**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 we speak with UC Berkeley graduate students about their work here on campus and around the world. Today I'm joined by biologist Ashleys Miley from the Department of integrated biology. Uh, and she's here to talk about her work on biomechanics. Welcome. Hi. Thank you. Of course. Uh, so you work on the biomechanics of bird flight? Yes. So I am in the Animal Flight Laboratory [00:00:30] in the Department of integrative biology like you just said. And specifically I study the family of hummingbirds. They're called Troquille a day Troquille a day. Okay. So hummingbirds and uh, these are just like the ones we see in the backyard. Maybe a, what's the, what are the ones here? Anna's hummingbird. Yes. So Ana's are the most common. You can see them, you know, everyday on campus you can see them in your backyard.

**Speaker** 1: There's been a lot of studies [00:01:00] on Anna's hummingbirds in my lab though I actually studied tropical hummingbirds, so I'm interested in Colombian hummingbirds and how their biomechanics, how that changes across species. And how many hummingbirds are there, maybe like relative to other types of birds. Are there like tons of different species or just you know, good representation? They, they are not the most diverse family of birds, but they are extremely diverse. There are currently [00:01:30] about 353 species according to the most recent IOC bird checklist. And what makes them really interesting to work with is that they are considered a rapid radiation. So essentially that just means that they've diversified relatively quickly with respect to how long they've been around. So can you put some numbers on that for us? Yeah. So in the grand scheme of bird evolution, they're [00:02:00] relatively young taxonomic group. Their most recent common ancestor is present in the fossil record around 22 million years ago.

**Speaker** 1: So the transitional fossil form where we link avian dinosaurs to modern birds occurs at about 150 million years ago. So they're not that old. However, they've diversified into nine principle clades that, like I said, has 353 species. But if [00:02:30] you look at that in comparison to other bird families are useful, but sort of rough comparison is pigeons. So pigeons, the Columbia Day family, they have their most recent common ancestor around 55 to 66 million years ago. So they are roughly three times as old as hummingbirds, but they have very similar amount of species. They have about 342 so in a third of the time they've diversified a lot more than [00:03:00] the other bird family Kalama Day. Okay. I have some questions. So maybe people don't think about birds when they think about fossils, but it is, so birds can be fossilized. Yes, yes. They have bones and they do have bones.

**Speaker** 1: Then I heard the bones are very light though. Is that, is that true? Yeah, they, um, they're actually hollow and because birds are so diverse, we, you can't always say that, you know, all birds have hollow bones. We, we can see instances where [00:03:30] some birds have solidified parts of their bones. For instance, in mannequins. They have a way to solidify some of their wing bones so that when they flapped them very rapidly, they can actually make high-frequency sounds. What's a mannequin? I mean what's a bird mannequin? A bird mannequin. It's a, it's a common name for a family of birds in the tropics and they're very colorful. They have really famous display patterns that you can probably find on that Geo. [00:04:00] Very charismatic as well. But W and what about the hummingbirds? They live all over the world. Uh, you said you studied tropical ones, but are they in Europe and Asia?

**Speaker** 1: So they're restricted to the western hemisphere. They occur anywhere from southeast Alaska to the tip of the Chilean country. So pretty large span. And there have been fossil forms that have been linked to early humming hummingbird [00:04:30] forms in Eurasia. But, um, most scientifics scientists say that they've radiated out of the tropics. So, so we should, we should appreciate them then. Cause, but other people in other parts of the world don't, don't get to see how many birds in their backyard. Yeah, yeah. That's cool. Uh, so have you always been a bird person? Is that like your favorite animal forever? Is that how you chose birds? I guess I've, I had gotten my start and research studying house friends, Peruvian birds, um, house friends [00:05:00] are actually in North America as well, but the subspecies that I was interested where previously. So yeah, to answer your question, I've, I've always studied birds, but now that I'm kind of shifting into this biomechanics realm, I'm more interested in functional morphology.

**Speaker** 1: So in the future I would be really interested to start studying bats or you know, other flying animals that may not be birds. Uh, and can you tell us about some of your earlier research before [00:05:30] he got to Berkeley? Cause it looked like, yeah. You, you spent time in Peru, spent time in, uh, anywhere else in Sheila and Sheila. Yeah. Tell us about that. So when I was studying house friends, I was in a lab at the University of New Mexico and everybody in that lab studies birds. And it was kind of Nice because we would go on a lot of collection exhibitions to Peru. So we all had our own projects that we could, mutualistic benefit by collecting birds and taking all [00:06:00] of the parts of it that we need for our projects at the same time. So we would spend two months during the summers just mist netting and collecting tissue samples, study skins.

