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I: Welcome to the Big Questions. I'm your host, Rachael Funnel, and today I would like to talk about octopuses. It's no secret that octopuses are intelligent – but are they sentient? "Sentient" is loosely defined as an animal's ability to have subjective experiences, and that can include things like pleasure, pain, and fear. Evidence for or against sentience in animals can have a significant impact on the rights they are afforded both in science and agriculture and just out in the wider world. To find out more about the intelligence of octopuses, we caught up with Sy Montgomery, author of *Secrets of the Octopus*, which accompanied the National Geographic series of the same name. We wanted to hear all about her first-hand experiences with these incredible animals.

So, Sy Montgomery, it's so exciting to be chatting to you ahead of *Secrets of the Octopus* with National Geographic. How was it writing the book for this?

R: Oh I loved it. I had previously written a book, *The Soul of an Octopus* in which I came to know a bunch of octopuses personally and since that came out in 2015, there was a ton of new science and in many cases the discoveries that were being reported explained things that I had wondered about for years and shed new light on these behaviours that had enchanted me when I was spending so much time with these animals. It's a dream working with National Geographic too, I've got to say. Gosh, I think so many of us who are science writers have dreamed for years of writing for the magazine or being associated with it. This has been a real joy.

I: I'm so glad. You mentioned there your experience with octopuses. For people who don't know can you talk a bit about that?

R: In 2011 I met my first octopus and her name was Athena. She was a giant pacific octopus. Each arm was about three and a half feet long, she weighed about 40 pounds, and I went to New England Aquarium and asked my now good friend, Scott Dowd if he would lift the lid to her tank and I saw her float out of her lair, look into my face, lock onto my eyes and then she turned bright red with excitement and flowed out like a beautiful crimson silk scarf in the water and her arms came boiling up out of the water with her white suckers first and I asked Scott, could I touch her and he said, sure. So I plunged my hands and arms into the freezing cold water and instantly my skin is covered with dozens of these soft questing suckers that are not just touching me but they are tasting me and I realised I was going to have to go home and explain to my husband why I came home from the big city covered with hickeys. What struck me so much about this interaction, that went on for quite some time, was that this animal who was so distantly related to me, that we last had a common ancestor half a billion years ago when everyone was a tube, that this creature was just as interested and curious about me as I

was about her, and that set me on a quest. For three years I would go in and interact with the various octopuses. Athena, alas, was old when I met her. Giant pacific octopuses only live three to five years and by the time they come to live at the aquarium they're usually a year or two or three years old, so she died not long after I met her, but I did get to know other octopuses for their entire tenure at the aquarium and I considered them my friends.

I: I feel like it's such an interesting story to hear because quite often sometimes you see octopuses spoken about as if they're kind of alien and they are these strange creatures but just goes to show that even across, like you said, such distantly related animals you had that moment of her perceiving you, it wasn't just you perceiving the octopus.

R: Absolutely, and you exactly get to the crux of why its so exciting to get new insights into the lives of these creatures. They are so different from us you really would have to go to science fiction or outer space to find something so alien. Their head isn't even where we think their head is, you know. I have a little octopus plushie. Everyone thinks this is their head. It's not. This is their body, this is like their torso and then this is their head and then their arms attach to their head and their mouth is in their armpits. So, they're very unlike us and they have no bones and they change colour and shape and they pour themselves through tiny openings and they taste with all of their skin and they have three hearts and they have blue blood and like, wow! You can be friends with someone like that and you can recognise the intelligence at their disposal, that they use to solve all kinds of real-world problems and this film shows this in detail never before seen.

I: I really wanted to ask about that because I know the series is broken down into Shape Shifters, Masterminds, and Social Networks. So, the intelligence is a really key part of it. What were some of those never-before-seen insights and what is some of the new science that just really demonstrates just how clever these animals are?

R: One of the scenes that really sticks with me is there is an octopus who is beset with an annoying shrimp and you would think like, oh a shrimp, what's that going to do? Well, there are certain shrimp that have these pointy spears on their bodies and they can poke you with it and the octopus is a soft bodied creature, he doesn't like that. So, he's on a sand substrate and he doesn't want to leave but this shrimp keeps annoying him. He looks around, he sees the shell over here, he picks it up and holds it up like it's a shield. It's so insightful, it's so smart and there's other octopuses who will hunt around and find two halves of a coconut shell and they'll carry these things in their arms under their interbranchial webs and use two of their arms to walk around like a person. It looks like a person coming out of the subway carrying a bunch of luggage, and they will lug this for quite a distance, well what for? Well, they'll put it together and it forms a beautiful Quonset hut that protects them from everything. So, this is just like a person building a shelter. The shield is just like a person, a gladiator holding a shield up against an enemy. They're so familiar and yet these behaviours are being performed by somebody separated from our kind by half a billion years of evolution.

