POLLINATORS.INFO PODCAST EPISODE 1: INTERVIEW WITH DR. STEPHEN BUCHMANN

Quick Glossary of science terms that aren't explained in this podcast:

1. Pollinator: an animal that makes pollination happen.
2. Pollination: transfer of pollen from the anther to the receptive female organ of a flower (the stigma).
3. Anthers: parts of a flower that hold pollen.
4. Pollen: sperm-transport vessel for a flowering plant.
5. Stimuli: things that make (stimulate) something (to) happen. For instance, tasty-smelling food is one stimulus that can make your mouth water.
6. Flight room: an enclosed area in which flying animals are allowed to fly around.
7. Foraging: looking for food.
8. Quantifying: counting some aspect of a thing. For instance, counting the number of times a bee buzzes when it lands on a flower.
9. Macro camcorder: this is a video camera for making videos of tiny things.
10. Thermally: in relation to temperature. For instance, I don't like being cold, so 30°F is not the right climate for me thermally.
11. Chemical assay: a particular type of chemical test. For instance, a chemical test that measures the amount of protein in pollen is called a "crude protein" test.
12. Mutualism: a relationship in which both parties benefit.
13. Stone fruits: the ones with a really hard "pit" in the center, like peaches, nectarines, and cherries.

Athena: Hi there, thanks for joining us today; this is pollinators.info podcast episode 1. I'm Athena Rayne Anderson, the author of pollinators.info. It's July 20th, 2011, and today I'll be interviewing Dr. Stephen Buchmann, co-author of The Forgotten Pollinators and several other books, he's the International Coordinator of NAPPC, the North American **Pollinator** Protection Campaign, and he's also an adjunct faculty member at the University of Arizona in Tucson. Today I'm going to be talking with Dr. Buchmann about buzz pollination, or sonication.

ARA: Can you give the listeners a description of what that means?

Dr. Stephen Buchmann: Sure. Buzz **pollination** is really amazing. It's something that I've been working on, off and on, since high school, actually. It's just fired up my imagination. If you look at the flowers of a tomato, eggplant, blueberry, or cranberry, those are typical crops that need to be buzz pollinated, and it really means that the **anthers**, instead of having loose pollen all over them, have little holes in the tips of the anthers and that is really the only way the pollen can get out of the flowers. So, bees literally turn themselves into living tuning forks; things like bumble bees. Honey bees, for some weird reason, can't buzz flowers like that. But anyway, bees like bumble bees will land on the flower, bite into it, and sonicate, or buzz the pollen out of the flower. And it happens very quickly; it can happen in just a few tenths of a second. And it makes kind of a comical noise, the buzzing of the bees on the flower, so I just tended to call it buzz pollination. It is a very efficient type of pollination so that bumble bees using the buzzing on

tomatoes, or blueberries, cranberries, a number of plants... kiwi fruit, actually, in New Zealand, can vibrate the pollen out about 400 times faster than a honey bee can [get the pollen] just kind of scrabbling around in the flowers. It's pretty neat. It turns out that about 8% of the world's flowering plants have those funny little holes, those pores, in their anthers, and have some kind of bee that comes along and vibrates them to get the pollen out.

ARA: Ok, did you say 8% of flowering plants?

SB: Yeah.

ARA: Ok, so you already mentioned that bumble bees can buzz pollinate, and that honey bees don't. Are there other bees that are good at it?

SB: Yeah, there are bees in the sweat bee family, the Halictids, so, brilliant metallic green bees like [the genus] *Agapostemon* and others, that will go to tomato blossoms and that sort of thing. Then we have the giant black carpenter bees, which occur over much of the United States, we have quite a few of those in Arizona, and they are really adept at the buzzing, so they're great at buzz pollination too. So, a fair number of bees do it. There are some exceptions; the leafcutter bee family, we don't really know of anything in that family that does it. And honey bees. So, those are the two main exceptions.

ARA: Ok, so what are you currently involved in dealing with buzz pollination?

SB: Yeah. What we're doing with buzz pollination, I'm actually working with Dr. Stan Pappage and [Dr.] Annie Leonard, one of his postdocs at the University of Arizona in the Ecology and Evolutionary Biology Department. So, we're using real flowers and artificial flowers, you might think of them as sort of robotic flowers, to kind of tease out what are the **stimuli** that make the bees buzz. So what is is about a flower that will make one of these bees [buzz], and we're working with bumble bees- commercially available colonies of a bumble bee called *Bombus impatiens*. And so we have these in a laboratory and in the **flight room** we're presenting the bees with different combinations of flowers and different shapes and just trying to figure out what is it about certain flowers that indicates to the bees that, "Hey, this is a flower you need to do this fancy buzzing on."?

ARA: Do you have any results for that yet?

SB: Not too much, we're just starting the study. We're at least getting bees to visit our artificial flowers, which are kind of interesting, and we designed some artificial anthers so we're changing colors and size and shapes of those to see what difference it makes on the bumble bee **foraging** behavior.

ARA: Ok, and what are some particular challenges that are involved with this work?

SB: Mainly **quantifying** the behavior, so we're actually using a little **macro camcorder** so when the bees land on the flowers, whether they're the real flowers or the modified artificial flowers, we videotape them and then we have a little tiny microphone mounted nearby. So if they do vibrate the flowers, we can actually hear the buzzes that the bees make, and we can quantify them and count the number of buzzes, the duration, the frequency of the vibration, that sort of thing. So, that's the biggest challenge: really trying to quantify and see exactly what's happening.

ARA: What has been your favorite part of this work, or what's been the most rewarding part of it?