**Speaker** 1: Some people did projects on parasites. So we would all go out, get all the things we need and then come back and analyze that data within the university. So I was studying cardiac morphology along in elevational gradient. And it's a really [00:06:30] interesting question because these birds live anywhere from sea level to over 4,000 meters in elevation. So you could imagine that the low partial pressures of oxygen would cause some, some consequences in perhaps their flight. But I was more looking at their physiology and how they're able to function at high altitude and pump blood that is

more viscous than, than a blood and birds that are living at sea level [00:07:00] and cool. And you, and you did that with Ms Nutso or what? What's a mist net? A mist net is this nylon net. Um, kind of like a hairnet that he would wear in a restaurant, but more fine and somehow more expensive.

**Speaker** 1: So we would capture these birds that would fly into these nets and take them back to our research station, which was actually a rei tent. But yeah, so it's mis nets are only effective for birds that fly at the level that they're set [00:07:30] up. So they weren't effective for canopy birds or sometimes even hummingbirds because humming birds can fly backwards. So if they can see the net, they'll pause and either fly around it or just back up and fly in the opposite direction again. Yeah. Well, I saw on, uh, on your CV that you've all, you mentioned Renz, but you've also worked with woodpeckers, right? Yes. So I studied in endemic population of [00:08:00] Magellanic woodpeckers in southern Chile. So they require old growth forest to make their cavity nests in, and it takes a really long time for them to raise their young, so they're particularly sensitive to changes in their forest space.

**Speaker** 1: And in that part of the world, a lot of logging is starting to impact the availability of those [inaudible] Vegas forests. And so with logging, we were seeing a reduction in [00:08:30] the size of that population. So what we would do is we would actually track these birds, capture them using miss nets and attached gps and VHF transmitters to them and figure out how that space that they partitioned was shrinking and what was happening in terms of competition between different families and how we could extrapolate it into the future and potentially use that information to inform logging [00:09:00] companies about the damage that they're doing and perhaps explore alternatives for, um, utilizing those resources. Okay. Uh, but hummingbirds seem to be used to all these different birds, but hummingbirds are your preferred bird right now. Yeah. Right now. And do you, why? What's so glamorous about hummingbirds besides their ridiculous coloration, which is beautiful.

**Speaker** 1: Um, they're just, they're kind of out of this world in a lot of ways. So I study, I study how changes [00:09:30] in size affects their acceleration and velocity Maxima, which we can use to inform how they've radiated through their space. But there's other projects in my lab about hummingbirds. They're equally as interesting. Like one of the postdocs is studying how they move liquids through their bills and what's happening in the tongue and how their bill is actually changing shape as they're drinking. So it's insane to think about that. It's this oscillating asynchronous movement [00:10:00] that results in like, you know, nutrition consumption. But when you're watching it, you can't really see it with the naked eye. You have to zoom in, film it, slow it down, and track those points through space and time. And when you see it on a plot, it's just this like psychedelic wave of movement.

**Speaker** 1: And yet it's kind of, it's kind of magical. But what I'm interested in is the diversity of [00:10:30] hummingbirds. So they change in size anywhere between one and a half

grams to over 20 grams. So as they grow developmentally and across species, they have disproportional changes in length in their wings and their tails. And that's something that has never been explored in terms of characterizing their comparative biomechanics. So I'm really interested in characterizing acceleration and velocity. [00:11:00] How quickly are there wings moving? That depends on the species. So it's hard to make broad statements about their movement as a family because there are so many species, it's hard to come up with a ballpark too. It's okay. But it seems faster than my eye can detect. Right? Yeah, very fast. Yeah. And I have heard those like, you know, anecdotes about how many beats per minute their heart is going to maintain that velocity.

**Speaker** 1: Uh, so [00:11:30] they're definitely doing something crazy in terms of how much they're moving. Right. Yeah. So can you talk a little bit about what brought you to Berkeley in particular? Yeah. So when I was finishing up my project about house friends and I was thinking about high altitude more, that's when I became interested in biomechanics because how is the environment in tropical forest impacts these birds species is really interesting to me. So it's kind of that interesting [00:12:00] intersection between a biotic and biotic factors in biomechanics. So there are actually not very many biomechanics labs in the United States. So I was first interested in Berkeley because as an undergraduate I did a research summer experience in, uh, here at cal Berkeley. With my current advisor, Robert Dudley, and we did this side project about electrostatics in hummingbirds in terms [00:12:30] of how they use this. Suppose it's sense to tell whether or not a flower has been visited.