I: Yeah, its remarkable, like you say to see those similarities despite how incredibly different the way they perceive the world is. I think as well, another area... we're getting to the

social lives episode, that's another way in which you see that actually they have these interactions. Can you talk a bit about the insights that come from that episode?

R: Well that really blows my mind because when I was working on *The Soul of an Octopus*, one of the things I wondered about was why did Athena and Octavia and Kali and Karma, why did they even want to be friends with me? Octopuses were believed to be almost entirely social. There is something like 350 species of octopus, they keep discovering new ones all the time and they vary from tiny little guys who fit on the tip of your pinkie to animals that grow to over 300 pounds, but most of them were believed to be solitary and the giant pacific was believed to be solitary. Turns out this is not so, and that in some circumstances even giant pacifics can be found in octo-condos, and in some areas, other species such as the gloomy octopus – who is not really gloomy, he just has big expressive eyes – in most places in Australia where you will find this animal he is living alone. But there is a place called Octopolis where he lives in like, big “cities” and in addition to not living alone, but living with other octopuses, the film shows us instances in which they form relationships with other species just like Octavia did with me and Athena and did, and Kali and Karma. Why would they bother to make friends with another species if it's such a solitary animal? Well, octopuses, as it turns out, in some areas and in some species, use other animals to help them hunt in partnerships similar to humans hunting with dogs or hawks, or cheetahs if you go into, you know the coursing with cheetahs thing. A fish will come and get an octopus, there's one species that actually will stand on his head to signal to the octopus; look, I've got an idea, let's go hunting. So the octopus is like; okay. The fish goes off. The fish knows where there is some hidden invertebrate prey but it's stuck inside the crevices of a coral and the bony fish can't fit there, he can't get to it. But the octopus can because he can just pour his boneless body into that crevice and out comes all these delicious things that both species can enjoy.

I: It's amazing to hear. I feel like this film is coming at a really good time because we talk about octopuses a lot at work in the context of animal rights and things like that. There are some bizarre things in the world in which they are not given the same rights as other creatures because they're not legally classified as sentient but, you know, based on everything that you have learned across all of your work, surely you must be of the opinion that they are, of course.

R: Oh absolutely, and the Cambridge Declaration on Consciousness, which was signed by so many leading minds in neuroscience and other biological sciences, specifically included octopuses and there is a real good reason that animals as well as humans think and feel and know. To deny that would pretend that we came up with these abilities *de novo* and it would deny that the ability to think and feel and know and feel affection and remember stuff, that this has no adaptive for anybody except for humans. Well that's absurd. It has enormous adaptive value for almost everybody and now we are learning that trees communicate through the wood wide web. I mean, being able to sense your environment and interact with others in order to survive makes a lot of sense. Our world is so much more alive than Westerners would have liked to pretend. For the longest time we have put ourselves on top of this pyramid and that's how you end up ruining the climate. That's how you end up with an ocean that has more plastic in it than fish. The way out is recognising we're part of a family and I really think that films like this reach out, like an octopus and enchant the viewer and invite them into the mind of another

creature. This expands our heart; it expands our compassion and I hope makes us better citizens of the Earth.

I: Absolutely agree and I think that word, enchanting, is so perfect for these animals. The more you watch, they really are just the most charming, charismatic things. Given everything you've learned, what's one thing that you wish everyone knew about octopuses?

R: That they love their lives as much as we love ours.

I: Yeah, that's a really beautiful idea. Well thank you so much Sy Montgomery. It was great to hear about your insights from the show. I'm really excited for everyone to watch it and to read the book.

R: Great, thank you so much Rachael.

I: It's safe to say there's a lot pointing towards octopuses having advanced intelligence and awareness of the world around them, so how is this reflected in the way that they are treated? Given everything we know about octopuses, is it really ethical to farm them? We spoke to Sophika Kostyniuk, Managing Director at the Aquatic Life Institute to find out.

I: So, Sofika, for my first question I wanted to ask is octopus farming currently legal, and if so, where in the world is that the case?

R: Well that's a wonderful question to kick us off with. So, it is legal, the only place where it is currently not legal is Washington State in the US. They recently passed the first ever bill and law to prohibit octopus farming in their jurisdiction, but everywhere else in the world it is open for consideration.

I: I know the Aquatic Life Institute have been looking a lot into the detrimental effects of octopus farming. First of all, could you just tell me about what the environmental risks are of octopus farming?

