Andrew Saintsing: Hi, you're tuned in to 90.7 FM KALX Berkeley. I'm Andrew Saintsing, and this is The Graduates, the interview talk show where we speak to UC Berkeley graduate students about their work here on campus and around the world. Today I wanted to do something a little different. Rather than sharing an interview I did with a particular guest, I wanted to talk to you about some fieldwork I helped out with this summer. Basically I recorded a few audio clips while I was there, and I thought it would be fun to turn into an episode for the show. Oh, and please forgive the random changes in audio quality. I'm just a poor graduate student. I don't have money for fancy equipment, just intermittent free time and a laptop. So, in case you don't know, I'm a PhD candidate in the Department of Integrative Biology, and I study biomechanics and physiology. My advisor is Bob Full, but I also consider myself an honorary member of Caroline Williams's lab. Caroline's a physiologist, and she's also an IB, and I've been going to her lab meetings basically since I started here. Anyway I tell you all of this because it explains why I was on this particular trip in August. So, first let's start with some background info. Oh, and there were lots of people on this trip, and I'll introduce you to all of them as we go, but let me go ahead and introduce Lisa Treidel. She's a member of the Williams Lab.

Lisa Treidel: Okay, so Sedgwick is just is one of the…

Saintsing: Hold on. Sorry, this is her telling us about where we did fieldwork. All right, go ahead.

Treidel: So, the UC system has like a large number of reserves, and so they're basically you know field stations that are places that work, that any kind of university researcher has access to to visit and then perform kind of like ecological and environmental studies. And so Sedwick is just one of those reserves. It's managed by… it's down in the Santa Ynes Valley. It's managed by UC Santa Barbara.

Saintsing: It's also really nice. It was this old ranch that was donated, and they have this renovated ranch house where there's running water, electricity, a full kitchen, beds. Yeah, it was very luxurious field conditions. But that's not the reason we went. The real reason is…

Treidel: We started to go to Sedgwick back when our lab was first established in 2015 because another researcher had told us that the crickets that we were looking for were there. And these crickets are the… the species of crickets that we were catching was *Gryllus lineatoceps*, which are just the variable field cricket. And they actually have a pretty wide range all along the western coast, from like southern Oregon all the way down to Baja.

Saintsing: Right, but we care about these crickets because…

Treidel: Our lab is mostly interested, or at least my dissertation work, which was all on the crickets, is interested in life history evolution.

Saintsing: Wait, what is that?

Treidel: Just the time, how an organism times its lifecycle. So, when it, when and how much it's going to reproduce, when and how much it's going to grow, and like how much it's going to invest in maintenance. And so, that kind of affects survival. So, basically the schedule of life.

Saintsing: And what does this have to do with crickets?

Treidel: We use the crickets because they're actually a great model for understanding the mechanisms of variable life history, and the reason that is is because they have a polymorphism.

Saintsing: Which is?

Treidel: So polymorphism is just when you have multiple traits or different traits within the same species, and so there's a life history polymorphism in this case where some of the crickets are flight capable and they disperse, and other crickets are flightless and instead of flying they have an advantage in terms of reproduction, and so they don't need to invest any kind of resources into flying because they don't have like functional flight muscles or the ability to fly. And so instead they can take all the energy that they have and then invest it into reproduction. And so there's like this trade-off between leaving your resident population and reproducing.

Saintsing: Wait, so why don't they all just do the same thing?

Treidel: Dispersal polymorphisms, which is kind of what this is (is whether an individual disperses and leaves the population or not), are relatively common across insects and other animals. So, some of the hypotheses are like: it's advantageous to be able to escape from predators, and so we do see a ton, a ton of predation in the field. There are a large number of other bugs that will eat crickets at night, and that, and having the ability to fly, to get away from those predators, is really important for your survival and your fitness. It doesn't really matter if you can find a mate, but if you can't, if you don't have time to lay your eggs, you get eaten by a predator, it doesn't you know, it doesn't matter. And so that's one big reason. The other thing is that some of what I've seen or been thinking about more recently is the importance of being able to sort of move to find other males. And so often times when we see, when we're out there, we see more females. Like the females actually outnumber the males especially in years where there are natural parasitoids (there's these flies that we know target males, and they drive the male population down)

Saintsing: We'll come back to those.

