Transcript

Speaker 1: You're tuned in to 90.7 FM, k a l x, Berkeley. My name is Tesla Munson and this is the graduates, the interview talk show where I speak with UC Berkeley graduate students about their work here on campus and around the world. Today I'm joined by evolutionary biologists, Darko, Cota Ross in the Department of integrated biology. Actually no more. Right. Have you turned your dissertation in? Yeah. You've turned your dissertation in a, you are pretty much a doctor. You're a doctor now. Yeah. Yeah. Congratulations. [00:00:30] Yeah, no, I think we all think that. So don't worry. Darko. And its been a long what, five years? Five and a half. So you got out easy, nice and easy.

Speaker 2: Well I can stay longer then because I'm an international student then there's the non recent tuition becomes expensive.

Speaker 1: Oh okay. So yeah I guess I've heard that international students have different requirements for how long they can stay.

Speaker 2: No, it's the, there's a nonresident tuition, which after three years of your quals, uh, then you have to [00:01:00] pay that.

Speaker 1: Okay. So it's different than like a, some of the Brazilians have like a certain amount of time they're required to be here and then they go home. That's different.

Speaker 2: Yeah. Maybe that's really the, with their scholarship. If they have something from their country.

Speaker 1: But you're not Brazilian? No, I'm from Chile. Okay. Yeah. That's good to know. Ah, and you've been, you've definitely been around the world, so we'll talk about some of that stuff. But how did you get started? How, how'd you get involved in science? Back in July,

Speaker 2: I really always liked biology. My, my parents are microbiologists. They work in biotechnology, [00:01:30] uh, the university. And since I was a kid I will talk with them about what they were doing with the bacteria or in the lab. They will take me to the lab, uh, commune, the microscope and watch little things. So it has been science and biology in particular has been always very close to, to me and my family, especially playing in the garden of my house. I, I spend a lot of time out there like looking little animals, roly polies, nails, [00:02:00] flowers, plants. And I was always very amazed about how diverse it was in terms of size, color, shape. So my interest in biology, I think I, I think I always have had it and that's why I started my undergrad in biology in chiller. I studied the one year CIA Chile.

Speaker 2: During my time as an Undergrad I took many, many courses, explored very different things. But from the beginning I was very interested in neurobiology and evolutionary biology. Those two things. [00:02:30] I do many courses ready with both areas. And towards the end of my Undergrad I kind of decided to focus more in evolutionary biology. After that I did a master's in ecology and evolution at the same university working in evolutionary developmental biology, which I thought was a very cool field, we guess combines cell biology and molecular biology with swirled year and evolution. So I did my dissertation working on that and in evolution of gene [00:03:00] networks involving upended to development. So I was comparing, which are the deans or more than the deans itself, like the interaction between genes rate with the production of appendages, like legs, fins in arthropods and vertebrates in particular. The zebrafish. Okay. So first as I, I work on reconstruct those gene networks based on, on liter to review. And after that he used the networks to compare expression and predict what should [00:03:30] be expressed in one organism based on what I learned from the other.

Speaker 1: And can you just tell us, tell the audience what an arthropod is. Oh No, it's no problem. Arthur buds are bugs. Nice. Any kind of blood. So they have lots of appendages to think about them. Right? Yeah. Um, did you do any sort of, was this all lit review or did you do any sort of lab work where you manipulated? Okay, sure.

Speaker 2: So my master at the beginning was really to to review, to build the network. So based on an [00:04:00] experiment, so you should, any developmental biology is not, it's very nice to work because papers will be, oh, we studied these gene that is expressed on these tissue from this time to this time. So really quickly you can acquire the basic and more relevant information of what they're dealing with. And so at the beginning, I, I build a network base kind of getting that data. And after that I will have to, gene net was one for to fly on one for the fish, uh, [00:04:30] after Rena Lugo bioinformatic to make sure that I was capturing all the genes that were important. I will see both networks and realize, well that's not my realization. Like people know about that for a long time. That's, that's why I started working on that.

