

Dr. Dara Orbach
Interviewed by Maxwell McClure
September 15, 2020
WebEx Meeting
Transcribed by Maxwell McClure

[MM]: Okay, so we are recording. It is, uh, September 15, 2020. My name is Maxwell McClure. I'm here with Doctor Dara Orbach, um, and we are going to be talking about her work with cetaceans and reproductive ecology. Um, before we start the interview, Doctor Orbach, do I have your permission to record the interview?

[DO]: You most definitely do.

[MM]: Awesome, awesome, alright, so I guess the first thing we can talk about is sort of your early life and, like, what got you into marine biology.

[DO]: So, it's interesting because the majority of marine mammal researchers since a young age have known they want to work with dolphins, or whales, or seals, and my story is very different. I'm Canadian, so I'll drop some abuts every once and a while (McClure laughs). And I grew up in Toronto, which is a very big city by lots of lakes, but not near the ocean. And I went to my undergrad. I was at university of British Columbia, which is in Vancouver in Canada, so very close to Seattle, Washington. And that's a six hour plane ride away, right on the ocean, the campus is a beautiful peninsula right on the ocean, and I fell in love with a way of life. I really enjoyed the idea of a place where people would bike to work in their business suits, and where people would have picnics during their lunch just because it's a beautiful day outside, and this whole mentality which seems to be prevalent in coastal cities. And so for me, my decision to become a marine biologist was not so much driven by the animals themselves as a lifestyle and finding a place while I'm in my Zen, and my happiest, and being the most productive because I have the greatest, um, work-life balance and enjoy myself the most. So, that was really, um, what got me there. The reason I eventually became a marine mammal biologist, it was not the most direct route. Again, I didn't know what I wanted to do, and I was doing two bachelor degrees simultaneously: one in classic near eastern and religious studies, a Bachelor of Arts, which is very different, and one in a Bachelor of Science in Animal Biology. And in my third year at the university, or my fourth year because it took me four and a half years to do two bachelors, I did a field course and I really enjoyed field work. And I found—that was my first experience [2:27] doing field work. It was in the Yukon, and I just really enjoyed designing my own experiments. And so, in my final year, I did a directed study, like, an honors project where I did some diving duck physiology. And again, that was a wakeup call for me that I really enjoy doing research. Um, at that stage, I didn't think I had the qualifications to do a master's degree with marine mammals, and so many marine mammalogists started a much younger age in high school ready, and they're often volunteering or interning every single summer, and I just didn't have that background experience, so I took a very unusual route and I decided to do a master's degree looking at bat echolocation thinking that acoustics is a transferable skillset. And we know so much more about acoustics and echolocation in bats compared to what we know about in cetaceans, which are dolphins, whales, and porpoises. So, the idea was to do this, um—to learn a skillset that I'd then be able to apply towards the marine mammal world. And it turns out that I

don't enjoy acoustic analysis very much (McClure laughs), but it got me, it got my foot in the door, and I can talk more about that perhaps later question, but that was sort of how I transitioned into marine biology.

[MM]: Okay.

[DO]: It was knowing that I wanted to always live by the coast. I enjoyed teaching. I enjoyed traveling. I wanted to amalgamate these things together, and to me, studying animal behavior and animal biology of a marine mammal would guarantee me that coastal lifestyle.

[MM]: Okay, great, great. Um, so what was your grad school experience like then? You said that you did that, um, acoustic research in grad school, right? (both speaking)—

[DO]: —PhD.

[MM]: Um-hm.

[DO]: My masters was in the University of Western Ontario in London, Ontario.

[MM]: Um-hm.

[DO]: And that project itself was looking at flight mechanics, acoustics, and, um, sensory modality integration. I basically tried to understand why bats crash into stationary objects by looking at their echolocation, and I built a bunch of obstacles in their natural environment where they fly through during their mating season, called swarming season, and, um, there were different opacities, and different lighting conditions, and basically tried to figure out at what point they collided with these objects, how they use echolocation and vision, and at what distance. And that was okay. I liked having the liberty of designing my own experiments.

[MM]: Um-hm.

[DO]: It was really roughing it. We were middle of nowhere, Ontario camping, um, there was an abandoned mine nearby with some water. We would just put our food in plastic bags and bury it in the mine instead of having a fridge.

[MM]: Oh wow.

[DO]: We used the generator at nighttime to recharge our equipment, [5:19] but we had to wait for it to rain to have a shower. It was really, really roughing-it conditions.

[MM]: Yeah.

[DO]: Um, so that was an experience to say the least. It built some character, but I also had an opportunity. Um, so, I was studying bat flight mechanics, and essentially they have their offspring inside the month of June give or take, and what's unusual about bats is that they fly

with their babies on their backs and their babies can be up to twenty-five percent of their body mass, which is incredible—

[MM]: —Wow—

[DO]: —when you think about it.

[MM]: Yeah.

[DO]: But you would intuitively expect that they would collide into objects if you're flying with an extra quarter of your bodyweight on you. Um, so it didn't make sense to collect data during that month. And my master's advisor recommended to me during that month that I go to Israel and help teach a field course which he had taught for several years in the summer. And at that particular location, the field course was on bats, and at that particular location, they had done the first alcohol studies where they gave the bats choices of fruits, these are fruit [unintelligible] [6:21] bats, and they had a choice of which food to pick based on the amount of alcohol content in it. So, I kind of put two and two together that I studied flight mechanics and decision making. I could combine that with alcohol, and so when I went to Israel, I designed a study where I got the bats drunk and fed, yeah, (McClure laughs) force fed them alcohol, and then flew them through a flight chamber and saw how they collided with objects.

[MM]: Wow.

[DO]: Um, and if they slurred their speech so to speak. So, I was looking at their acoustics and the actual flight mechanics.

[MM]: Wow.

[DO]: Which went really, really well, and actually won us a grant to send the whole lab to Belize to do a similar experiment looking at many species of fruit bats.

[MM]: Wow.

