost is really locationally dependent. So California, for example, does not have any pycnopodia anymore. And in Oregon—they haven't seen any since wasting outbreak. We still see some in some locations in Washington and British Columbia. And there were drastic, drastic declines in pisaster as well in the southern locations. Again those populations seem to have potentially recovered in some locations in British Columbia for the pisaster.

[00:13:09] AG: We are trying to—with the sunflower sea star—to work toward recovery. And so one of the things scientifically we can do, which I talked about, is work towards captive breeding and breeding

for resistance. But we do know that pycnopodia can get stuck in crab traps. And so something that people can do is if they happen to see that sea star on a crab trap they can just throw it back. It's very simple. Just make sure you put it back in the ocean. And then they'll be fine.

[00:13:46] AG: But really probably—this is a hard thing. The biggest thing we really need to do is fight climate change as much as we can. It's really the temperature change that's a problem for these sea stars. Whatever you can do to combat climate change is going to be the most rewarding of our options.