Speaker 2: That many genes may, signaling pathways are common and share, but there are others that don't seem to appear in both cases. So I say okay if, if, if in the flight gene a active gene B and in the fish there is some data that gene a is present. [00:05:00] The natural question is what happened with B. So based on my two networks, I will start planning experiments with different kinds of certainty and how much information or background information I had. Each never had like 50 genes total had like 13 good candidates that could or could not be expressed. Then I did experiments for like seven something called NC two hybridization. So it's a way to detect [00:05:30] when the gene will be expressed. I found some genes express in other tissues on a Capitol Express. Actually in the, in the fin of the fish, I use the fish as a experimental model.

Speaker 2: And those two genes that I found were really too with the same signaling pathway. So then I look for a third gene all, sorry, with that pathway, but not only the, the Messenger RNA, which is what tells you that something will be expressed but will look for the protein, which is one [inaudible] the genius [00:06:00] actually translated or forming to a functional macromolecule. And I also found that macromolecule so we're using the kind of like a really broad screening protocol. I narrow it down to one dean pathway. So I got experimental data showing that that pathway was also important in the, in the, in the murder rate and it was pressing on the, on the fly then. Then what'd you do with that information? Well, um, in this particular case I [00:06:30] was interested in seeing how much of the gene architecture west conserve in the formation of this structure between these two very different lineages.

Speaker 2: And that is interesting on itself because there's no fossil evidence that the ancestor of vertebrates and invertebrates had appendages. There is these big eyeballs, this is called the Erbil, a theoria. We just, any policies that came from the field of developmental biology mostly where people realize that many genes in extremely distant organisms [00:07:00] are the tree of life seem to have similar functions. Even if there's no data. The ancestor had the destructor for example, pack six express an eyes, teen man in hard, the hawks genes related with segmentation. These still list rate. Do we dependence. So my, my work is framing that conceptual. It isn't that concept of framework. So basically I put together more information that could [00:07:30] or could not support his hypothesis. In the case of my work it seems that it's supported,

Speaker 1: it supports hypothesis that the ancestor did have this shared gene or illicit gene machinery, the gene machinery. Cause then if you see it in these different groups, that evolved over many years. So it must have been really important as well if it would evolve so long ago and then stick around. Yeah.

Speaker 2: Right, right. So the interesting thing is that it tells us that the, that the ancestor had the capability or the tools [00:08:00] to build those instructors, but we don't know if he'd actually had them. And based on the fossil record we have, there's no evidence that those instructors were present.

Speaker 1: Is there a fossil record for invertebrates? Yeah. Yeah. It's pretty extensive. Yeah. Even little bugs. Yeah. Even little bugs. Oh, what part of the world do they find most of those fossils?

Speaker 2: That goes a little beyond my expertise, but it depends on how old. For example, I know in the Baltic Sea and in Dominican Republic, [00:08:30] there are a lot of fossils are preserving amber, like the ones in Jurassic Park. In other areas of the world, you can find fossils on rock. Um, the group of spiders that I studying right now has one fossil in the Flores in beds in Colorado. But I don't know if these like hotspot for fossils of things. Yeah.

Speaker 1: So you're studying spiders now and that's what you said, you didn't get far from that backyard looking at bugs, Huh? [00:09:00] Yeah. That's not a real question. That's okay. So can you tell us a little bit about these spiders? I know they have a cute little name, at least the one you call them, right? The Hawaiian happy face, Spider Hawaiian happy face. Although to be fair, most people are happy face when they're in Hawaii. Right, right.

Speaker 2: So just to link with the previous question, what I did for my master was evolutionary developmental biology, but during the time that I'm working, I was working on that and actually towards the end of my Undergrad I [00:09:30] became very interested in able to show biology as I said. But in particular I discovered at it the worlds that happen in islands is very interesting on itself that because of a interoperability with a professor in Tila who, and I was working with Ana with a Grad student, she was studying diversification of a group of lizards in comparing population from the continent on the islands in southern Tila. And that got me into the liters or of what happened in islands. [00:10:00] And it's very interesting. It islands are like natural experiments of evolution and ecology. Why? Why is that? Because they have a lot of particularities in comparison to the nearby continental areas.

Speaker 2: Those particularities are related to with um, weather conditions, how the community of organisms is formed. In the case of volcanic islands, it's like doing a reset on the, on the ecosystem because at the beginning there's nothing, there's just water and then they will clean up years in the middle of the ocean [00:10:30] and you have like bare laba so that the process of colonization starts from scratch, but they call mutation is not random. It's determined by Q can make all the way to the island. So that creates very unique dynamics, but at the same time, then I make that can show you more general patterns so we can learn about things that happen in the continents by looking islands as a more simplified systems in some aspects and more complex in others. So [00:11:00] I started learning about that and I feel, wow, wow, this is really cool.