[DO]: And that is, you can imagine, is one of the first, um, alcohol studies on animals in natural conditions in the wild, got a lot of media and a lot of publicity, which put me at a huge advantage in terms of applying for a PhD working with mammals because I had experience in acoustics. I had published. I supervised other students. I had led field projects. So, it really set me up for success. Um, so my master's thesis itself, I lost interest in it relatively quickly, (McClure laughs) which sounds terrible, but the alcohol study, which was just a side project, became just as much of my time, and fascinating to me, and really, um, helping that balance of working on multiple projects at once and these leadership opportunities was an amazing experience that helped me develop skillsets that I'd use throughout my academic trajectory.

[MM]: Okay, wow, great, so basically, your work with bats sort of transitioned you into marine mammalogy, then, and that was your PhD whenever you transitioned to marine mammalogy?
Or—

[DO]: —So my PhD was with marine mammals—

[MM]: —Okay—

[DO]: —and, uh, shortly after I finished my master's with bats, I knew I wanted to switch to marine mammals, but the end goal had always been marine mammals so that I could live by the coast. If I were to work with fisheries, I might land up by lakes, and I really wanted to be by the ocean because that is my happy place and where I thrive and am able to be the most productive because I just feel more at peace with myself. Um, so, I attended a conference shortly after finishing my master's. Every two years, there is a Society for Marine Mammalogy Conference—

[MM]: —Um-hm—

[DO]: —and that one happened to have been in Canada, like a ten hour drive away, and I said, “I’m just going to go,” and I contacted in advance several prospective PhD advisors who studied acoustics, and I arranged to meet with them there. And while at the meetings, I went to their talks and found them very dry and I was thinking, “There’s no way that I could spend six years studying acoustics (McClure laughs). I mean, there’s a way, but I wouldn’t be happy.”

[MM]: Yeah.

[DO]: Um, so I was feeling a little discouraged because I really—and I will say that most cetacean researchers actually do acoustic analysis. It’s one of the most common things to do and it’s very important.

[MM]: Um-hm.

[DO]: But for me, it wasn’t as interesting as actually interacting with the animals themselves. Looking at sounds in the computer didn’t appeal to me anymore. So, I wasn’t as excited about the prospect of an acoustic study as I should have been, but I happened to have walked into some other talks and I heard one about dolphins and mating and how almost nothing had been known about dolphin mating in the wild with all of the logistical challenges. And at the end of the talk, this student mentioned that dolphins have these really weird structures in their vaginas, and maybe they have something to do with sexual selection in some way, or a way to control paternity.

[MM]: Um-hm.

[DO]: And being the lateral thinker I am, I thought about a seminar I’d heard in my master’s about spiders and sperm dumping and the idea that the male can tap on a female and force her to ejaculate sperm from the rival male.

[MM]: Hm.

[DO]: And this made me think, “Maybe these vaginal structures are also a way for females or males to control paternity after copulation.” [10:30] So post-copulatory sexual selection, which we don’t know that much about, um, from the female perspective.

[MM]: Yeah.

[DO]: So, I picked that idea to that student PhD advisor, and he loved it and said, “This is a really outside-the-box idea.” And I will mention that I love going to conferences. I love networking, and I love learning new information, but it can get kind of tedious because often it’s the same question over and over and over (McClure laughs), and they change the location, or they change the species, but there’s not as much innovation as one would hope. And so, he was very excited that this was something brand new, way-out-there questions that hadn’t been addressed before. So, I also was very fortunate that my PhD advisor, Bernd Würsig, is extraordinarily famous in marine mammalogy. He’s the one who is attributed with discovering photo ID of dolphins, which is the main way to know dolphin abundance and distribution, taking photos of them, which your wife does all the time.

[MM]: Yeah, right.

[DO]: So, he’s the one that discovered this is possible.

[MM]: Really? Wow, I didn’t know that.

[DO]: And usually when he goes to conferences, there’s a line of students waiting outside the bathroom just to talk with him and to shake his hand and meet him. And as it turned out, he got sick just before the conference and didn’t attend. And so, I was the only student that I know of who sent him an email pitching an idea. Um, so it was really a matter—I know it’s wrong to be grateful that he got the flu, (McClure laughs) but I’m so grateful he got the flu because it really was a matter of right place at the right time that I happened to have walked into that room, that I happened to have gone to that seminar on spiders and these ideas together, um, that I decided to attend the conference, that I had the skillset in acoustics, that I had published already, that I had dealt with media, that I had supervised students. It really was a combination of all of these past prior experiences, and timing, and mostly hard work that poised me to get into my dream PhD, which is where I finally got to do research on marine mammals.

[MM]: Yeah.

[DO]: So, the PhD was in Galveston, Texas, so not too far from us over here, just a three and a half, four hour drive away.

[MM]: Um-hm.

[DO]: And I spent much of my time in New Zealand where I was filming the dusky dolphins there and trying to understand more about their mating patterns. [12:49] And I got very involved in dissecting reproductive tracts from marine mammals from all over North America. I get them sent to me in Galveston and would dissect them and look at their weird vaginal structures and try

to quantify them and look at their variation across species, in species, across age classes, by population, so really trying to understand this coevolution of anatomy and behavior, and how we can use anatomy to predict what mating would look like in the wild, and also understanding coevolution of mating strategies between males and females.

[MM]: Yeah.

[DO]: And that interface of coevolution between the sexes, and also between pre and post copulatory is very rare to see applied to an animal to look at such a broad view of coevolution. So, that was really exciting for me, and it turns out that cetaceans, which again are dolphins, whales, and porpoises, have the most diversity in their reproductive tracts compared to any other clade of mammal that exists. So, they have this insane level where the number, shape, size positioning of these vaginal folds differ across species. And I'm at a very unusual point in my career where I would get sent a reproductive tract, I can tell you what species it is just by looking at it.

[MM]: Wow.

[DO]: They are *that* distinctive. And I have gotten samples sent when [14:08] someone told me, "It was species x," and I opened it up and said, "It's not right. Are you sure you got your data correct?" And they said, "Oh, you're right. We actually sent you the wrong data. It's species y."

[MM]: Yeah.