Treidel: So we can broadcast male song, and you get a ton of long wings that sort of fly to that song, and that's what we do in the pitfall traps. They just come right to us.

Saintsing: We'll come back to those, too.

Treidel: And so that, to me, says that they're acoustically (they fly at night, so there's not many like light cues that they're using to navigate, but they're probably acoustically navigating), and so they may have a really great advantage of just being able to sort of fly and find a good mate in an area that's probably like oversaturated.

Saintsing: So, it's one of those two reasons?

Treidel: The other kind of big advantage is that like having the ability to migrate would sort of allow you to sort of expand your species range and sort of find better like suitable habitat and better microclimates and things like that. So, there's, it's probably a combination of factors.

Saintsing: Right, but it's probably one of the three reasons you mentioned that we're getting these alternative life histories?

Treidel: And then the last kind of alternative is the idea that: is it costly to actually be able to fly? So, one of the things that I've seen in my research in the lab is that the flight capable crickets can very easily give up their flight capability, and if they do it quick enough, they don't end up with a reproductive cost. And so it's quite possible that there's a pretty low cost to the flight capability, and that, that's kind of why it persists as an alternative. There's a lot of alternatives.

Saintsing: Okay, fine. But you get the general idea. We were there for the crickets. So, I was at Sedgwick for a long weekend. I did fieldwork on Saturday and Sunday evening, but everything I'm playing you in terms of like clips from the field is from Sunday night just because that was the night I actually recorded anything. And just to give you a sense of where everything is happening, there's this like headquarters space near the ranch house where everyone meets and kind of gets their assignments and then leaves to do their part of the fieldwork and then comes back to after they're done. So, first things first, we had to go set up the pitfalls that Kisa was mentioning earlier. We did that before the sunset so they were ready to go as soon as the crickets were out and about at dusk, but also so we could see stuff while we were doing it. So, here we go. Sunday night. Where are we going?

Treidel: To the pitfalls.

Saintsing: What are we doing at the pitfalls? What are the pitfalls?

Treidel: The paintballs are buckets that are flush with the ground and dug, so they're basically holes, and we're going to be setting out some speakers that will be playing cricket song all night and attracting crickets to the holes.

Saintsing: So, basically we just set this noise, and the crickets come, and we get them in the morning. Oh, and the majority of this work is about collecting crickets because…

Treidel: The reason why we initially went to Sedgwick is because we wanted to collect field, like natural crickets in the field to use and bring back to the lab to establish a lab population. So, one of the things that we do every year at Sedgwick is we bring crickets back to the lab and then re-integrate those into our lab population which sort of keeps our population genetically similar to like natural population as possible. We want to keep it outbred to kind of avoid long-term lab adaptation.

Saintsing: Okay, so back to the pitfalls, where the speaker's now set up.

Treidel: Are you recording this? You should record my chorus.

Saintsing: Record your what?

Treidel: My, all of my crickets singing.

Saintsing: Record your recording of the crickets.

Treidel: Yeah.

Saintsing: Oh, and by the way, Lisa was a little excited that that speaker was working because it had actually been broken. I'll let Lisa tell the story.

Treidel: So, what happened was we went to go set it out and it didn't turn on. Thankfully someone out there, someone out in our field crew was handy and was able to sort of open up mechanisms and check out what's going on and discovered a wire that had gotten torn. It was attached to a knob, and then the knob through overuse, it came apart. And then we welded it back together, and our speaker was happy again.

Saintsing: Okay, yeah, that wasn't the most interesting story, but it did prompt Lisa to tell one of her favorite field stories. I'll get it started. So, this coyote…

Treidel: Bit through the entire mp3 player, like there was a bite through it, and one of my cables destroyed, and dragged the speaker out. I swear to god. Are you recoding this?