Speaker 2: And if I want to do evolutionary biology, looking island systems is a privilege area where I can explore these kinds of questions. I finished my undergrad and then I wanted to move, I wanted to do a phd abroad because I kind of want to have the experience of going to another country and, and I realized that since I finished my Undergrad, the closest that I can start my phd was at least a year and a half. So in the meantime [00:11:30] I did the masters and I already had some experience working in the developmental biology lab because of um, of a, of another internship that I did. And I was very excited about the field developmental bio evolutionary tell biology. So I decided to work on that. But knowing that my interest was in a longterm, let's say in the PHD transition towards studying island systems. So that's how I ended up life to several places.

Speaker 2: Among those here [00:12:00] at Berkeley, I'm a regional needed was to work with the Hawaiian happy face spider. So a little bit long introduction to, to reach the, the, the animal. And what I wanted to do was to see the genetic mechanisms or the developmental mechanisms that create this color variation that gives the name of the spider. So this spider is a tiny little yellow animal that has a sort of like a smiley face on the abdomen. You have the minis, the back power of the animal, and [00:12:30] it's extremely variable. So there are at least 20 very variations. Some of them will happy face, some of incompletely red, some of the yellow, some others with black spots. And I also, well it'll be very interesting to see which genetic mechanism is creating all these diversity. And that's what brought me to here. But at the same time what I was here, I started learning about other things, things called phylogenetics and population genetics.

Speaker 2: The first one kind of tells [00:13:00] you what are the relationships among different species. So like creating a tree, a geologic tree and population genetics is pretty much where you will see in when you're watching a national geographic documentary and see how humans move from Africa to here. And then the population was very small. So the tools that allows scientists to save that are basically the population genetics tools in part. There are other things too, of course. But, so I learned about all those things that I knew about them. I'd never worked with them. [00:13:30] And I feel that for the Phd, I would like to focus on those tools. Doing evolutionary biology on a non model organisms is extremely non trivial and it's very difficult. On the other hand, I have all these sweetest of genomic anesthetic and methods I don't even know about. So for well, if I tried to do everything, it's gonna take me forever. So you need to pick something. And that's how I decided to shift towards working morning followed genetics and I ended up still working with Hawaiian spiders [00:14:00] with another, but we another group, not the happy face. So if I can tell you about Hawaiian spiders, I can tell you more about the [inaudible] spiders, the long Joe spiders.

Speaker 1: Yes. But first I'll say you're tuned into 90.7 FM K LX Berkeley. This is the graduates. My name is Tesla Monson. Today I'm speaking with evolutionary biologist, Darko Kotera Ross talking now about Fila genetics of the why unhappy face and other spiders. So, uh, please tell us about these other spiders. What'd you call them? Tetric Nathans

Speaker 2: considering NAFA [00:14:30] the are they long Joe spiders long Joe Long Journey.

Speaker 1: Oh, long jaw. Okay. Yeah, yeah, no, don't apologize.

Speaker 2: So my dissertation work was focused on these, these other group and the kind of question that tried to address or their address where related with it, what's the temperature they NAMIC of species. This group is very interesting because in Hawaii you can find around 37 species describe their even more. It's [00:15:00] pretty much 11% of the world's diversity and these tiny archipelago does. Brings up the question like why? What happened there? That creates so many species of the group. Another only that

there are two main subgroups within the Hawaiian to their Nathan, one of them that spins web, which is a very similar, with something very similar to what all [inaudible] around the world to do, but they send another one the best in has been with anymore. They are active hunters in the forest, which is something very unique, [00:15:30] but not only that, they are active hunters on the, their corners match their background.