[DO]: So, the reproductive tracts are *that* distinctive and I'm, I don't know if it's something to be proud of, but I know them well enough that I can tell what a species is just by vaginal morphology.

[MM]: Wow.

[DO]: Which as weird as that sounds, in insects, a lot of the way that a species is identified by looking at their penis morphology.

[MM]: Okay.

[DO]: So, using genital morphology to identify a species is not unheard of before. Um, it just is a little unusual to do in a mammal.

[MM]: Right. And when you were in, um, it was in San Francisco, right, that you studied harbor porpoises, right? I did a little bit of research into some of your articles and I found one of them that talked about, um, there was like a correlation between, like, there's like a leftward bias with the penis and the vaginal shape, right? And that's correlated to the way in which they mate? Could you talk a little bit about that?

[15:12]

[DO]: Yes, so, San Francisco is one of my other main—so, New Zealand, San Francisco, Texas, Canada, I'm all over the place—

[MM]: —Yeah (laughs)—

[DO]: —I get to travel a lot, which again, was one of the goals of an academic career. Um, so I'm fortunate that in addition to Kaikoura, New Zealand, one of the only other places where we can see cetaceans mating under natural conditions regularly at the surface of the water is in San Francisco.

[MM]: Yeah.

[DO]: So, San Francisco Bay is [unintelligible] [15:40] and the narrowest point is actually right underneath the Golden Gate Bridge. And the porpoises there, uh, realize that so every single day, their food moves in and out of the bay with the tide. So, at high tide and low tide every single day, they collapse underneath the bridge at this exact period to be [unintelligible] [15:59] in an hour of tide, and because it's the narrowest point, males know that if they hang out underneath the bridge, they're likely to encounter a female who's passing by chasing after her food.

[MM]: Um-hm.

[DO]: So, if you stand on the Golden Gate Bridge at high tide and look down, uh, it's pretty often that you will see a splash, and that was actually a porpoise mating. The whole event is less than two seconds. It is aerial where the male leaps out of the water, the female has no idea he's in the area, she's swimming along, and then will come chasing her far away, dive deep, and they come up leaping out of the water at such force that he knocks her out of the water most of the time.

[MM]: Wow.

[DO]: And his penis extends all the way to his tail, so it's three quarters of his body length, and while in the air in less than two seconds, he has to wrap his penis around the female into her reproductive tract. So, his belly is towards her back, and his penis is so long it wraps around her body inside her, inseminates, end, then he lands in the water and she dives. And it's all in, like, blink of an eye.

[MM:] Wow.

[DO]: It's pretty amazing.

[MM]: Yeah.

[DO]: And it turns out in watching, spending, and it's mostly my colleague, Bill Keener, [17:09] who did most of the work, but in spending hours on the Golden Gate Bridge over the course of several years, we collectively documented about two hundred events of harbor porpoise mating,

and in both on video and on camera, and in every single one of these events, the male is on the left side of the female.

[MM]: Yeah.

[DO]: So, every single time when they actually made contact, he is on her left side. And so, there's this laterality in sexual approach, which has never been documented before in any mammal, and it's very, very unusual. So, me being a reproductive morphologist, um, I started to think about, "Well maybe the reason for this laterality has something to do with the reproductive tracts and coevolution." And so, we dissected several female reproductive tracts and we basically measured all the bends to the left, to the right created by these vaginal folds and created vaginal [unintelligible] [18:05] essentially. And we also inflated the penises of dead animals to look at the natural kinks in their shape and compare those to animals, photos we had taken of live animals with their penises extended.

[MM]: Yeah.

[DO]: And it turns out that there is an optimal approach that the male has to take for his penis to bypass all those vaginal folds and get close to the cervix. So, the idea being the deeper the penis can penetrate, the shorter the distance that sperm is going to have to travel to fertilize the eggs and the more likely he is to gain paternity. So, that's exactly what we found that for the best, deepest possible penetration, the male has to approach the female from her leftward side, and he has to approach her from his belly towards her back. And [18:52] in any other position, the penis will not penetrate very deep. So, it turns out that genital shape has to coevolve with this behavior and it's not the chicken and the egg discussion: "What came first, the behavior or the genitalia? Was it the female [unintelligible] [19:08], was it the penis came first?" And these are very difficult questions to answer, but there does seem to be this amazing coevolution between anatomy, and behavior, and both sexes as well.

[MM]: That's fascinating.

[DO]: So, that's, um, something I'm always excited about, and my colleagues and I were at the, uh, they were formerly at the Golden Gate Cetacean Research Center, and now they're at the Marine Mammal Center working on collecting, um, photos and videos of harbor porpoises mating from around the world. And there's not that many documentations. I think we maybe have fifteen so far from other, fifteen other locations, and it seems it's always left sided in those locations as well.

[MM]: Wow.

[DO]: Um, which is really interesting, so this is not just a population-specific pattern. This is a taxa-related pattern it seems to be ubiquitous across them.

[MM]: Yeah, was it difficult to observe them in some certain months? Because I've been to the Golden Gate before and it was in, like, June or July, and it was like very foggy there that point in time. There was like no visibility. How did that kind of work with your study?

[DO]: There definitely are, um, very difficult months. Also, high tide might be at four in the morning and at four PM where it already is after dark in the winter, so it's not always possible to get out there. So, a combination of the right weather, tide being at the right time, the sun's too high in the sky, you can also miss them. So, we did capture mating in every single month of the year, but there were certain months, particularly the foggy months, where it was, um, much more challenging to obtain that data. But they do seem to mate year-round.

[MM]: Yeah, okay, um, could you talk more about your work in New Zealand as well? And that was with dusky dolphins, correct? And you guys used you used, um, what was it? It was UAVs, right? It was a sort of a new sort of approach to studying them that kind of helped out?