Saintsing: Yeah, I started recording it.

Treidel: It was like one of the like most, one of those like unforgettable like who would have thunk.

Saintsing: Did you see the coyote do it?

Treidel: No, I put the speaker out at night and then I came back in the next morning, and my speaker wasn't playing, and it was dragged away from where it was supposed to be and completely eaten. It was unforgettable.

Saintsing: But hey you live and you learn, right?

Treidel: I learned my lesson the hard way on that, and I have to now, when I put the speakers out, I put them in a box, so that if the coyote gets it, it just pushes the box. And they don't get into my speaker because I almost lost the speaker that way.

Saintsing: I can verify that the speaker that we put out at that pitfall was in a box. But I think the music it was making wasn't just turning off the coyotes.

Kevin Roberts: It sounds like somebody farting.

Saintsing: It does kind of sound like that, yeah. This one. I don't know. It's distorted a little bit.

Roberts: Yeah, I think that then…

Saintsing: Oh, that's Kevin by the way. He's also in the Williams Lab, and he was also on the show before. Here he is describing some of what he did for his dissertation.

Roberts: Yeah, part of it is burying beetles alive and then coming back and checking on them.

Saintsing: Uh, hold on. Let me see. I might have something better.

Roberts: Basically take a beetle, put it in a tube, and then put it into a bath of ethylene glycol. Propylene glycol. Some liquid that doesn't freeze until really low temperatures, and it will just cool them down. You can kind of like precisely control what temperature they're experiencing, so yeah that also doesn't sound… Yeah, the list of stuff I'm saying now: burying beetles, freezing beetles…

Saintsing: Just keeps digging himself deeper doesn't he? Okay, no. This stuff all makes more sense in context. Definitely check out that episode, but basically he just you know wants to see how the Sierra willow beetle is able to survive the winter, buried underground and how much snow cover affects that survival rate. So, yeah he doesn't study crickets like Lisa, but he's a helpful person, and also going to Sedgwick is kind of just like a vacation with a couple hours spent doing some cricket work at night. But I digress. Back to the pitfalls where you can never get Lisa down.

Treidel: The distortion they don't care about.

Saintsing: It definitely sounds like someone is just doing like you know…

Treidel: Yea. I think they hear different frequencies anyway, and I don't think they care.

Saintsing: Do they not have preferred frequencies?

Treidel: Oh, I'm sure they do. I just don't know what like, I just don't know like what it actually sounds like for the cricket, you know? You know that they hear through their legs, their ears are in their legs. There are like organs in there.

Saintsing: That's cool.

Treidel: Fun fact about a cricket. They can also like sense vibrations and like touch with their like antennae, you know?

Saintsing: Yeah, and they taste with those, they're antennae, right? So, we finished up at the pitfalls and headed back to the headquarters that I mentioned earlier, but on the way Lisa was already planning everybody's tasks.

Treidel: I want to send like a group to, not the field by the like barn, but you know when you turn down the road to the water tank there's another field that goes past? I want to search there.

Saintsing: She's talking about collecting crickets by hand. So, not only are we collecting crickets in the pitfalls, we're also going around, walking, looking for crickets on the ground, picking them up, putting them in bins. And together, the pitfall crickets and the hand collected crickets will all be used to maintain the diversity of the lab population.

Treidel: So, I should go there.

Roberts: Okay, I can do transect.

Saintsing: Oh, and a transect is…

Treidel: So, a transect is basically sort of a… well, we're using a transect as like a line. Back in 2018, we wanted to sort of have a systematic way of sampling the same sites every year, and so that's where we established the transects. And so with the transect, what we're doing is we're just setting out flags at 40 feet intervals in the same locations, and then we walk along those same flags, walk along those flags and observe everything we find in between all those flags for 30 minutes. And so basically what we end up having is a very systematic way of year after year looking at a same, similar distance in our field and recording for a similar amount of time what we find. When and where. And so that's what the transects, the purpose of the transects are serving is allowing us to get a picture of the same location year by year by year. This is what the population… how we can compare what the population is like in 2018 to 2020 or 2021.

