POLLINATORS.INFO PODCAST EPISODE 5: INTERVIEW WITH DR. TED FLEMING

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

- Columnar cacti: these cacti grow in what look like columns. Saguaro has one main stem with smaller stems that grow from its sides. Cardóns have more than one stem growing up from a base.
- Reproductive success: this describes an individual's ability to reproduce; in this case, become pollinated and set seed.
- Geographic variation: this is something that changes with some aspect of the landscape. In this case, the saguaro pollinators change with latitude.
- Netting: scientists use a fine mesh net, called a mist net, to capture birds and bats, without harming them, for study.
- Bagging flowers: by putting a mesh bag over a flower, a scientist can prevent animals from visiting it. If flowers that were allowed to be visited have higher fruit set than those that weren't, this suggests that the animal visitors were important pollinators.

Athena (ARA): Hi there! I'm Athena, the author of pollinators.info, and you're listening to podcast episode 5. This is an interview with Dr. Ted Fleming and he's going to be talking with us about lesser long-nosed bats and pollination of saguaro cacti, and also his research monitoring hummingbird feeders in the southwestern US.

So, how would you describe your position, or what is it that you do?

Ted Fleming (TF): Well, for almost 40 years I was a university biology professor, and I retired in 2008. I guess I'm retired in quotes, because my wife would deny that I'm really retired. I'm very busy with an academic schedule, even though I'm not teaching very much, but I'm writing, giving talks, and attending conferences.

ARA: So, how would you describe your work with the bat and the cacti in their natural environment, and then with the feeders?

TF: Well, in 1989 I was invited to begin looking at the role of the lesser long-nosed bat as a pollinator of giant **columnar cacti** in Sonora, Mexico. In 1988 this bat was declared federally endangered, both in the United States and in Mexico, so there was quite a bit of concern as to what would happen if this bat were to disappear.

How would this affect the **reproductive success** of giant cacti, such as saguaros, organ pipes, and cardóns? So, Merlin Tuttle, the founder of Bat Conservation

[International], and I got a grant from National Geographic to do experimental studies demonstrating the importance of these bats as pollinators [for] these giant cacti.

ARA: Ok, so how long did you do that study?

TF: Well, we began in 1989 and it really ended in 2000. By that time we had lots of experimental evidence, from our study site in Sonora, Mexico, as well as one study site in western Arizona- the Organ Pipe Cactus National Monument, that bats are indeed important, but not the exclusive pollinators of columnar cacti.

It turns out that, in the northern part of the range of these cacti, which is the Sonoran Desert, bats, as well as birds and bees, are important pollinators. In contrast, if you go farther South, in arid parts of Mexico, and also in the arid parts of tropical Venezuela, bats become the exclusive pollinators of the columnar cacti there.

ARA: Interesting!

TF: In the northern part of the range, bats share pollinator duties with diurnal species, such as birds and bees.

ARA: So, which birds are involved in the cactus pollination?

TF: Well, in the Sonoran Desert, the saguaro cactus is most heavily pollinated by white-winged doves, and organ pipe cactus are most heavily pollinated by hummingbirds.

ARA: Oh, interesting!

TF: Only the cardón, of the three that we've studied intensively, relies almost exclusively on bats for pollination.

ARA: Ok, neat! Did you guys do any research into why there might be a difference in pollinators from the northern to the southern range of the cacti?

TF: Well, the key difference in the **geographic variation** is the resident or migrant status of the bats in a particular area. In the Sonoran Desert, the nectar-feeding bats are only seasonal and their numbers fluctuate from year to year.

Farther South, in arid parts of tropical Mexico, as well as arid tropical Venezuela, the bats are residents year-round, so they are a more reliable visitor in the tropical latitudes than they are at northern lats. And, as a result, species such as saguaro really shifted in

the time of flower opening and closing to take into account the greater reliability of diurnal birds as pollinators.

ARA: So, what's a little bit about the monitoring that you're doing with these bats and hummingbird feeders?

TF: Well, it turns out that nectar-feeding bats are residents in southern Arizona from spring to the fall, but they feed on different flower resources during this period. Early in spring and in the summer, they're feeding on flowers and fruits produced by columnar cacti. In the fall of the year, they switch their feeding to century plants- agaves- which occur out of the desert zone in a little higher elevation. So, the bats are pretty much supplied with flowers from the spring through the fall.

But we know that lesser long-nosed bats and Mexican long-tongued bats have been frequent visitors to hummingbird feeders [in eastern Arizona] for decades. But, beginning in 2006, people throughout Tucson [Arizona] began to find that their hummingbird feeders were being drained at night, and when they watched their feeders at night they saw nectar-feeding bats visiting them.