Speaker 2: So you have the green spider, at least under the leaves, the big brown in Bar, the small brown on tweaks, the Maroon, the leaves on, on Moss. But those color at the same time, those colors evolve more or less independently on different islands. So there are several things that happen to this group, make them making it very unique and kind of like a privileged situation where you can ask questions about convergent evolution. [00:16:00] So when things evolve repeatedly changes in their ecology. So going from web spinners to active hunters and also long be on dispersals, how things get to islands and how the landscape affect their population structure and relate with that, the species production. And that's what I was doing. So I was looking at the young island, so the big island of Hawaii and the middle late island group of [inaudible]. So Maui, Lanai, Molokai, and Kohlrabi. But I didn't work in Colaba of [00:16:30] course. And I was studying how the landscape affects the production of new species. In particular how the volcanoes in the islands can produce population structure on a young island, let's say the big island and how that eventually will form new species that you will expect to find on a meal. A Thailand group. [inaudible].

Speaker 2: So in order to, to test that, I did a population [00:17:00] genetics. You seen Sanger sequencing, would you say more traditional method and excellent capita, which is a method they use another strategy of sequencing called next generation sequencing. They set sort of like a high throughput, a way to get a ton of data.

Speaker 1: Yes. Yeah. So when you say that the, how the landscape effects population structure, do you mean cause there's like forests on one side of the volcano or it's like more rainfall on the other side of volcano. What, what [00:17:30] do you mean by that? Right. So one way

Speaker 2: to produce these species is by just separating populations. If you have one single population, that is where all individuals can mix. They'll go, we can have like, hey, we'll just a unity. But then there is uh, a river in between or a mountain range. Those organisms would one be able to reproduce with each other. So I was looking how they will kainos [00:18:00] itself can produce various to the special or more than various, the habitat where the spider leave. The montaine rainforest really doesn't occur all the way down to the lower elevation. So basically eatable Caner can be considered on island. So we have a system with islands, we deny islands and I was trying to see if each volcano was actually a separate unit to the one nearby.

Speaker 1: And what, what did you find? Can you give us now that you're dissertations [00:18:30] and you can give us the highlights, right.

Speaker 2: The uh, the, the system is not as simple as that. It never is. Right. And what happened is that more important than the separation between volcanoes is the continuity of rainforest. Because many in, if you see the, the big island of Hawaii in the windward side, in the west side, there are several volcanoes right next to each other. If you go north, the south and between those volcanoes there is a solid, like a belt of rainforest. [00:19:00] And that becomes a unity, even if the hurricanes are different, even if they have different ages. So what seems to be more relevant in a structuring populations is the rainfall patterns. And that's something that has been shown previously for Drosophila. And when you see the plant diversity, it's also suggested by, by that

Speaker 1: well, continuity of rainforest. That's definitely something we hear about in today's conservation [00:19:30] minded science. Right, right. Um, well that sounds pretty fun. So you get to hang out on Hawaii, Huh? Yeah. Well as long as I can get grants to go there. Yeah. But you might, you must've done a lot of work there. Is that just involve like traipsing through the forest and yeah. Looking for spiders, like every kid's dream basically. Yeah. So the, the field work,

Speaker 2: this is just what you describe. Well, first is getting the money to go there, which is not trivial getting permits because a lot of the land, pretty much all [00:20:00] the land where I work is preserved either by private organizations, federal land, state land. So going through all the regular procedures to ask for permission. So me the the communication, uh, late after the work submit reports. So going, going over all the process. And when's that, when all of that is said? It's the, the fun part. If you, one way when you go to the forest and the spiders that I study, they are more active at night. So [00:20:30] I spend a little bit of the time during the day and then a seen the forest after sunset and keep collecting with a flashlight. Some forests are easier to access than others. Some of them you can park your car and walk in, say the reserve. Others you need a four wheel drive to go there in a couple cases I need a helicopter to there. Wow. So it's very, very well. And the logistics involved in going to different sites also vary enormously. Some cases you can just go by yourself. In other cases you really need to contact someone [00:21:00] from a conservation agency or the state who can bring you to that place.

Speaker 1: And is that because it's dangerous or because you'd get lost? I mean it's Hawaii so you don't really have to worry about like big animals at night. Right?

Speaker 2: Yeah, no, I see Hawaii is kind of the safer place to work in terms of, um, dcs or poisonous anyway, but there's nothing really that can hurt you. There are beginning Mazda because I already introduced like peaks but peaks are, I mean as long as you make noise, they [00:21:30] escape from humans. So you mate, you really need someone to bring you there because um, yeah, I don't know some, sometimes that there are gates or, or the trade is not very obvious.