Treidel: Okay, which one do you want?

Roberts: [inaudible]

Treidel: Okay, you're driving me. But you're gonna pick us up?

Roberts: Okay.

Treidel: Okay, sounds good. I'm gonna go find my… That's a good idea. I'll go find my headlamp now. Andrew…

Saintsing: Thanks, Lisa. Okay, so we finally got back to the headquarters, right? And actually here there are a lot more people, so I'm gonna take a minute just to introduce the rest of the field collecting crew. Oh, and this next part's pretty off the cuff, so bear with me. So, first off there's Andre. He's another member of the Williams Lab, but whereas I would say Kevin and Lisa are physiologists who study insects, Andre is very much an entomologist who studies physiology. I think over the course of this weekend he showed me like five different bugs he caught. There was an assassin bug, probably multiple beetles, a praying mantis. That was pretty cool. He didn't want to put that one in ethanol because I guess he felt that it had too much soul in its eyes. So, here he is describing to Caroline how to identify this fly. Oh, and that's Caroline whose lab this is. She's there too by the way.

Andre Szejner Sigal: So, thankfully, this is a fly that's easy to ID. Yeah, I was scared that we were, we needed like a specific bristle somewhere.

Saintsing: How did you identify it?

Szejner Sigal: It's just a pretty distinct color yellow fly with two epaulets in the wing bases. So, like two black dots in the wing base.

Saintsing: Oh, and I should say that these aren't just any flies. They're the flies that Lisa was mentioning earlier. She's actually had a run-in with them in the past.

Treidel: 2018 was one of my worst years sampling, and we know for a fact that there were these flies. There was probably a really high prevalence of flies, and there was a really, really, really, really, really low prevalence of crickets. So, these flies are bad news for the crickets because these are flies that are parasitoids, and basically they lay their larvae on the ground (which are the their babies), and then they infect the crickets. And then the cricket, the crickets basically get eaten alive. And so the larvae will sort of like eat on all the guts of the crickets, and then once they are big enough to develop, they come out, and they kill the cricket. So, it is a lethal infection. The infection takes a couple weeks though, and so I think that's kind of why… So, these flies have been or have been known to… in fact they don't just, they're not specialized on just the crickets at Sedgwick. They can infect a whole bunch of other crickets as well. They've been… their presence fluctuates year by year. There has been a good amount of research on them I think that the reason that the crickets field populations persist despite the parasitoid presence or absence is like because the infection period is quite long, and so they do have a window during which they kind of successfully like reproduce. And the population can go on.

Saintsing: So, anyway Andre's carved out a place for himself as the fly catcher.

Szejner Sigal: I need flies to have a large landing surface to crawl into, and they can't come out. So, at the moment the working model is some sort of like you know…

Saintsing: A funnel.

Szejner Sigal: A funnel, but what's the most efficient way to make a wide funnel?

Saintsing: He actually got really into that funnel trap that night. He spent a lot of time on it. The funnel gradually got bigger. It was pretty impressive by the end. Here he is describing it to Emily while Lisa's trying to wrangle everybody else and make sure everyone has tasks.

Szejner: I'm going to put it out there with some crickets, so it smells like cricket a little bit, and then the flies have a larger area to land on.