This is a new phenomenon. So, it turns out that lesser long-nosed bats spread throughout the greater Tucson area as visitors to hummingbird feeders only in the past few years. We are now monitoring this phenomenon and we have a network of over 100 citizen scientists who report to us via a website. And, people are reporting when the bats first show up in their yards in the late summer [and] early fall, when they leave their yards in the fall, [and] when the peak numbers of bats occur. And many of these people have taken digital photos of the bats so that we can identify which of the two species are actually visiting their hummingbird feeders.

ARA: Ok, neat! Can you tell us a little bit about the bat's life history? So, we're mostly talking about the lesser long-nosed bat... so, what does it look like, and just a little bit about its reproduction and natural history?

TF: Ok, the lesser long-nosed bat is a very handsome bat; I've worked with bats in many places in the world, and it turns out that the lesser long-nosed bat is my favorite bat. Adults are fawn-colored and they have big, bright eyes, and a somewhat elongated snout. They have a little flat triangular flap of skin above their nose, which identifies them as [part] of the American leaf-nosed bat family.

These bats are specialized nectar feeders, but they don't eat nectar exclusively. They also eat fruit; they will eat fruit of the columnar cacti, whose flowers they pollinated.

They also eat insects occasionally. These bats are migratory; they spend their winter in south-central Mexico. In the fall of the year, females and males congregate in particular mating caves. Females become pregnant a month or so later and they begin to migrate North, feeding on the flowers of columnar cacti.

By early April, they are in northern Mexico and in southern Arizona and females form maternity roosts. These roosts can contain tens of thousands, and one roost contains over 100,000, pregnant females. Females give birth to a single baby, beginning in mid-May, then the mother nurses the baby for about 6 weeks, then the young is nutritionally independent [from] mom, but it still forages with its mom when its mom is out visiting flowers or fruit. So the mother-young pair, we think, we don't have banded bats so we can't know for sure, but the mother-young pair probably stay together for most of the season when they're in the North.

Then all of the bats migrate back down South, beginning in early to mid- October. The bats are here in our yards in Tucson from about mid-August to mid-October. Very few adult males migrate North. Females actually do have to migrate in the case of lesser long-nosed bats, because they're migrating from southern Mexico to the Sonoran Desert, where you have an abundance of flower resources [and] fruit resources- much higher than would be the case in south-central Mexico.

ARA: So, can you tell us a little about the natural history of the saguaro?

TF: Well, the saguaro and the cardón are two very iconic species in the Sonoran Desert. The saguaro, of course, is the dominant columnar cactus around Tucson and southern Arizona. The cardón doesn't get quite as far North; it's restricted pretty much to Sonora and Baja, California.

They're both very large, they get to be 20 meters tall (about 60 ft.), sometimes they weigh tons; they're huge plants. They produce lots of flowers. In the case of cardón, the plants are highly dependent on bats. Saguaros are "hedging their bets," and make their flowers more available to diurnal visitors, such as the white-winged dove. Flowers open first shortly after sunset in the case of the cardón, a little bit later in the case of the saguaro.

Flowers of cardón close the next morning [permanently], an hour or so after sunrise, whereas the flowers of saguaro stay open until that afternoon. So, the saguaro flowers are exposed to diurnal visitors for a much longer period of time. And, it's no surprise to find that saguaros are much more cold- tolerant and are the most northern in distribution [of the columnar cacti], because they can have pollination by birds throughout their

range, whereas bats are not pollinators North of Tucson, for example, in Arizona. Saguaros go much farther North in Arizona than just Tucson and white-winged doves are the ones doing the pollination up there.

ARA: What are some major results from the studies that you did?

TF: Well, we found some very fascinating things. For example, it takes about 8 or 9 flower visits to recoup the cost of flying up to 25 miles- that's 8 or 9 visits out of a total of 100 or 120 flower visits a night. So, it's a really low cost to commute long distances to good feeding areas.

ARA: So what are some results that you're getting from people sending you information about the feeder usage?

TF: Ok, what we're learning is that in most years, bats arrive in people's yards on a very predictable date. In my yard, for example, they arrived on the 3rd or 4th of September in 2009 and 2010. Things changed this year; the bats in my yard, and in many other yards, began arriving at least 2 weeks earlier. We don't know why this is, but we think it's linked to the availability of natural food resources, such as the agave, or century plant. This was not a particularly good flowering year for those plants and so the bats probably moved into the urban areas earlier than they normally would because of the absence of food resources in the wild.

We also know that the majority of people are tracking 10, 15, 20, 30 bats coming to their yard to their feeders. In my yard, I typically get 2-5 bats visiting my feeder per night. This year we actually **netted** bats in my yard one night and we caught 12 different individuals. More bats were feeding in people's yards this year, which suggests, again, that their natural food supplies were low this year.

Most people, once they begin monitoring these bats, get hooked on it. They love the bats! They're very tolerant of being observed at very close range, they don't mind being photographed, so lots of people get great pleasure out of discovering that they have nectar-feeding bats coming into their yards on a seasonal basis.