**Speaker** 1: So we did this project, we got a kind of a short neat publication out of it and I decided I wanted to come back. And we have a lot of great tools and resources here. We have our animal flight lab, you have two wind tunnels and a lot of machine machinery that I would eventually like to use if I can never get myself out of the field and doing a project here on campus. Yeah. So I guess [00:13:00] I should have asked this earlier, but what is biomechanics? So this is a question that I'm often asked and I like to think of it as this open relationship between biology, physics and engineering and open because we as bio mechanicians can sort of borrow principles in physics to make predictions about animal and plant locomotion. And in turn [00:13:30] we can use that information to inform engineering design if that's what you know we're interested in.

**Speaker** 1: So a lot of my predictions about how I think animals are going to move in my field system. They have physics underpinnings. And you, you mentioned some really cool sounding equipment, so a flight lab and two wind tunnels. What a, so is wind tunnel. That's like what we saw in the movies where they just like blast air and you [00:14:00] can like fly through the, tell us more about this wind tunnel. Um, it's just a way to replicate both laminar and potentially turbulent flow. So the idea is you can put a flying animal or object inside of this tunnel and film it and you can, you know, turn up the wind speed. You can turn it down and figure out that there's a point of failure. There's a point at which the animal can no longer fly. It depends on [00:14:30] your question. Or perhaps you could characterize the board of seeds that are shed from the wings as it

flaps in certain ways. You can change like the angle of attack for the air foils. It's entirely dependent on your research. But there's a lot of potential and it's just kind of this easy way to characterize kinematics, but I can't fit in it or can I, can I come visit it? No, I don't. We don't have a big enough. Okay. Okay.

**Speaker** 2: [00:15:00] Well if you're just tuning in, you're listening to the graduates here on colleagues. My name is Tesla and today I'm joined by bio mechanicians Ashley Smiley from the Department of integrative biology telling us about her work on the bio mechanics of flight in birds and her previous work and in South America looking at rens and woodpeckers. What about in your work? You said you spend most of the time in the field, uh, now, so what sort of equipment do you use out in the field? No wind tunnels out there.

**Speaker** 1: [00:15:30] Um, no, so unfortunately we don't have access to a wind tunnel at our field site. So my field site is about 60 kilometers south of Bogota in Columbia. And because we don't have a wind tunnel and I'm interested in forward flight. I had a friend helped me pick up a bunch of two by fours from home depot and I, before I left, I built a model of this tunnel that is just, [00:16:00] it just has a frame made of two by fours. So the idea is that I could have a bird fly through it and if I set up cameras around it, I could compare maximal velocity as well as acceleration amongst the species that I record. And if you take that same horizontal tunnel, you can even rotate it 90 degrees and look at vertical flight as well. So a lot of my time is spent capturing hummingbirds and essentially [00:16:30] releasing them through this space. And I'm also interested in, like I said before, acceleration, but that you know, that encompasses both linear and rotational acceleration. So that requires having a bird start at rest, um, hovering at rest. And so we take an object to scare it and have it move in the opposite direction with a high speed camera. So we track points on its body. We can [00:17:00] characterize that and compare. So can you

**Speaker** 2: walk us through a day in uh, at your field site? So you're in beautiful Columbia, like how many hummingbirds do you end up catching in a day? How many different species are in that one area?

**Speaker** 1: So at the field station that I work at, you can see up to 22 species and the entire second floor of the field station is lined with hummingbird feeders. So you can just walk [00:17:30] along the balcony and see those, see those birds who have become so accustomed to humans around that they don't even fly away. They'll fly right by your face. So it does make it easier to catch them because we have this magnetic trap that we borrowed from Chris Clark. And if you stand a distance away and you hold up the, it's kind of like a cartoon, you know, like you have a box and a stick and then an animal goes inside and he like kick the stick out. Except [00:18:00] we use magnets instead. And so birds fly into a feeder and as soon as you find the species that you want to record or a certain number of them, you just, you know, click it shut and then you pick them up.