Saintsing: Emily's another grad student in our department. She's also a physiologist, but she's in the Vasquez Medina Lab, just like Kaitlin, who's also here. They both study marine mammals. So, Emily actually studies elephant seals. I went with her to do her fieldwork last spring, and we got to go to Point Reyes, and you know take pictures of elephant seals to see how hot they were. It was pretty fun. I haven't done any fieldwork with Kaitlin. Well, other than this trip. But Kaitlin collects elephant seal placentas, which sounds less fun. And then just to round out the non-Williams Lab grad students that are here, there's also Cathy. She's in IB, our department, but she's not actually a physiologist. She studies how bacteria interact with the viruses that infect them. She and Lisa's other roommate Jenny, who's also here, and I were all part of the same cricket collecting group last night. And we were led by Caroline's daughter Liana, who I think is starting middle school. But she led us to the top spot. We collected the most crickets that night. I mean not to brag or anything. Angie was also in that group. Angie didn't actually come as part of the Williams Lab group. You remember Lisa was saying like Sedgwick is part of the UC Reserve System, and so you know anybody in the UC system can try to use the facilities, the UC reserves, for their own research. Angie was doing her own plant ecology related research, we ran into her, and then she ended up wanting to come out and do cricket fieldwork with us on this night, Sunday night. Angie and Emily and I are all going out with Lourenco, who is another student in the Williams Lab. He actually just started his PhD, like this weekend, but he already knows the hell out of this thermal camera.

Lourenco Martins: And it takes a while to calibrate, but once it's calibrated, we take a photo with the trigger.

Emily Lam: Okay.

Martins: Um, and then once the photo… well, it'll give us like some sort of like ID for the photos, and so we'll just write down.

Saintsing: Oh, and the temperature of the crickets is interesting because…

Treidel: So, taking off to fly requires a lot of energy, and it requires a lot of heat. And so actually at night, it's quite cold. And so, that serves as a potential challenge for the crickets to warm up their body, and so they can't actually entirely rely on the environment to find a warm enough spot. They'll do what's called muscular thermogenesis. Basically shivering, where you can generate heat by shivering and contracting your muscles. And so they have a form of muscular thermogenesis where they'll like contract their muscles really, really fast and waste this energy to convert it into heat. And they'll keep their body up so that they can get warm enough so they can take off the fly. So, we're trying to take thermal images because, typically, you cannot see a cricket because they blend in so well they match the temperature of their environment that you can't tell them apart, but when a cricket is sort of getting ready to fly and it's warming up its wings, it will start to pop out, and it'll end up being warmer than its environment.

Saintsing: Right, so just trying to catch them in the act of shivering. And thermal physiology is actually a good segue into our last introduction, Nicki, who's a high school biology teacher and has helped the Williams Lab develop and test high school teaching labs about the subject. And I think that's everybody.

Treidel: Hi, Lucky dog.

Saintsing: Oh, yeah. Can't forget Caroline's constant companion. Oh, and I should mention that Sadia from the Williams Lab and Kevin's brother and future sister-in-law were all there on the trip, but they just had to leave before Sunday night. Okay, here's where I should probably confess that most of what I recorded was from the pitfalls and from the prep meeting before we actually went out. And as far as the time we spent walking around at night trying to collect crickets, I can tell you it was really cool sweeping your headlamp across the ground and catching all of the cracks where little tiny spider eyes would reflect up at you. Which sounds kind of creepy, but also it had its own charm. But more than anything, I just wanted to introduce you to everyone, and I wanted to end this episode with some audio from the night before. (Ah, scripted speech.) I guess it's important to say that this wasn't just any Williams Lab trip to Sedgwick. It was Lisa and Kevin's last as graduate student members of the lab. That's not to say they won't be back.

Treidel: Personally I very much hope to get back to Sedgwick.

Saintsing: But if and when they do return, it will be as post-docs or professors from different labs at different universities. You see, Kevin and Lisa and actually Cathy, too, all finished their PhDs this past August. They are now full-fledged doctors, and they've all left Berkeley to take the next steps in their careers. So, that Saturday night, we had a graduation party to celebrate the three of them. I tried to get some audio from the party

to share with you all, but I didn't end up getting much to work with. Like this is what I got from Kaitlin. Here with Kaitlin Allen.

Kaitlin Allen: Oh, no.

Saintsing: And from Emily. Why wouldn't I record it?

Lam: Because… there's no reason not to.

Saintsing: And from Andre. Andre refused to respond to this interview.

Szejner Sigal: I'm OK with that.

Saintsing: I don't know why, but people just really didn't want me to record them. It was weird. It wasn't like I was asking tough questions. I mean here's me talking to Cathy and Lisa. I'm here with Cathy Hernandez, and she says this isn't real fieldwork. Explain yourself, Cathy.