R: Yeah absolutely. Well, first of all you're going to be breeding a wild animal in a controlled environment on land. We have only heard of land-based octopus farms that are proposed at this point in time, so you are taking this complex, highly evolved creature and putting it into a confined intense breeding operation. So, from that, as we know with land-based animal farming, when you put animals into tight confines they become stressed, they become more vulnerable to disease. Their bodies are more susceptible to infections, so we will definitely see the introduction of antibiotics, pesticides, fungicides that will flow out into the environment. We would certainly anticipate and hope that would go through a filtration system but we do know that there will be effluent into the natural environment. These sites, so far, have been proposed right along the coast and shorelines of various jurisdictions, like in the Canary Islands, in Mexico, in Hawai'i so that would be flowing out into the ocean, these additives. We do know that nitrogen and phosphorus will also be added to the farms, that will also flow out into the environment. Any pathogens that begin to occur on these farms, viruses, we know that octopuses can be highly virulent, that could also flow out into the environment so we have a lot

of concerns around environmental impacts directly surrounding and possibly even further out from these proposed farms.

I: Yeah so it's obvious that there are ways that octopus farming can affect wild animals by leaching into the environment but then for the captive animals themselves, it seems with octopuses they would be much more concern around the kind of ethical considerations. What is particularly difficult with octopuses when you think about farming in that way?

R: I can't even begin to list all of the concerns, but the ones that come top to mind for us and the ones that we have researched and produced publications on are the fact that these are carnivores, so we would need to feed them approximately three times their own body weight in other animals that are coming from the sea. So this would come from fish mill, fish oil, other species that could otherwise be used for human consumption, so that is a major concern. These animals are very very fragile, they don't have an exoskeleton, so their skin can rip very easily. They are cannibalistic, actually, and there's a farm in Mexico that we've created an investigative report on that farm as information has come out way. There was over 52% mortality of octopuses in that farm/research facility. A significant bulk of that comes from cannibalism. When they become stressed they become territorial and they can actually attack their own kind. That is incredibly concerning from a moral, ethical standpoint, if that's not enough of an argument to already say this is completely unacceptable. These are animals with incredibly highly evolved brains and we know that they are capable of extraordinary feats, they're masters of disguise, they have more neurons in their arms or tentacles than they do in what we call the "head" of the octopus. Their arms connect independently of the rest of the body, even if they're severed from that body for up to an hour. They're shape shifters, they're chameleons, this is just an animal that is 100% not suited for an intense farming operation.

I: Yeah, I absolutely agree and that statistic of 52% is really shocking. Even if you were to ignore all of that somehow, is it right that... I think I've read about how these animals, they have quite a fragile life cycle, one that isn't easy to replicate in captivity. So is it even a practical approach for these animals?

R: We have not heard yet of a facility that has successfully been able to complete the full life cycle, so breeding, grow out, and reproduction on land. So the farm that is being pursued in the Canary Islands, they have been trying to secure all their permits and have everything set up to actually initiate this farm for almost ten years now and that's the issue. These animals are so complex that we can't, as humans, yet even understand how to help them breed successfully on farms so gain, why are we continuing to push on this? Because this is definitely a product, if you want to call it a product, at the end phase that would go to feed an elite palate. This is definitely not a species that's going to alleviate world hunger, for example. So, it also creates this huge inequity because as I mentioned before, they're carnivores, they will require to be fed other animals from the sea, but those feed fish, the ones that get turned into the fish meal, fish oil, tend to come from the global south so we're depleting the resources from the global south, feeding them to this very expensive animal and then selling that to the global north. It's riddled with problems, the whole cycle.

I: It's crazy what you said earlier about how they eat three times their bodyweight, was it? So it's not even just the equivalent amount we're taking, it's massive proportion more.

R: Exactly and we refer to that as the hidden loss, or the hidden cost, of farming carnivorous animals. We also see the same thing happening with salmon, trout, shrimp, other carnivores that we're breeding in highly intense environments.

I: I know that the Aquatic Life Institute has done a lot of work into octopus farming but for people who aren't familiar with your work, could you just introduce what it is you have been researching and the action you've been taking?

R: Yes absolutely. So, Aquatic Life Institute, we are a fairly young nonprofit organisation. We're a 501C3 charity based in the US, but we operate at the global level and we work with policy makers at the global and country level. We work with large scale corporations that buy a lot of aquatic animal products, sea food products, and we also work with sea food certifiers to strengthen their standards to incorporate aquatic animal welfare as a priority criteria for anything over which they have oversight. We have largely been working on industrial scale agriculture and industrial scale fishing practices to reform what is currently being done. Around a year and a half ago, two years ago, octopus farming presented itself to us for the first time. We didn't even know that this was something that the industry was interested in pursuing and immediately we had this visceral response, like most people do when they hear about the fact that industry and perhaps even some governments are interested in farming octopuses at scale. Everything about it seemed wrong so we started looking into it, we conducted our own novel research, we also vetted some existing research that is out in the world from the non-profit field as well as from academia and it became glaringly obvious that this was a practice that needed to be stopped before it took root. The fact that octopuses are just so relatable to us, most species in the sea are not and that's why it's just kind of this aside concern for most people if it even ever crosses their consciousness. But there are a few animals in the sea, I would say maybe dolphins, sharks, clown fish, nemo because we relate to it through films, and octopuses. They really have captured our imagination and our attention because they are so extraordinary and the Netflix documentary of course, *My Octopus Teacher*, really helped people around the world connect to this incredible animal in ways that they never even thought possible before. So we have this, we have this visceral emotional reaction to the notion of farming octopuses but then when we look into the research and all of the reasons why this is morally, ethically, environmentally a huge concern it's just... this is a very clear example of a black and white scenario. It's an absolute no go.