[DO]: Yeah, so we went in 2017 in December back to New Zealand to Kaikoura, and we used UAVs, which are unmanned aerial vehicles and drones to film dolphins in different contexts. So, we were filming them in nurse groups. We were filming them in mating groups, and we were filming them in large pods. And my research, um, the part I'm interested in was largely in the mating groups. And so, there's different—in general, dusky dolphins in Kaikoura, there's about two thousand present any given time out of a national population of ten thousand dolphins. So, they're constantly leaving the area and coming into the area. And they tend to form these very, very large pods with about one hundred to over one thousand dolphins present, [21:50] and then there are smaller satellite groups nearby as well. Um, so, there's these different group types, and we sometimes see mating inside these larger groups, but for the most part, they form these smaller satellite groups (watch beeps). Everything's beeping at me at once, so I'm very sorry.

[MM]: Oh, that's okay.

[DO]: Let me turn off everything beeping [unintelligible]. [22:11] Phone is on silent. Everything is going to stop beeping. Okay, um, so what's unusual about Kaikoura and the reason it's possible to film their mating there is that there's a very deep canyon that comes within a kilometer ashore, and it's a highly productive area because there's a convergence of several different waterways. So, you have warm and cold waters converging, lots of primary production, secondary production, and the dolphins are very opportunistic foragers that they feed on the [unintelligible] [22:42] layer of squid and lantern fish which have a daily migration pattern. So, every day, those fish—migration is not necessarily horizontal in the ocean. It can also be vertical. So, it's called a diel, um, movement pattern, but they migrate every single day, these are the fish and squid, inside the waterfall, and they up towards the surface of the water late at night. And the dolphins are opportunistic that they wait until the dolphins, until the fish and the squid, are as close to the surface as possible, and that's when they dive down to forage. So, they don't have to hold their breath. They don't have to work as hard. They don't have to dive as deep. Um, so, they're very opportunistic. They're feeding only at nighttime, which means the daytime, I don't believe they've ever been observed foraging during the day, which is also very unusual for a dolphin. And we know that just two hundred kilometers north of the other field site, the same dolphins that we see in Kaikoura [23:38] feed in the day, um, in our other field sites. So, it's specific to this area that they are opportunistically using the environmental conditions and the ecology to facilitate their feeding. So, they can feed in the day, but they don't in Kaikoura. And that leaves a lot more time for other activities like wrestling, and traveling, and socializing, and

especially mating. And during the austral summer, which is October through February, there is a lot of mating that occurs. It occurs at the surface of the water. It is very high speed. There's typically four males chasing one female. Um, they engage in scramble competition where they're essentially trying to get a position close to that female and line up their body with her, but not very aggressive towards each other. Um, they're not very aggressive towards the female, but they're very agile, rapid, fast paced chases, and the female behaviors are extraordinarily evasive. She's doing everything she can to get away including diving deep, leaping through the air, abruptly stopping and changing directions, constant direction changing, slapping her tail. So, all of her behaviors are evasive, and all the male behaviors, um, are very aggressive in terms of their persistence. So, you have these chases which can persist for maybe ten minutes at a time, and then they break apart in a group, form back together, and new dolphins move together, but they're typically in these smaller groups. And so, we flew the drone over these mating groups, and we are trying to understand their behavioral patterns and to compare those to mating that occurs inside these mega pods or these very large pods. And my thought was that if you're in a group of dolphins with, like, five hundred individuals present and you're mating, there's lots of dolphins in the area, you can't move around very much because there's so many dolphins around, there probably is more of a social function than a sexual function. Whereas in the mating groups, I thought it would be more of a conceptive function. So, something unusual about dolphins is that they're one of the only groups of animals that mate year-round, even though they cannot possibly conceive. So, we know the bonobos, humans, a few other species also do that. And for the most part, animals only mate when the female is in estrus and there is possibility of conception. Whereas in the dolphins, they mate all year round. We see a lot of homosexual mating as well. So, mating cannot—it can serve other purposes. It might be, um, for fun. It might be to build, um, dominance relationships, a way to work out dominance hierarchies. It could be for social bonding. It could be practice and learning. [26:28] There's a lot a reasons why an animal might mate besides for, um, conception. So, we film the drones over the two different groups and we actually found very few differences depending on the context and we found that our numbers were also very similar to what we've come up with in the past doing boat-based surveys where we didn't have the drones. So, what the drones offered, which was amazing, is the ability to see behaviors a lot better and pick up more subtle behaviors, and also the ability to track individuals. So, we can see an individual over repeated different behaviors that they're performing, and in theory understand how things like a male's body size or how particular a behavior might lead to, um, him being more successful in gaining copulatory position.

[MM]: Yeah. Okay, and your, um, your study itself, was it funded by National Geographic? I thought I saw something like that on one of the articles.

[DO]: Yes, so, oh my gosh, my emails are exploding. I'm sorry—

[MM]: —Oh, it's okay (laughs).

[DO]: I don't know if you can see my screen, but I think it's on the recording, so I'm sorry for that. I don't know how to disable—

[MM]: —Oh, it's okay (laughs).

[DO]: Um, the—yes, so we were fortunate that my PhD advisor, Bernd Würsig, won a scholarship from National Geographic to fund the research on mating behavior, um, that I did throughout my PhD, and I also had won a NSERC, which is the Canadian equivalent of an NSF grant.

[MM]: Oh, wow, wow.

[DO]: So, I had won that at the PhD that of which also helped fund that research, and Texas A&M University at Galveston provided a lot of small funding as well. So, a lot of our funding came from, um, the university, federal funding, National Geographic, and it was wonderful to have that sort of opportunity to do that exploratory work on dolphins. And, um, we are grateful to all of our funders.

[MM]: Yeah, definitely, um, did they do like any, like, recording, like, for any of their shows or anything of that sort? Or was it just like a funded study?

[28:33]

[DO]: That one was a funded study, but there was a documentary called *Sex in the Wild*—

[MM]: —Um-hm—

[DO]: —that, um, [unintelligible] Farms, which is like a BBC station in the UK, did a documentary about mating in four different groups of animals. One was elephants, I think one was primates, and one was cetaceans, and for that video, they came to New Zealand. They spent two weeks there, um, filming the dusky dolphins on the boat with us. We'd be talking about what we were doing, and then they also flew to San Francisco and did some work on the harbor porpoises there as well, um, documenting again some of these mating [29:11] behaviors, but I believe in that project they also, uh, were fortunate to witness a dolphin giving birth in the water.