**Speaker** 1: So that's usually all throughout the day. I'm doing that. I get up early, I start catching the birds. We sometimes have to refill the theaters because it turns out we go through about 40 liters of nectar a day. And this past summer [00:18:30] I was able to film on average 25 to 30 birds per day. And that's with taking, you know, lunch. Wow. How do you tell the different hummingbird species apart? Is it like the length of the tail or you mentioned body size at one point. So in general it's a little bit more difficult if you're in an unfamiliar place and there are certain field marks that you can guide yourself with. Um, [00:19:00] but in at my field site, we are so used to the same species that it's, it's very obvious, which is a mango or which is, you know, the endemic species, the indigo capped bird.

**Speaker** 1: Yeah. Well, scientific names easier, something. Yeah, yeah. They're there if they're a genus of Amazonia Santa frons. So that's their scientific name. I'm, I'm most often comfortable with scientific names over common names just because that's what they go by in the literature. [00:19:30] It's funny because I feel the same way, but there was definitely a point when that was not true. And then I got into the phd program and then at some point had switched and now I'm like, wait, what's the common name of that monkey? I have no idea. Yeah. Um, cool. Well, uh, is there anything else about your uh, dissertation work to date that we haven't touched on? So that's how cool it is. How many hummingbirds you get to hang out with in Columbia? No, I mean the general ideas there, it's, [00:20:00] it's a, I could go into more detail about the specific morphometrics and how that changes, but it's, I don't know, it can get pretty dense. The general idea is that we can, we hope to be able to take a bird and based on its, you know, more for metrics, like I said, like its wing parameters, its body size, it's bill length. And make predictions about how fast that bird can rotate and ostensibly in the future, if somebody wanted, [00:20:30] they could, you know, use bio inspired design and improve current aircraft and you know, say that this research has been done. So we know that larger objects can accelerate faster or that smaller objects are more maneuverable in space.

**Speaker** 2: So. Okay. Yeah, that makes, that makes sense. So bio inspired design that that must be, I'm a big part of the applicability of biomechanics research cause I've seen like those, the classic example of the Gecko you eat [00:21:00] and then they turned that into like very popular adhesive. You're trying, you're going for the birds. No Geckos. Yeah. Um, uh, what, what about, do you have any advice for, uh, people in the Berkeley area who are now interested in seeing more hummingbirds or learning about hummingbirds? Uh, it sounds like it might be easy to see them, you know, in your own neighborhood. So what advice do you have for them?

**Speaker** 1: Well, I would say get a hummingbird feeder. I mean, that's the quickest way to see a lot of hummingbirds. And [00:21:30] for the first week or so, it'll probably take them a while to find it, but they will find it. They always do. And really, you know, pro piece of advice that I would give about feeders is, um, to put some Vaseline on the string holding it up

because there's a lot of aunts in Berkeley that will take over your feeder and then all of a sudden you have an insane it problem. But yeah,

**Speaker 2:** Peter is the way to go. I think that is an excellent pro tip. What about [00:22:00] advice for students who are interested in learning more about biomechanics or, yeah. Do you have advice for students who don't quite know what they want to do or thinking about research?

**Speaker 1:** Um, yeah, I, I would, uh, I would say four or specifically for Berkeley undergraduates here can sign up for opportunities in research. You know, there's the you rap program, they can, they can actually browse different projects that phd students are working on and apply for a position that, you know, [00:22:30] could last anywhere from a semester to the whole time they're here. So I have a Europe student and um, she's, she's actually a bioengineer students and she has not classically worked with wild animals. So it's kind of a cool experience coming from her engineering background and incorporating evolutionary biology. So there's, there's always something for students out there if they wanna, you know, get involved with biomechanics, especially in my lab. I mean we have people studying mosquitoes, [00:23:00] Geckos as well, other types of birds. Just, there's just so many questions.

**Speaker 2:** Okay. Yeah. And do you have any advice from your own, uh, background? You mentioned you did like a summer research opportunity, so that was that for you, one of the most influential things getting you into research? Yeah,

**Speaker 1:** I think so. I think, I think getting that experience was really crucial in strengthening my CV and my application. But what inspired [00:23:30] me personally was field work, being outside and being able to make observations that inspired a lot of my questions today. And if you are like me, I can't be an office all year. Like I, I to be outside. So if possible, my advice would be to try to apply to a, to a field research position. Because when you're out there, you kind of have to use the resources that you have around you to be successful. And when you're in a foreign place that's [00:24:00] very challenging, but it'll make you a better researcher at the end of the day.

