

Insect-eating bat outperforms nectar specialist as pollinator of cactus flowers

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The lesser long-nosed bat feeds on nectar and pollen from cactus flowers. Credit: Winifred Frick

(Phys.org)—Of the two bat species known to visit the flowers of the cardon cactus in Baja California, one depends entirely on nectar and is highly specialized to feed from the flowers, which are adapted for pollination by bats. The other is an insect-eating bat best known for its ability to hear the footsteps of large insects and scorpions and capture them on the ground.

In a surprising result, scientists at the University of California, Santa Cruz, have found that the insect-eating pallid bat is a more effective pollinator of the cactus flowers than the nectar-feeding specialist, the

lesser long-nosed bat.

"The lesser long-nosed bat is highly specialized for nectar-feeding and was thought to be the primary pollinator of the cardon cactus. But when we measured their effectiveness, we found that the pallid bat actually delivers about 13 times as much pollen per visit," said Winifred Frick, a research scientist at UC Santa Cruz. Frick is first author of a paper on the new findings published online in [American Naturalist](#).

The study highlights the complex nature of the mutually beneficial relationships between plants and their [pollinators](#), which in most cases have evolved together over long periods of time. There are often conflicts of interest between the partners, according to coauthor Kathleen Kay, assistant professor of ecology and [evolutionary biology](#) at UC Santa Cruz.

"What is actually happening in terms of how species are mutually interacting can be more complicated than what meets the eye," Kay said. "You would think the coevolved species would be a better pollinator than a naive interloper. But the adaptations for nectar-feeding of the lesser long-nosed bat are to enable it to get more nectar, not for it to do a better job pollinating."

Frick said several factors may explain the difference between the two [bat species](#) in pollination effectiveness. The lesser long-nosed bat is able to hover at the open cactus flowers and uses its long tongue to extract the nectar, transferring pollen from one flower to another in the process. The pallid bat, in contrast, has to land on the flowers and plunge its head deep inside to get to the nectar, resulting in longer visits and more copious accumulations of pollen on its head. In addition, the lesser long-nosed bat relies on pollen as a source of protein and regularly grooms itself during a night of flower visits, removing some of the pollen from its fur and eating it.



The pallid bat mainly feeds on insects, but is also an effective pollinator of cardon cactus flowers. Credit: Winifred Frick

Frick, a bat ecologist, had observed pallid bats visiting cardon cactus flowers during earlier research projects in the area and knew that the bats often had pollen on them. For the new study, she teamed up with Kay, an expert in pollination biology and plant evolution. They monitored cactus flowers at 14 study sites in Baja California, working with a team of student assistants from Mexico and UC Santa Cruz. The cardon cactus is a large columnar cactus and is the dominant plant species in the study area. When the researchers saw a bat visit a flower, they would identify the species, climb a ladder to the flower, remove the stigma, and count the number of pollen grains the bat had delivered. They also took data on the number of flower visits by each of the two species at each study site.

The results showed that the pallid bats not only delivered more pollen per visit on average, but in some areas were frequent enough visitors to be more effective pollinators overall than the lesser long-nosed bats.

"This is particularly interesting because the pallid bat comes from an evolutionary lineage that has no other nectar-feeding bats in it. It's a naive interloper into this mutualism and is actually doing a better job than the coevolved pollinator," Kay said.

Plants that are adapted for bat pollination have large, sturdy flowers that bloom at night. The lesser long-nosed bat belongs to a large family of nectar-feeding bats that are important pollinators, especially in tropical habitats. The pallid bat, in contrast, is the only nectar feeder known in its mostly insect-eating family, which is the largest and most widespread family of bats.

"A lot of pollinators come from lineages that are quite old and have been coevolving with plants for a long time," Kay said. "You might think that a new pollinator would not be a good pollinator, but in this case it's actually a better pollinator because it's not well adapted for nectar-feeding. It's exciting to get a glimpse of what the initial stages might be in the evolution of a novel feeding behavior."

Frick said she has video of a pallid bat attacking a large moth on a flower, so it's not hard to imagine how the insect-eating pallid bats might have discovered the sweet nectar hidden inside cactus flowers.

Kay noted that many animals that visit flowers are just feeding without pollinating the flowers or otherwise benefiting the plants. There are also examples of invasive pollinators that disrupt a coevolved plant-pollinator relationship and do a worse job of pollination. "In this case it's the evolutionarily newer pollinator doing a better job, and I haven't seen that before," she said.

The lesser long-nosed bats were effective pollinators of cardon cactus flowers at many of the study sites. But the study found considerable variation between sites, and because the lesser long-nosed bat is

migratory, there may be variability from year to year as well, Frick said. The greater variability of the migratory lesser long-nosed bats could make the resident pallid bats especially important as pollinators of cardon cactus.

"The lesser long-nosed bat is an adequate pollinator, but there is a lot of variation in where they occur. We would like to look at that variation over several years," Frick said.

Provided by University of California - Santa Cruz

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