Speaker 1: Yeah. Okay. Um, I definitely want to hear, cause I heard this at your finishing talk, but I want to hear your, uh, for, for the audience. Can you tell us about your trip to Easter Island? Cause that's gotta be like a dream for so many people, right. [00:22:00] Easter island, right. That's the one with the big heads.

Speaker 2: Yeah. Yeah. That's uh, the most isolated place in the world really. It's actually like the furthest away. Yeah. Is the, is the, the island that is more, is the most, is the point that is more far for any continent or Massland. Wow. Or a group of islands. Hawaii is also pretty isolated, but you have an archipelago in Esalen. It's a single one and a, you fly there then, right. [00:22:30] So Easter Island, uh, is very well connected. It's very isolated geographically, but not in terms of access. So that are flights pretty much every day. And during the summer, twice a day, I think it's off the coast of Chile. Right, right. Is 40,500 kilometers of the NGOs of Chile, 4,500 from Tahiti in between the helium Nissa and the repeat Corinne islands. Um, so yeah, it's pretty remote. Uh, I [00:23:00] went there, a sponsored by this center of Latin American studies here at Berkeley and I did a joint expedition with other colleagues from Tealeaf, from the Institute of [inaudible] here. The of the [inaudible]. And the reason to go there is, well, is there any, there's a very interesting place because all the cultural history had happened over there, but at the same time as the most remote place, [00:23:30] it brings up the question with what kind of animals and plants made all the way over there to the most remote place.

Speaker 1: I don't even know how humans made it there, let alone like spiders. What [inaudible]

Speaker 2: uh, interesting for me. The only ever recorded in demic spider is a spider from the group that I was studying. What is endemic mean? Oh yeah. And then make means that it only leaves there. You cannot find it anywhere else. So that became, [00:24:00] that turns [inaudible] immediately a very attractive place for me because there was this spider that could be a colonizer from the western Pacific or from South America. If there is a place in Polynesia that there was South American introduction or more the introduction, natural colonization that will be Easter island. Is it close? And then there was some data also that, for example, the palm tree, the [00:24:30] [inaudible] extinct, but the endemic power from Easter island morphologically at least looks more similar to the Chilean palms done to the other Polynesian palms. So yeah, probably could come from, from the, from the east.

Speaker 1: And how would it do that by air or like floating on a branch or what?

Speaker 2: So, um, there are many ways of dispersal. The animals I studied these long, just spiders, they do something called ballooning. Basically they fly, they do kitesurf [00:25:00] not Kate's of reading. It's, yeah. What kind of guys? They, they will start spinning web towards the air at some point from a high, from high elevation place. And then they get caught in a wind, wind currents and then they literally just fly. There are these experiments in the 60s where people will put gin, entomology, GL nets, those kind of like

a butterfly cutting nets. And they put [inaudible] on a boat coming from Asia [00:25:30] to North America and they will check the net to see if there was something there and they were able to find stuff. The spiders are, they studied the group to think NETHA is one of the most commonly find groups on these IRL plankton.

Speaker 1: And how long would it take to fly? I mean, they can just survive flying around. I don't know. That's crazy. I mean, if you think

Speaker 2: it's probably an extremely unlikely event, uh, the odds of dying in the way are huge, but you just [00:26:00] need one pregnant female to arrive because of you. If you hope to f that to a male and a female would make it to the island and they will see each other. And that's very unlikely. So probably the colonization happened through an eve. Yeah, probably that's, that's unknown. But, so that's, that's basically the biological reason to go there. Uh, once we went there with my colleagues with Steve for three weeks working on the island and it was [00:26:30] too risky to go and just tried to go like one single spider died, all other are acknowledges who visited the island, didn't, haven't found. So we did a broad survey of the art for pods and read to wrestling murder rate. So we collect land snails, insects on the spiders.

Speaker 2: And Luckily for me, I was able to find one spider to be belonged to the genius that I was interested. So at the beginning I said, well, great, should be something to work with. But the previous are [00:27:00] acknowledges from Belgium. Describe the very commonly distributed of Sitcom tropical species was living on the islands. So my first thought was I, well I found the same species that he found. But after coming back to the lab and looking more carefully the morphology, it was pretty clear for me from my advisor who is an expert on the group, Professor Rosemary Gillespie. It's pretty clear for us that despite of that, I found this time Watson do it. The one that the previous are acknowledged [00:27:30] is mentioned. So that's as a question would, what is this and trying to look for in the liter turf for other Pacific species or other species from the continent, the answer wasn't really clear. So now I'm working with DNA sequencing to try to figure out too what is closely related in order to try to get the answer through that route. Interesting. Um,

Speaker 1: well, we're actually coming up on the end here. So I want to ask though, [00:28:00] before we end, do you have any, any advice you'd give to students or any, uh, you know, anything you really want to say to the public?