[MM]: Oh wow.

[DO]: They did [unintelligible] [29:20] behavior [unintelligible] [29:20] in Mexico. So, um, that was a, uh—and I also am a finalist right now for a grant with, um, the Explorers Club, which is pitching the ideas to Discovery Channel, and the goal of this current grant is that they want to make a documentary out of the [unintelligible] [29:40]. So, if I do, think I'm in the top five choices right now, so if I do win the grant, um, this research that we're proposing to go back to New Zealand and do some energetic and physiology research, that would become a documentary of some sort sponsored through Discovery Channel.

[MM]: Wow. That would be awesome. Um, would you say that New Zealand is one of your favorite places that you've gone to, or do you have any other favorites?

[DO]: I love to travel. It's my favorite thing to do.

[MM]: Yeah.

[DO]: And besides, I'm taking pictures of sunsets on the ocean, um, (McClure laughs) and I am unusually lucky that I have been to forty-six countries. So, traveling is really my passion. So, I do have a lot of favorite places in the world, but Kaikoura is definitely one of my top ones. Um, it is a piece of paradise of this rugged beauty. Um, it just is a stunning landscape where I say, "You can't take a bad photo there." It's like Iceland (McClure). You just can't take a bad photo because it's so beautiful everywhere you go.

[MM]: Yeah.

[DO]: And it's really special because the dolphins there are so acrobatic that's it's a great opportunity to get photos of leaping dolphins, um, which is always really, um, wonderful. They're very charismatic. And I think on my best day on the water, we saw nine or ten species of marine mammals, which is also almost unheard of anywhere the world. It was a really, really good day.

[MM]: Wow.

[DO]: But Kaikoura is such a—Kaikoura means "tasty seafood." It's known for (McClure laughs) its, um, its productivity, and it's also very well known for its sperm whales, that there are sperm whales there year-round. Um, young bachelor sperm whales move there on their way towards, migrating towards the poles and separating. So, it's known for its sperm whales. It's known for its New Zealand fur seals. It's known for a waterfall that unfortunately got wiped out during the last earthquake. This waterfall, um, there are a bunch of baby fur seals that would leave their mothers at the [unintelligible] [31:41] and go through, like, tunnels (McClure laughs) and get to this waterfall and it was just an area where little baby fur seals would be jumping through the waterfalls. It was like the most amazing (McClure laughs) place in the world [31:50].

[MM]: Wow.

[DO]: Um, that was definitely one of my favorite places to practice photography.

[MM]: Yeah.

[DO]: So New Zealand to me is a very special place. I call it one of my homes, um, one of my favorite homes, and I miss it dearly. And the dusky dolphins there are just so charismatic. Um, there's Hector's dolphins there, which are an endemic species to New Zealand, which are often endangered.

[MM]: Um-hm.

[DO]: They're very, very small. They're one of the smallest species and they have these like Mickey Mouse ear-shaped fins (McClure laughs). So, there's just, um, orca, we saw orcas there. We saw humpback whales there. Um, just an amazing, amazing place for viewing marine mammals and for connecting with nature. Um, and the people there recognize how special their environment is. Um, they're very respectful of their animals. The Māori culture there also is very

involved in animal [unintelligible] [32:42], and so it's a really wonderful community that works together in terms of all the dolphin watching, the whale watching, the researchers. People work together and are really interested in conserving these animals and promoting eco-tourism in a safe and sustainable way.

[MM]: Okay.

[DO]: So, it's somewhere I'd highly recommend, uh, people go should they have the opportunity.

[MM]: Definitely. Um, I was actually going to ask about their environmental regulations over there. Um, how are they compared to, like, say for example, if you were to study something in the U.S., in a region here, uh, how would that compare to studying in New Zealand?

[DO]: Um, so in both cases you need permits from the government.

[MM]: Um-hm.

[DO]: Um, in both cases for a drone permit, you need to have an operator who has extensive experience, who has specifically a pilot's license and has extensive experience flying over marine mammals. So, they do take their regulations very seriously, and the distance that you get towards those animals is also regulated. Um, so for the most part, these are protected mammals. It is illegal to harass them in both counties. People care about them. Something interesting about Kaikoura specifically is that there was a land-based study where they were observing how interactions with the animals, both the sperm whales in one study and the dusky dolphins in another study, how interactions, boat traffic with them, affected their behaviors, and when it turned out there were some effects, the locals voluntarily changed their boating, um, schedules to accommodate these animals [unintelligible] [34:17].

[MM]: Wow.

[DO]: So, in New Zealand, uh, or in Kaikoura, it's a mandatory but it's voluntary rest period where between eleven and one p.m.—I'm pretty sure those are the hours. It was two hour period in the middle of the day where they find that dusky dolphins are resting the most, and so the boats do not approach dolphins during that period. They leave them alone to rest, um, and it's sort of known that it's a social faux pas of the area to harass a dolphin when they're resting.

[MM]: Yeah.

[DO]: So for us, it was always really special because we would launch our boat, um, in Kaikoura, and then the places we could go might be twenty-five, thirty, forty, kilometers [34:57] away from where we launched the boat. And for a long day in the water, it was too far to travel all the way back to come back again in the afternoon, so we would just cut our motor at 11 p.m. and have a two hour lunch break siesta. And oftentimes, we'd spend the whole morning looking for dolphins and couldn't find the ones we were looking for. And it seemed that as soon as it was

rest period and we would cut our motor, that's when they would (McClure laughs) come right by the boat when we couldn't take photos or harass them, so—

[MM]: —Yeah.

[DO]: Um, they didn't read our protocol very well (McClure laughs).

[MM]: Well cool, um, so could you talk about kind of, like, the work you're doing now here at, uh, Texas A&M – Corpus Christi?