Cathy Hernandez: Oh, no. We have luxury housing conditions here at Sedgwick. Very luxurious.

Saintsing: How do you feel about this, Lisa Treidel?

Treidel: I think that the housing conditions are in the wild, and they're surrounded by coyotes and natural habitat, making it still legit fieldwork.

Saintsing: We have a disagreement here. Lisa called Cathy a liar. Cathy, do you care to respond?

Hernandez: We are in a field, so that's fair. I did see a coyote in the water fountain.

Saintsing: Well there you have it folks. That's what fieldwork's all about. Total softballs. Super friendly stuff. I guess some people just get a little microphone shy. Fortunately I did get to record some ambient noise from the dinner.

[Sound of a pig eating]

Caroline Williams: Moment of happiness.

Saintsing: Okay, yes, that was Caroline feeding the pig. Sedgwick has a pig. It's basically a farm. But I think that clip does a good job capturing the general mood of the party. I did actually get a pretty good interview with Liana from that night. Youngest grad student here, Liana. Liana, how's your grad student experience been?

Liana Williams: Um, whacking unicorns is awesome.

Saintsing: What are you trying to accomplish with this research?

L. Williams: I am trying to figure out how hard you have to whack a unicorn with a stick to discombobulate it.

Saintsing: What's the measure of discombobulation for a unicorn? How does one determine whether or not a unicorn has been discombobulated?

L. Williams: When the head falls off.

Various voices: That's important. Yeah, what about the candy? Yeah, you gotta poop the candy, or throw up the candy. Yeah, and then, or it like gets split, and it's got some candy fall out. Which stick is the weapon?

Saintsing: And that was Liana, the youngest and most violent of the grads. For those concerned, we weren't talking about a real unicorn, just a pinata. And I know what your follow-up question is, and the answer is yes. I was the one who broke the pinata. What can I say? I have a killer swing. Oh, and I went 10th, but that's probably not relevant. But in all seriousness, I think the real reason I wanted to do this episode was because I've gotten so used to having Kevin and Lisa and Cathy around over the past four years and now they've moved on to their next chapters, and I guess I just wanted some way of commemorating the transitional nature of this trip to Sedgwick. When you have to say goodbyes can make you ponder the nature of things, and what I've started to realize is that, in the end, the PhD really is the friends we made along the way. I'm so sorry. That moment got a little too heavy. I panicked, and I made a joke. Let me try it again. Scientific research is about looking for order amidst the chaotic noise of the world. When you're trying to figure something out, you have to control for all the other things that might throw you off. That's why tools like repeatable transects are important. If you want to see how a population of crickets is changing over time, you better make sure your observations are actually comparable. But controlling for the chaos of the world is easier said than done. Sometimes parasitoid flies decide to decimate your study organism without warning or a coyote decides it doesn't like your music. You just have to roll with it and adjust on the fly. And on top of whatever nature might throw at you, you have to navigate all the things that are going on in your own life and the lives of those around you. You often have to do research while doing ups and downs that have nothing to do with what you're studying, and because you can never really do research alone, getting anything done means trying to coordinate groups of people with their own ups and downs and varying interests, goals, and timelines. That's why finding the right community is so important in science. So, I'll take my moment to address the audience directly and say: studying science in graduate school can be difficult, and it can be frustrating, and it's not always the right choice for everybody at any given time. But if you have the opportunity and the inclination, it can be an incredibly rewarding experience where you can learn something about the world and about yourself. Just make sure, if that's something you choose to pursue, you surround yourself with a community of people who will put up with you, and support you, and push you to grow.

And I hope for your sake, that community includes someone with the infectious exuberance of Lisa Treidel.

Treidel: Magic. There is a magic in the grad life.

Saintsing: I'm Andrew Saintsing, and I've been talking about my trip to Sedgwick with the Williams Lab. Thanks for listening. Tune in in two weeks for the next episode of The Graduates.