I: Yeah, I think what you said there about how relatable they are and the way that they behave, it really does amaze you when you see it. We are always interested in the concept of sentience when it comes to animals, so would you say that sentients are something that absolutely applies to octopuses?

R: 100%. Yes, this is one of the most, as far as we know as humans at this point in time, one of the most intelligent creatures in the aquatic animal kingdom. The number of neurons that they have is mentioned in their entire bodies, not just in their heads is unmatched anywhere. They sense fear, they respond to their environment, literally through the changing of the colour of

their skin. They shape shift, they are very playful. They are incredibly inquisitive, that is the definition of sentience.

I: I think that then, when you consider all of that it's interesting to see how seemingly misunderstood they are when it comes to things like certain policies and laws about animal rights and their treatment in research. Are there any examples that you can think of where it seems as if their level of intelligence just hasn't been taken into account?

R: I would say across the board it hasn't for any jurisdiction that hasn't banned this potential practice because we really have to get so much better and do this really quickly as humanity because it's got us into a lot of hot water and continues getting us into hot water. We just don't think about the consequences of our actions. We think about all of our pursuits on a dollar basis. Is this going to make me money, is this going to make my shareholders money? Fantastic. How intensively can I do this? And where can I cut all of my costs? That is really the business mindset that has got us into the hot mess that we're in with the climate crisis and biodiversity crisis and so on. So, everybody needs to just start taking a deep breath, thinking far more logically about any new grand ideas that we have and then thinking about the ripple effects. We know with certainty that nothing exists in a vacuum. Nothing exists in a vacuum and we, as humans, are entirely part of this ecosystem. What we almost always forget is that we are 100% dependent on a healthy ecosystem, on a healthy planet. We are 100% dependent on healthy biodiversity levels. We don't even know the consequences of our actions most of the time but we know enough that we should stop and think and reconsider, is this an absolute necessity, yes or no? Clearly, in the case of octopus farming this is not a necessity, we just don't go there. We look for smart alternatives. The solutions are out there, whether it be diet change solutions, whether it be energy solutions, we have the solutions, we need to start leapfrogging ahead and getting to that place where we can see a hopeful future for ourselves and nature with whom we share this planet.

I: I think that's such a good point and yeah, that sentiment of is it a necessity? We've often got used to having anything that we want, whenever we want it and I think that's a really good message to start questioning the environmental impacts and ethical impacts. So, just to finish on, what changes in our attitudes to octopuses and the animal rights do you hope to see in the future?

R: Well we are incredibly, at Aquatic Life Institute, encouraged and emboldened by this progressive step that Washington State has taken and Governor Jay Inslee on March 13th, signed the banning of octopus farming and octopus imports in his jurisdiction. That is a huge deal. Hawai'i has since introduced a similar ban, California has since introduced a similar ban. We anticipate in the next year to two there will be a cascade of similar laws being put into place in major jurisdictions so that is fantastic because we need legislation to act. With our large-scale corporate buyers, they too are incredibly concerned and disturbed by the fact that this might become another "product" that's available. I believe that corporations will begin taking action next, again, because this is a problem that doesn't yet exist so it's much easier to get ahead of it and block it rather than wait for the industry to start up and then try to intervene. So we're very hopeful in that regard. We've already seen some plant based cellular alternatives to octopus on the market. I haven't tasted this product yet but we have seen it and

we're really excited about the fact that this now exists and is available to the general consumer audience, so that's extremely hopeful and again, we just have to come to terms with the fact that we, as humans, can't just take take take, replicate replicate. We have to be far more thoughtful and intentional about our actions because when we go into these places where we absolutely should not be venturing, the impacts will be long lasting and significant and we will feel the consequences as humanity. We have loads of resources on our website which is ali.fish if people want to go there. We have octopus farming ban campaign page where you can follow all of the updates, all of the recent news. There are lots of resources and ways to take action as an individual or as a corporation and a policy maker,

I: Thank you so much to you and to the rest of the team at the Aquatic Life Institute. It's really exciting to see what's already been happening in terms of legislative changes and I'm really looking forward to seeing what more you guys achieve in the future.

R: Thank you so much Rachael. I really enjoyed this conversation.

I: Thank you very much for your time today, it's great to have you on the podcast.

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