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Hunting for wild bees to understand the drought

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It was June 21, the summer solstice, and the sagebrush landscape of the Rio Grande del Norte National Monument had a flat, washed-out look under the stark light of the dry, cloudless day. But the harsh light couldn't hide the twinge of excitement in Oliva Carril's face as she stooped down to a prickly pear cactus, where a small, bulgy bee was tucked into its pale yellow flower.

"I love deserts. I love feeling I might be finding something new, and I love hiking, taking pictures and doing it all with my kids," Carril said, her two young girls in tow as she walks around looking for bees in a stretch of the rugged landscape outside of Cerro. Carril, an entomologist from Santa Fe who works throughout the high-desert environments of Northern New Mexico, is leading a foundational study of wild, native bees (any bee but a honeybee, *Apis mellifera)* in the national monument.

But it's not all fun and games. With humans needing to understand shifting ecosystems and our place in an extreme environment that's only getting more extreme thanks to changing climate, the data is an investment in the long haul.

In a "normal" year, the bees usually found perusing for nectar in prickly pear cactus would be a welcome though boringly familiar sight. But this summer, the desert pollinator *Ashmeadiella* is a rarer find because of the pronounced drought that has crept over New Mexico over the past year.

While droughts are par for the course in the arid Southwest, the grip of this particular dry spell has been worrying; farmers, firefighters and people who need shallow wells for their drinking water have all kept watch on the dry conditions. A lack of snows and then a shortage of rains has also meant fewer flowers. And fewer bees.

Nonetheless, Carril's research presses on. Besides being "fascinating and beautiful," bees and their unique and vital role in a functioning ecosystem have to be understood before the landscape changes too much, she said.

New questions

Curious as native bees are, scientists know this much about them: bees are most diverse in arid places like New Mexico. Go to a jungle to study frogs, but come to the desert to study bees. The only place that rivals the American Southwest in bee diversity is the Mediterranean, with its sandy soils and just-right climate.

Bees quite possibly number between 20,000 and 30,000 species worldwide. North America alone is likely home to about 4,000 species while New Mexico has about a fourth of the bees found on the continent. And Taos County — though official databases list fewer than 40 species — is likely home to at least 400 species of bees, Carril said.

Carril's research in Taos County looks at the types and numbers of bees found in the national monument, along with what months they're out and what flowers they're pollinating. When Carill's

research wraps up in about a year, her collection of the native bees will be the most complete study of its kind for this part of the state.

But her research isn't the only work that's attempting to take the guesswork out of the native bee landscape.

Karen Wright, a doctoral candidate at the University of New Mexico who now works in the insect collection at Texas A & M University, conducted similar research at a long-term ecological research project at the Sevilleta National Wildlife Refuge located about an hour south of Albuquerque.

She designed and launched the study looking at the native bees and what they're eating in 2001. It's now in its 17th year and is one of the longest-running and meticulous data sets in the world for native bee research.

In 1906, T.D.A. Cockerell came to New Mexico to collect bees. Cockerell found an incredibly rare specimen, *Osmia watsoni* , a "really striking, beautiful bee" of metallic blues and greens with red hairs, Wright said.

Cockerell published the first list of bees for the area. It was the only list for about a century.

That's when Wright designed and launched her study. She also found *Osmia watsoni* . Turns out, the bee is very common in that region, "but nobody saw it again" until they actually looked.

So it goes with the study of a lot of native fauna. Even though native bees pollinate most plants in the world, the science about them and funding to do it hasn't caught up. Just asking the questions and collecting the bees is a big step toward understanding the local ecosystem.

Carril's research in Taos County not only lays the foundation with an initial count, but also possibly sheds some light on the impacts of grazing and wildfire on bee communities. And after 2018, it'll have an extra element: the drought.

Carril wonders what the impact of drought will be on native bees. But within that are many more questions: Are twig nesting bees differently impacted than ground-nesting bees? Are specialists that feed on only one flower, like Ashmeadiella, differently affected than generalists that can pollinate almost anything? What's the role of habitat? And are wetter places like the banks of the Rio Grande, or places at different elevations, better for native bees during bone-dry summers like this?

"I didn't know it'd be a drought," Carril said of the timing for her study. "But here it is, so let's ask the questions and see what we can learn."

Swipe, sweep and swat

At times, the field work has an element of wandering around, but not aimlessly. Like Wright, Carril designed her study with rigor so that another scientist can repeat the research decades down the road. This ensures the data has a long shelf life.

In 2016, she established five plots, each 100 meters by 100 meters, in key spots in the monument.

Carril has two sagebrush plots, one on each side of the Rio Grande Gorge. Cattle run on an allotment on the west side, giving her a chance to look at the impacts of grazing.