SB: Just working at it officially. I hadn't worked on buzz pollination for 4 or 5 years, so it's kind of nice to get back into it and to be able to work with it in a controlled situation. Sometimes the vagaries of working in the field can be pretty challenging and really exasperating, so it's nice to be able to control the stimuli that we're giving the bees and do it in the setting in the laboratory. So, I think that's been the most fun so far.

ARA: Yeah. What are some broader impacts and how this research, and buzz pollination research and understanding in particular, can benefit the public?

SB: I think just making the fact known that the blueberries, cranberries, eggplant, kiwi, tomatoes, some peppers... that some of these important crops, like tomatoes, are dependent upon bees for fruit set. For example, the world's largest greenhouse is located about three hours from my house, near Wilcox, Arizona, Bonita Nurseries, and they have almost 400 acres of glass greenhouses. They grow 1/6 of all the TOV, tomatoes on the vine, for the United States. So it's a huge, huge, you know, billion dollar operation, and people are not running around in there with little tuning forks. I mean, they buy bumble bees, and bumble bees are pollinating the crop, so they're essential to the crop. Just like many of these crops, tomatoes, peppers, and eggplants that the home gardener might grow in their yard are dependent upon bees that they don't know exist, or that people don't observe. A lot of times this buzz pollination happens really early in the morning, right around sunrise. So a lot of people might get up at, you know, 8 o'clock and have a cup of coffee and walk out into their garden at 9 or 10 o'clock and they don't see any activity because, well, it was happening five hours earlier.

ARA: Aah. Do you know of any research explaining why they do it so early?

SB: No, not really. A lot of these bees, especially bees in the desert southwest just start foraging really early in the morning. I mean, it may have something to do with it just being too hot later and maybe not right **thermally**. Also, there's probably also an advantage to being some of the first bees to hit the flowers that are full of pollen. A lot of these flowers, like tomato blossoms, do not contain any nectar; they're pollen only. But the pollen is a super-rich food. I did some chemistry on it years ago and I found that protein content of average pollen from a typical [non-buzz pollinated] flower would be 20 or 30% crude protein, and yet I found some of these wild

deadly nightshades in the genus *Solanum* and then also *Licopersicum*, the tomato genus, had wildly high values of crude protein- up to 60, six-zero, percent protein in the pollen.

ARA: So, the crude protein is better for bees than another kind of protein?

SB: No, the crude protein is just a **chemical assay**, but a higher protein value is better, so the fact that most flowers are producing only 20 or 30% protein, and the pollen from almost all of these buzz [pollinated] flowers that I've looked at is 40, 50, even 60% just makes them a super-nutritious resource for the bees.

ARA: Ok, so the last question is, as a pollinator researcher, what would you recommend for people who want to help pollinators? What are one or two things that they could do in their lives or on their property that would be beneficial?

SB: Sure. First thing I would say is actually, may sound kind of funny, but don't be so neat and don't chop everything down. For example, standing dead trees or even a dead branch in a tree is important to leave because there's an intense partnership, almost a **mutualism**, between beetles and bees. And so, when wood-boring beetles, especially in the families Buprestidae and Cerambycidae, when their larvae tunnel out of the wood and they become adults, they leave those tunnels, those galleries, behind. And 10 or 20%, at least, of the native bees in an area are what we call leafcutter or mason bees, which tend to be excellent crop pollinators, especially of different **stone fruits** and sweet cherries, lots of fruit trees, those mason bees and leafcutter bees can't dig their own nests in wood. So, they rely on finding a pre-existing cavity or hole. So female leafcutter bees and mason bees move into those holes based on the size; they select them and then that becomes their nest. So it's really important to leave the odd dead branch or, if you have a large property, a dead tree, because it's not just important habitat for pollinators, but also for other wildlife [like] lizards and birds. So that's one thing.

The next thing I would suggest to people is to use as many native plants as possible, native to their local area or region, because they are adapted to the local pollinators and they don't require huge inputs of fertilizer and water. They can pretty much take care of themselves and they're used to the local soil and climate conditions. So by using either native plants or older heirloom varieties, you get away from utilization or dependency upon hybrids. And if you go to nurseries and buy hybrid flowers, a lot of times these have been selected by plant breeders for human sensibilities, not for the pollinators. So a lot of times they don't have enough nectar or pollen, or sometimes not even any of those things, to support bees and other pollinators. So that's important to do.

People should also plant in clumps, not just one plant, but 4, 5, 6 of the same kind of plant in a clump because those are more attractive to pollinators.

They should make sure that they have plants that bloom throughout the year, spring, summer, and into the fall, because it's really important for certain bees, especially things like honey bees, bumble bees, and carpenter bees, which have very long-lived associations, that they need

nectar and pollen throughout the year. So you can bring pollinators into your yard and garden by having a diverse... having diverse flowering plants and making sure that things are coming on when other things are going out of bloom. So, kind of a steady bloom through the year is best if you can manage it.

ARA: Ok, so leaving branches on your property, planting natives, uh, planting in clumps...

SB: Yeah... gardeners need to be mindful that 90% of the bees in the world are ground-nesting, so they require compact, open, sunny spaces to nest. So if you go around and mulch everything with black plastic, or redwood bark, or under concrete paths, you're destroying nesting and living habitat for native bees. So you need to have kind of a light hand with mulching and that sort of thing.

ARA: Right, so be friendly to the messy spaces, basically?

SB: Yep.

ARA: Alright, well thank you so much, Dr. Buchmann, for joining us.

SB: Sure!

ARA: Once again, thanks for joining me. My name's Athena, I'm the author of pollinators.info. If you'd like to be a member of the Pollinator Conservation Movement, just go to www.pollinators.info and click on "Subscribe Here" and enter your information, and you'll get a free weekly email newsletter and some occasional other updates and notices of when you can look forward to other future podcasts. Thanks again, take care.