[DO]: Yeah, so, my work is, my lab is called “FABAEMM!” with an exclamation (McClure laughs) point: Functional Anatomy and Behavioral Ecology of Marine Mammals. So, the Functional Anatomy part, uh, is a continuation of my PhD and post-doc research trying to understand more about form and function of genitalia, how its coevolved. Um, some of our research for example, I have a PhD student started who just started, who's going to be looking at sperm properties that are collected using a biomimetic synthetic vagina to understand if you get a better quality of ejaculate when you use an artificial reproductive tract that simulates the natural elasticity and shape of a natural vagina. So, we have some aquaria that we'll be using that for voluntary semen collection. Um, we'll be artificially inseminating some dead animals as well, so a lot of work understanding semen characteristics. We were meant to go to Iceland but with the honors program, but it got canceled—

[MM]: —Yeah—

[DO]: —uh, due to COVID. We were going to go to Iceland. They have the phallogical museum there, the penis museum, where they have the world's largest collection of penises from mammals [36:43]. Uh, I happen to have the world's largest collection of marine mammal penises in my lab on campus.

[MM]: Wow.

[DO]: And they have the world's overall. It's a weird thing to brag.

[MM]: Yeah, yeah (laughs).

[DO]: They have the overall—they have every mammalian species that occurs in Iceland, they have (watch beeps) a sample of its genitalia—please stop beeping at me. Okay, this one I can't turn off unfortunately (McClure laughs). Um, so they, um, kindly allowed us to come there to take photos. And for the photos, have a 3D scanner. We were going to scan their penises and build 3D models of them and compare the shape of genitalia, and look at taxonomic patterns, and also how they coevolve with female genitalia, and that's still is on the backburner for when the natural travel or international travel situation changes and becomes safe to do so. At present, we also have, um, when these animals first die, the females before I dissect their reproductive tracts, I make—and I will mention that everything I do whether it's dealing with a dead animal or live animal, everything is under federal permits. I'm not just going out and harvesting animals. Everything is going through a chain of command and reported to the federal government, so

everything is, um, we're very careful about our permitting. So, what these animals, um, when I first get sent these reproductive tracts in the mail, which are very stinky, [38:05] before I dissect a female, I actually make a mold of her vagina out of silicone.

[MM]: Um-hm.

[DO]: And so that tells me what the lumen of the vagina, what the interior is going to be like in terms of its shape. And we've been able to make 3D models of those and look at the complexity across phylogenetic patterns. So, do certain species have more complicated vaginas? Are they closely related? Uh, does it have something to do with their penis shape? So, really trying to understand patterns of diversity in genital morphology. So that is one component of my research looks a lot across marine mammals. So, the questions are usually not species specific. Like, I might do a study like the one we talked about just on harbor porpoises. I'm about to finish up one on manatees, but most of my patterns are very much so question oriented. And I'll come back to the second part of my lab in a second, but while I'm on this tangent where we're talking about how I got into grad school, my success story, I think a large part of it is that for me, it was never "I want to study specifically humpback whales in Hawaii." I've always, I've wanted to live by the ocean and to feel sand of my toes every day. That was my life goal, and I've really been driven by the questions. So, I look at broad questions that haven't been applied to marine mammals before, and because I have a background in ducks, in bats, and all these other, um, with fish, like in all these other animals, I use a very, um, interdisciplinary approach where I take transferable skillsets and methods that have been used on other species of other systems, and apply them to marine mammals. So for me, the love, the joy of my research is being able to come up with very innovative ideas that have never been tested before on marine mammals because there really is no one else studying functional morphology in marine mammals. I shouldn't say just me. My collaborators obviously are very involved in these projects too, but there's not another major lab in the world which is highly invested in understanding functional morphology in marine mammal genitalia. So, this puts me at an excellent advantage that the sky is the limit in terms of questions and ideas, and we really push those boundaries. Like for example, we take dead dolphin penises and we inflate them with Vaseline and pressurized saline to simulate erection, or we'll stretch a vagina until it tears to look at its biomaterial [40:41] properties and its mechanical force it can withstand. So, we really have this sort of part [unintelligible] [40:46] in terms of everything's under permits and everything has a biological rationale, but there's so many unknowns. We have this amazing opportunity to take the research in different directions, and that's what I love about it that it's constantly evolving and for every question we answer, there's five new questions that come up. And, um, for me, like, the joy of being a researcher is this discovery component to it and understanding these biological patterns, and I'm constantly blown away by how little we know. Like, some things that we take for granted as being known facts are simply not known. People ask me all the time, but if they don't ask me, they tell me, "I saw it on a Snapple bottle, is it true that dolphins have sex for pleasure?" (McClure laughs) And the answer is, "No one's ever studied that before besides from me, and I haven't published that data yet. So—

[MM]: —yeah—

[DO]: —whether or not Snapple thinks this is true, like, this is something people assume, but we haven't answered these questions yet. So, it's a really fun opportunity where you think about just questions in general, and then especially my post-doc advisor, Patricia Brennan, who is a brilliant mind, also a very lateral thinker, she does reproductive morphology on [42:00] sharks, on, um, alpacas, on snakes, on water fowl, on all kinds of animals. We have a lot of fun coming up with innovative ways to answer these questions that are way outside, um, traditional, standard, "Here's how you answer this question." We have a lot of fun kind of pushing boundaries or breaking boundaries to do some pioneering research.

[MM]: Yeah.

[DO]: So, the second part of my research is the behavioral ecology part. So, New Zealand, all that research I was doing on mating behavior and how it relates to the environmental conditions [unintelligible] [42:35]. Um, that's behavioral ecology. The water here in Corpus Christi is very murky, um, which your wife just saw on the weekend. We saw dolphins mating and I couldn't even tell you how many dolphins were involved in that mating interaction. Um, so, it's very hard to know a lot about behavior here, but we're very interested in understanding their population biology, their graphics, their habitat use, their distribution, their abundance. So, the last study here, published study here, was over thirty years ago on how many dolphins were in the area.

[MM]: Wow.