She also has two pinon-juniper plots; the eastern one is a hike from the visitors center, the other is in the burn scar of the 2015 Perdida Fire. (The name comes from the Spanish word for "lost." Funny enough, the smallest bee in New Mexico, *Perdita minima* , named that because scientists kept losing specimens due to its size, lives in the burn scar).

"Every location has a different suite of bees. They're super localized and don't travel far," Carril said.

In each standard-sized plot, she and her field tech arrange 30 plastic cups from corner to corner in a giant X. .The cups, already spray-painted fluorescent yellow and blue, are filled with soapy water. They leave the cups out for three hours at a time and at the end of the day usually, have a few bees in the “pan traps.”

They also wander through the boundaries of each plot, looking for any trace of a flower or bee. And they collect along the road (in a drought year, the roadside has some of the best flowers due to runoff from the pavement). If they find a flower buzzing with bees, they’ll swipe, sweep and swat them into a net.

Obviously resilient, but how much

When you find something, maybe as simple as a Ashmeadiella or as special as a devilish, red-eye Centris (the northernmost recorded location of the bee), it’s exciting work, a momentary boost on the hot, dry days wandering through flowerless fields.

But collecting the bees is only the first step. Each specimen — thousands and thousands — has to be identified, pinned in an insect collection and the data set analyzed for trends to give context to the blips of excitement in the field.

As Wright can attest, there’s “definitely a lag time” to parsing through the data. Her work, like Carill’s, is painstaking.

It takes hours upon hours of microscope work to identify each bee down to the species level. Wright now has nearly 15 years worth of data for bees and the flowers they pollinate south of Albuquerque, making it one of the most comprehensive data sets for native bees in the world.

Wright abandoned any notion of hoarding the data a long time ago. Graduate students, professional researchers and people like Carill are all analyzing the information and beginning to find out new understandings of how bee communities change from one year to the next.

“We know the bees are very resilient to drought. They have to be, or they would have gone extinct a long time ago,” Wright said.

Wright has found in her research that in the desert, only half of flower species will be the same from one year to the next. “There are drought years where there is nothing in bloom. And I mean for miles. You don’t see the specialists the years the flowers aren’t there,” Wright said.

The bees’ resiliency shows up in surprising ways. A particular species can disappear for years at a time if their particular flowers aren’t in bloom.

But like clockwork, when the flowers show up again, so will the bees. Generalist bees tend to turn up most years, but the best working theory for specialist bees is that they respond to the same environmental cues as the plants they pollinate, such as soil moisture or temperature.

In the same way plant seeds lay dormant in the ground, so do bees. There’s an elegance to the mirroring. In the absence of many flowers in the national monument of Taos County this year, bees are few and far between.

Aside from this punctuated drought of 2018, a longer drought has been going on for the extent of Wright’s study in the Sevilleta National Wildlife Refuge. “There’s no real way to tease apart” the drought from climate change, she said. “We haven’t sampled long enough.”

It can take decades to understand what sort of impact the drought has on the bees. As Wright said, she hopes the Sevilleta study goes on long enough to see the long drought wane for five or six years, giving

researchers a chance to observe bees outside of the dry stretch. But to understand something with an even longer arc — climate change — will take more than even 17 years worth of data.

Both Carill and Wright's research sets the stage for better understanding climate change down the road, though some early evidence in studies of agricultural crop-pollinator interactions has indicated that some of the environmental cues that keep bees and their flowers in step could be losing their rhythm.

"If a plant responds to temperature and germinates, but the bees are programmed to come out when the soil moisture reaches a certain percentage," then losing the synchronicity between those cues could be disastrous for the diverse bees of the desert," Wright said.

"We can ask: Are they locally extinct or is this a down phase," Wright said. "But it's only in hindsight we can say that they're gone. Us humans....we can't see the evidence until it's already done."

In the meantime, they have to keep searching for bees, gathering the data that will outlive any of the scientists involved in it. They're the T.D.A. Cockerells of the 21st century.

The sun was barely past its peak on the summer solstice as Carill watched a bank of clouds trying to form over the Sangre de Cristo Mountains. It would be weeks before it really rained, and a few more flowers started showing up in the vast stretches of the monument.

"We need the monsoons," Carill said, still looking for another cactus blossom, another bee. "The spring may have been a wash this year, but I'm hopeful for the fall."

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— Karen Wright, bee scientist

Olivia Messinger Carril, of Santa Fe, fills yellow and blue plastic cups with soapy water June 21 to lure native bees as part of a foundational study in the Rio Grande del Norte National Monument.
Morgan Timms

A leaf cutter bee pollinates a showy milkweed flower Thursday (June 21) near Questa.
Morgan Timms

Olivia Messinger Carril, of Santa Fe, captures native bees on cactus flowers in a vial Thursday (June 21) in the Rio Grande del Norte National Monument.
Morgan Timms