ARA: Yeah. That would be so neat! So, has there been some sort of major change in habitat destruction or flowering that you all think has driven the bats to use feeders, or is it just that they're just such a good source [of food] that they're using them because they're there?

TF: Well, I think it's a very opportunistic thing. Once the bats discovered that feeders were everywhere, I think the word spread. We have no evidence of this, but just the behavior suggests that there had to have been communication. The year 2006 was definitely a year of low agave flower availability. They were forced to feed into town, and once they got hooked on this nectar, they kept going back year after year.

ARA: Interesting... Has anyone looked at the actual nutritive content of the sugar at the feeders? Are the bats getting the same kind of nutrition that they would at an agave?

TF: We know the sugar content, because we can control the sugar content of our feeder nectar. It's pretty much the same as the bats would encounter in either cactus flowers or agave flowers; about 25% sugar. That's fine. But what is missing from feeders, of course, is pollen.

The bats really need pollen to build proteins. Pollen grains have amino acids and the bats can digest the grains, get the goodies out of the grains, and with the amino acids they can build proteins. They don't need to eat insects because they can get a balanced nutrition from the nectar and the pollen from natural cactus or agave sources.

So the feeders only supply the energy that the bats need, but we know from just watching the bats, and taking pictures of the bats, that they come in with pollen on their faces in some cases. And they know they can discover pollen sources, most of these are exotic plants, plants that aren't really native to the Sonoran Desert, such as the night-blooming cereus cactus, which is a plant from farther South. But the bats discover these little pockets of good pollen sources, so they actually do get a balanced diet as a result of feeding on nectar in the feeder and then finding supplementary flower sources.

ARA: Now, what has been your favorite part about the work with this bat?

TF: Oh, it's just watching the bats interact with the flowers. I've sat out in the desert, staring into night vision scopes. Actually, sometimes when I'm doing experiments up on a ladder, **putting bags over flowers**, I can see these bats in action right up-close [and] it's always a very fun thing. And again, in my own backyard, I can stand out near a hummingbird feeder and watch these bats come in. And they forage in groups, so I can see 2 to 4 or 5 bats zipping around my yard and visiting my two hummingbird feeders on a regular basis. So, it's a very pleasant thing to do.

ARA: What are some broader impacts of this, just so that the general public, or someone who doesn't know much about bats or desert ecology, if they're listening to this, how can we make it so that they understand that this is important to them?

TF: Well, the general importance is much greater than just our studies of lesser long-nosed bats and cactus. There are, in the neotropics, 38 species of nectar-feeding bats. They're visiting hundreds of species of plants, and some of these plants, like the columnar cacti and kapok trees, are some of the dominant plants in their particular habitat. Certainly, if the bats were to disappear from southern Mexico, columnar cacti down there would be in big trouble; we wouldn't have columnar cacti.

Tequila is an extremely valuable resource in Mexico, as I'm sure you know, and tequila plants, the agave, ancestrally evolved to be bat pollinated. Now, tequila plants don't need bats for pollination because they are harvested before they put up their flowering stalks. But nevertheless, if we didn't have nectar-feeding bats, we wouldn't have agaves that produce a very important crop.

And around the world there are just a number of very important resources, bananas for example, that are ancestrally bat pollinated. Bats have played a very important role in the evolution of flowering biology in many species, many families, of tropical and subtropical plants. And some of these species have very significant economic importance.

ARA: Ok, what would you recommend to people that want to help bats in particular, or pollinators as a group?

TF: Well, have a very positive attitude towards bats, rather than a negative attitude. I think, certainly in Latin America, also probably in the United States and Canada, the general public has a negative view of bats because they get bad press whenever there's a case of rabies. So, everybody fears bats because they transmit rabies.

Well, dogs, cats, skunks, raccoons, you know, lots of mammals transmit rabies. Bats are no more likely to be infected with rabies than lots of other mammals. And they certainly aren't likely to transmit rabies to the general public. It ain't gonna happen. It happens rarely- Merlin Tuttle often said you're more likely to die of food poisoning from a church picnic than from rabies transmitted by a bat. Or you're more likely to be struck by lightning. Of course, more people die [every year] from bee stings and anaphylactic reactions than die from rabies from bats.

ARA: Ok, well Dr. Fleming, thank you so much for your time!

TF: Yeah!

ARA: Once again, you've been listening to pollinators.info podcast episode 5. This was an interview with Dr. Ted Fleming who was talking with me about lesser long-nosed bats and pollination of saguaro cacti, and their use of hummingbird feeders in Tucson, Arizona [US]. If you'd like to learn more about pollinators, just visit www.pollinators.info. And if you'd like to keep up with all the latest from pollinators.info, subscribe to the free weekly email newsletter. You'll also get discounts on upcoming product releases, a free e-booklet about killer bees, and several other goodies that you can look forward to. So, thanks again, take care, and listen in next time!