**Speaker 2:** Yeah, I didn't ask, but, um, what's it like working in a foreign country? Where there any differences between the countries or is it, um, fairly easy? Uh, you said you're taking Spanish, so I'm trying to get the language under your belt.

**Speaker 1:** Yeah, well there's so many challenges, but, and in terms of language, yeah, I think the difference between Peruvian Spanish and Chilean Spanish is [00:24:30] incredible. You know, Chili has a very interesting history about how it came to have those like intense accents. But aside from that, I think it was challenging expressing myself, um, scientifically and personally in another language and living with foreigners from all over the world. I mean, it was at the end of the day ended up being a really good experience for me. But initially, especially with cultural differences, [00:25:00] you know, as a

woman of color going to a new place and they have this idea of you as an American, but you know, most a lot of people tend to forget that the United States is very diverse. So they make assumptions about you before you get there. And just working through a lot of that is, was particularly challenging.

**Speaker** 2: Yeah. And it also makes me think how uh, it might, it must be challenging for scientists and other countries too cause we've kind of standardized English as a language of presentation [00:25:30] of science. So, uh, yeah, that's interesting to think about that. Yeah. Uh, well as we get to the end of the program, I want to make sure you have an opportunity to say anything about science you want to say or not about science. This is the quote unquote soapbox segment. So if you have anything you want to say, now's the time. Get it out there.

**Speaker** 1: Well, I mean, I don't want to get political

**Speaker** 2: man. Hey, this is a radio in Berkeley, California. You can do whatever you want. That doesn't involve obscenity.

**Speaker** 1: [00:26:00] [inaudible] although these days absurdities are close to the front of my tongue. Well, if there's anything that comes straight to my mind about, uh, soapbox territory, I guess I would want to emphasize the importance of higher education and valuing graduate research. Um, doing a phd is not easy. And one of my friends recently was expressing to me how noble of an act it is because what you're studying may not even [00:26:30] benefit you right now. You personally, we're not getting paid a lot, but in the future it's, we're, we're doing research that's gonna eventually benefit humanity. So I would encourage to call the representatives

**Speaker** 2: to, to think about how, you know, the recent house bill about texting graduate students for income that they don't actually make, um, how that's going to impact the scientific progress of, you know, our country [00:27:00] and future science. So Kali representatives, yeah. That, that tax plan has been going around quite a bit. And, um, my understanding of that for people who aren't as familiar is that, as Ashley said, they want to, um, tax our tuition waivers, which is just a way on paper for the University of California to say, uh, you don't have to pay tuition because you're a graduate student. Uh, but then taxing that, uh, more than doubles people's taxes. And for students who go to private [00:27:30] universities where the tuition is much higher, you're talking about, uh, taxing, you know, $30,000 a year of, of, you know, invisible income and then having to pay those taxes.

**Speaker** 2: So, um, yeah, definitely get out there. Call your representatives, uh, you know, science, we like to think that it's not political, but it becomes more and more clear everyday that this is a debate. We're still having a, that science may in fact be very political and we just can't disassociate it from politics or from history. [00:28:00] Uh, so important things to think about and to talk about. Okay. Well thank you very much, Ashley, for coming on

the show today and I know we'll be hearing more of you of the future as you transition into, uh, one of the graduates, uh, hosts and producers. So welcome to the team. I know, right? Yeah, I'm excited. Yeah, it's going to be great. And thanks for being here today. As you're listening to the graduates on KLX Berkeley or you listened to it. Uh, my name's Tesla Munson and today I was joined by biologist Ashley Smiley from the Department of integrated biology.

**Speaker** 2: [00:28:30] She talking about her work on the biomechanics of flight and birds and looking at acceleration and body size and heading out into the tropics to, uh, hang out with a bunch of hummingbirds more than 20 species in one day. That's pretty fantastic. Uh, I've got one, I know they're territorial, so I've got one in my garden space and I've named him and uh, when other hummingbirds try and come in, he attacks them. It's pretty cool. It can be kinda scary. I'm always glad I'm wearing my sunglasses. They, they [00:29:00] move fast. But thank you again, and we'll be back in two weeks with another episode. So stay tuned. You're listening to the graduates here on k a l x Berkeley.