[DO]: Um, so, it's very outdated in terms of our information on "Who's here?" um, "Are they here all year round? Do they have a preferred area they like to use? What are the conditions? What's the salinity in that area? Is it close to, um, some other element that would appeal to a dolphin?" This is particularly important here in Corpus because of the amazing level of exposure to different anthropogenic and natural disasters. So, for example, hurricanes happen quite frequently in the area. We're talking about building a desalination plant. [43:45] Freshwater is not good for dolphins. They develop skin lesions, which can basically compromise their epidermal integrity, lead to health complications, and they die from essentially exposure to fresh water. So, we need to have these baseline [unintelligible] [44:00] projects, um, and information there so that should a hurricane hit here, we can understand what is normal and what is abnormal. And so, our research here does a lot of boat-based surveys, um, really trying to look at the population biology all the way from Copano Bay and the Rockport area down to Baffin Bay. So, we have a pretty big span that we try to encompass every few months, and we go out multiple times in successive day periods over the course of, um, three months. We'll try to hit each of our regions within two consecutive days of each other for each region so that we can do a capture-mark-recapture study. So, we're not actually capturing these animals. We're not, we want to be as little invasive as possible, but they have natural markings on their bodies and on their fins, so when we take photo of these markings, we're capturing them, and when we come back a subsequent day and take a photo of the same animal, we've recaptured them. So, this is all by being three hundred meters away taking a photo of a dolphin, we can learn more about, um, how they are responding to potential epidemic disturbances and how they're surviving in their area. [45:12] So this area, um, has a lot of fisheries interaction. We've seen fisherpeople, uh, feeding dolphins, which is very illegal. Um, they're dredging the area constantly to make it

deeper as with part of the Panama Canal. There are over two hundred thirty plants that back onto Corpus Christi Bay, which has a potential for a lot of contamination in the water and pollution. So, these dolphins are very robust that they're able to survive through all these conditions, and we need to understand, "Are they here year-round? Um, how long can they survive? What are their baseline levels?" And, um, just in general, there's a critical need and the government has identified this area as an area of high concern, that we just don't know anything about them, and they are exposed to a lot of potential hazards.

[MM]: Yeah.

[DO]: So my other research here is taking photos of dolphins and just matching those photos to—by matching these individuals and saying, "We saw individual x on this day and we saw the same individual four months earlier," that already tells us that they inhabit the area for a long period of time. So just by taking photos, there's so much information that we can garner about the population biology, and we have consulted—our finding is from Texas Parks and Wildlife. So, the state is invested in this research, and we've consulted with NOAA, the National Oceanic and Atmospheric Administration, um, with their marine mammal researchers, to make sure that our protocols are something which will a utility for them for making management mitigation suggestions. So, we're very invested in the conservation of these local dolphins and working with the government on making sure that we're implementing protocols that can be used to help these animals.

[MM]: Wow, that's great. I never really thought that so much work goes into, like, uh, into dolphin studies and things of that sort. That's very fascinating.

[DO]: There is a lot. I mean, it seems kind of crazy that all the hours your wife spends taking photos of dolphins are, it's not busy work.

[MM]: Yeah.

[DO]: Like, that is—each photo is a valuable point of data, and this is also one of the reasons that dolphins put get so much—they're charismatic animals, and they're always smiling. I like to say that "Even a dead dolphin is smiling," so, they seem happy all the time.

[MM]: Yeah.

[DO]: Um, but there's a lot of interest in them also just because the data itself, the photos and the videos, which are data used to answer biological questions, are also very conducive for sharing with popular science and media. So, they've really won the hearts of a lot of people because the science itself is really interesting to do.

[MM]: Yeah, wow. Um, what would you say is like one of your favorite experiences working with [48:00] dolphins?

[DO]: Oh my gosh, there's so many—

[MM]: —Yeah (McClure laughing). One of my favorites was in New Zealand, and we had heard there was an orca in the area, and I hadn't seen them in the wild before, and so, we got in our boat and we were looking, looking, looking, and the Department of Conservation boat was nearby us, and we were on the radio saying, you know, "Where?" and he's saying, "It's somewhere around where you are." And all the sudden, it popped up less than two feet away from us (McClure laughs), um, scared us, and the, we were—so, I can send you the photos after. It's like one of my favorite photos ever, but the person on the Department of Conservation Boat took a photo of us, and when I look at that photo, I can still, like, in my mind hear my field assistant screaming, "Oh my god!" (McClure laughs) It was just, like, the most amazing, unexpected moment. Um, it was really, really special for me and just—I mean, these animals surprise us, and we have some amazing days on the water where unexpected things happen that just blow our minds. Like, we had, sometimes they're sad things, but we had one day where we were, and I need to work on publishing this already, but it was the same time I did that 2017 drone work, but we witnessed a group of about thirty dolphins trying to drown a little calf. We witnessed attempted infanticide. And it was heartbreaking to watch, but also so amazing and no one's ever captured this on drone before in such level of detail and continuous follows. So, just observing natural phenomenon, um, really inspires me every single day to keep doing what I'm doing.

[MM]: Yeah, what, um, what kind of advice would you give to someone who's interested in doing the kind of work that you do? What would be a good start for them?

[DO]: So, for me I didn't know what I wanted to do. I hadn't been interning forever. I was fortunate that I had a very famous master's advisor, who opened up a lot of doors and connections for me and gave a lot of liberties and experience, and I was able to use that, especially that alcohol work just got my name on a map. Um, but not everyone's master's goes that way. So my suggestion is to start applying for internships early, um, talk to professors you're interested in working with about being in their lab, about potential hands-on experience you can get, oftentimes and sometimes the grunt work and not so desirable, but you work your way up, and once your foot's in the door, often that's the first initial step to get there. My other suggestion would be to, um—it's not about, most things in life are actually not about being smart. It's about working hard. So, you don't have to be smarter. You have to work harder. So people say to me often, like, "Oh, you know, you must love it when you get to see all these dolphins," and what I'm thinking sometimes when we're photographing dolphins is that for every hour on the water, that is five hours back in the lab analyzing those photos.

[MM]: Yeah.