Speaker 2: Oh, that's sounds pretty broad. Um,

Speaker 1: well now's your chance to wave some hands, wax poetic, you know, things scientists don't do normally.

Speaker 2: Right. Okay. Yeah, I have an idea during my phd. Yeah, I was fortunate enough to visit many remote places and see very unique forms of life. But the same time [00:28:30] I

was able to see how that very unique forms of life are threatened by direct human actions or by more global effects as climate change. Uh, one time I was with a group from the University of Hawaii hiking down a slope of Mona Kia. At some point we started at a beautiful rainforest, then a hundred meters down in elevation. It was a beautiful rain forest with a little bit of invasive species. There's a strawberry lava in this case, a little bit down, [00:29:00] only strawberry [inaudible] and that all the way down, all the native forests disappear, including the insects and spiders and birds, et cetera. I asked the other researchers what happened at these intermediate elevation where there were just a few strawberry wireless and they all happen to be young and the answer was that's the front of the innovation is just a matter of time.

Speaker 2: That four is that you saw the middle elevation is going to be gone in a few years from now and there's nothing we can do. [00:29:30] That was very shocking for me because I was there. I was able to see many endemic animals, but in some way they were condemned. There's nothing you can do. In the past, humans did. We have done some actions that will have consequences, probably not immediately, but in a few years, even if we change our way of life today, some areas will be irremediably affected. So keeping that in mind, you realize how [00:30:00] critical these, the situation that we're experiencing right now is no, that might've St. Okay. Starting tomorrow, we're all going to change. Aware of life and the play will be fine. Even if we do that, which probably is not going to happen, it's too late for many areas. So that makes me realize how extreme is this situation where we are.

Speaker 2: That probably is worse than what we think. So if I have to kind of deliver a message, I don't want to be other means, but I want to say that [00:30:30] we have to take more serious than what we're doing right now. The environmental crisis that we're, that we are entering, not only because Holly's gonna Affect us as humans, but I think there are some ethical reasons to share the plan with other animals, other plants. It's, it's very, uh, selfish to think that you can do whatever you want and just because your organs cannot protest you, you have the right [00:31:00] to destroy. They leave.

Speaker 1: Yeah, no, that, I think you said it really well and we hear it a lot here on the graduates. It's definitely an issue of concern is this environmental crisis that we're in. So I'm glad that you got to see you are, we are privileged in so many ways. Being able to go see these really unique places in these unique animals. And um, yeah. And so we're the lucky ones in some ways.

Speaker 2: Yeah. And, and I would like to emphasize that in [00:31:30] many cases, Eh, I've been talking about the way of life because in many cases when you see people talking, oh, renewal energies or things like that, that's great. But I have the sense that in Maine, many times the messages, oh, as long as you buy these, uh, energy efficient light, you can keep doing things business as usual, which it doesn't change the root of the problem. The root of the problem is the over consumption. And [00:32:00] that's what he has to change is not about buying like electric cars and keep driving everywhere. It's

not about like doing compost, but keep flying all around the world for, for fun. Those are the things that have to change. Yeah. And when you see the consequence, it's terrifying. It does. Those things will happen. Stefan, what will happen? Yeah.

Speaker 1: Well, I hate to leave it like that, but I think we're going to, it's a true message for you out there. So, uh, [00:32:30] take heed audience. Uh, this has been another amazing episode of the graduates here on KLX. My name is Tesla Munson. Today I've been joined by evolutionary Darko coat at us who has finished his phd here at Berkeley onto bigger and better things and still hopefully outside enjoying the environment, enjoying all the different islands. I wish I could be there with you, to be honest, but, um, thank you again for coming on the show today. Yeah, my pleasure. And we'll [00:33:00] be back in another two weeks with more of the graduates. Until then, stay tuned. You're listening to 90.7 FM k a l ex Berkeley.