[DO]: So, it is—I do a lot of twenty-hour days. Um, I feel like an eighteen-hour day is my standard when I'm in the field. And I can do that eighteen-hour day—

[MM]: —Wow—

[DO]: —every day for four months. So, it is really, really hard work and not for the faint of heart. Um, it's not as glamorous as it sounds (McClure laughs) all of the time. Uh, it's exhausting. But it's really worth it. My other suggestion would be especially in COVID where

[51:24] so many conferences are online, attend virtual conferences. Learn more about research is going on. Reach out to prospective advisors. Start early. Um, look into funding opportunities. Try winning some undergraduate scholarships even that will make you more competitive for a potential, um, PhD or grad program. But the biggest thing is starting early, so trying to get that hands-on experience. Um, not waiting to the last minute to ask an advisor to be your supervisor, and when you do write those letters, I get every few days, like, a very generic letter which is, like, “Dear professor,” and then it’s copy paste all about them and is not tailored at all to what I do.

[MM]: Yeah.

[DO]: So, when you're sending those letters (watch beeps)—please stop beeping at me. I know I need to change the battery. Okay, um, when your sending those letters, um, make sure that you really put the time into investigating that principle investigator, that researcher. Read their articles. Talk specifically about why their lab is a good fit for you. They want to know about you, but they're receiving emails from students every single week who want to join their lab, so you need to make yourself stand out and show that you’ve really put in the time to learn about them, to learn about their research. Pose questions about something that their article intrigued you or potential project ideas. So, things like that to set you apart to make you from a good candidate to a great candidate is putting in that extra effort that makes the big difference. [52:57]

[MM]: Yeah, that makes sense. Um—

[DO]: —And then I think the biggest suggestion would also be: grad school is a big time commitment.

[MM]: Yeah.

[DO]: It’s not a forty hour job. It’s like an eighty hour a week job minimum. You feel guilty if you have a nap (McClure laughs). You feel guilty if you take a day off. You feel guilty when you're sleeping. You always feel like you should be working. A lot of students suffer from imposter syndrome, um, and a lot of students have very high anxiety too, which is part of [unintelligible] [53:23] being a grad student. So, you need to make sure that you are so passionate about that research you're doing. It has to be a labor of love, otherwise it will be painful to do.

[MM]: Yeah.

[DO]: It has got to be something where it doesn’t feel like work. You need to really love what you're doing, and also make sure that the lab is a good fit for you. Some supervisors are micromanagers. Some are completely hands-off. Some have huge labs that have no time. Some have tiny labs and have lots of time. So take the time to learn about what you would like in terms of the level of commitment you would need, or hand holding, and, um, hand holding meaning—I feel like that’s, uh, not the nicest way to say it (McClure laughs), but, like, “How much help do you need getting your feet wet and solving problems? How much independence you need?” And doing some research to find out which lab is a good fit for you.

[MM]: Yeah, that makes sense. [54:16] Um, I guess the final question that I have for you then is, um, what's basically your whole schedule, like, um, for your future work given all your work you're doing at Texas A&M? What's kind of looking the near future given COVID and everything? How's that affected all your work?

[DO]: So, a lot of stuff got put on hold. So, New Zealand probably won't happen this year even if we win the grant, um, because of COVID. I was meant to go to Florida in last year to collect, um, swabs from dolphin vaginas to do microbial research. We meant to go to Iceland. So, a lot of the research, international travel, is on hold at present. Um, that being said, we still are getting out on the water collecting those photos of dolphins, which is fantastic that we can still do that. And we have such a backlog of photos from the past five years that that keeps us plenty busy. Um, we have the aquariums, which are gratefully, we're grateful they're willing to work with us and collect the semen. So, there's really no holding back on a semen analysis [unintelligible] [55:26] claimed. And then there's several other projects I can do with dead animal tissue. Um, I mean so much of my research is working with dead animals that there's not really constraints related to COVID other than social distancing from assistants and, um, having—like, we're still able to do most of the post-mortem biological research there as well.

[MM]: Yeah.

[DO]: And then a lot of it is just, I had a lot of projects on the backburner where I had collected the data and needed a student to analyze it, or help with a part, or I had to find the time to just write it up, and I've really used this time to sort of get those things going or to reach out to collaborators where they had the data and put pressure to them, "Let's finish this off" kind of thing. So, I've used this time very wisely to sort of catch up on life. Um, and the hope is that soon we'll be able to resume, given this is the new normal, hopefully this won't be the new normal forever and we'll be able to resume travel [unintelligible] [56:28] research. But I think that most faculty at this stage are working with the data that they have available, or data they can collect locally and safely, and I'm very fortunate that I have existing data. I can collect data safely, and I also can collect data both in the field and in the wild these days. So, there's no, I don't have any excuse for being lazy.

[MM]: Yeah (laughs), right. Um, is there anything else that you'd like to add before we finish?

[DO]: Um, I think your questions were pretty exhaustive and pretty thorough. Um, I guess the biggest point would be that faculty are not as scary as they seem (McClure laughs) and they usually are happy to talk about what they do—

[MM]: —Yeah—

[DO]: —and happy to chat in their office hours and to help you if you have questions or even if you're not thinking about their research but advice on how to pursue different routes, I think most faculty would be happy to chat with you and help where they can. I mean, we all want to see students succeed and, um, the other amazing thing is that Corpus Christi is wonderful in terms of it being on the ocean for marine biology and having so many opportunities to get involved in

research, in conservation, volunteering at the aquarium, at the Sealife center. Um, there's so many organizations locally where students interested in animals have the opportunity to get that hands-on experience. And I would highly encourage those, and usually it is voluntary and interning at the undergraduate level. It's pretty rare it's a paid position, um, but if you that availability, I would highly recommend, um, seeking it out and getting that hands-on experience to help determine what you don't like. Like I learned in my undergrad, there's certain things I don't like to do, and I'll never design a project which involves doing these sorts of projects. It's just not my wheelhouse and not something that appeals to me. So, getting the experience, even if it's a negative experience, can still be really valued in helping you fine-tune what your ultimate goals are.

[MM]: Yeah, alright, well, uh, I think that'll about conclude it. Thank you very much for the opportunity. I really do appreciate you taking the time to do this interview.

[DO]: My absolute pleasure. And I enjoyed—I'm sorry I didn't have enough time to hear more about what you're doing. Um, (McClure laughs) but hopefully (Orbach laughs) we could correspond about that.