Clever bat experiment explains why plants tend to produce dilute nectar

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Big eared townsend bat (Corynorhinus townsendii) Credit: Public Domain

(Phys.org)—A clever, exhaustive experiment created and carried out by a combined team of researchers from Germany, the U.K. and the U.S. has explained why some nectar-producing plants produce dilute nectar in spite of a highly sugared preference by bats. In their paper published in the journal *Science*, the researchers describe their experiment and what

they found. Hamilton Farris with the Louisiana State University School of Medicine offers a Perspective piece on the work done by the team in the same journal issue.

Prior research has shown that despite an apparent love of sugar, bats do not necessarily always choose a plant with the sweetest nectar, which results in plants that produce diluted nectar in areas frequented by bats. Why this occurs has baffled scientists—logic suggests the opposite would occur. To find the answer, the researchers devised a novel experiment they believed would finally solve the puzzle.

The experiment consisted of outfitting 23 artificial flowers (in a part of a Costa Rican rainforest) with sensors and pumps that were able to mix sugar into an artificial nectar and then pump it to the flower. All of the flowers were connected to a computer, which counted the number of bat visits and controlled the concentration of the nectar for each flower. The researchers then routinely captured a number of bats and tagged them with tiny radio transmitters. This setup allowed the researchers to monitor and even influence bat feeding in the wild over a period of six years (and multiple generations of bats) and to see the impact it had on plant evolution.

As part of their analysis of the data, the researchers assumed that a bat visit to an artificial flower resulted in the transfer of virtual pollen to another virtual flower, resulting in virtual offspring—this approach allowed the researchers to cause the artificial flowers to evolve at a much higher rate than natural flowers. The team also found that they could manipulate the numbers of bats present in the study by manipulating the nectar, and they found that as a bat population grows, each bat is able to consume less nectar, which made them less discerning concerning sugar concentration and more concerned about finding more to eat—that in turn led the plants to produce less sugar and a diluted nectar. The team also found that the Weber effect may have come into play at certain

points—where increases in sweetness led to diminished returns for the plants.

More information: Vladislav Nachev et al. Cognition-mediated evolution of low-quality floral nectars, *Science* (2017). DOI: 10.1126/science.aah4219

Abstract

Plants pollinated by hummingbirds or bats produce dilute nectars even though these animals prefer more concentrated sugar solutions. This mismatch is an unsolved evolutionary paradox. Here we show that lower quality, or more dilute, nectars evolve when the strength of preferring larger quantities or higher qualities of nectar diminishes as magnitudes of the physical stimuli increase. In a virtual evolution experiment conducted in the tropical rainforest, bats visited computer-automated flowers with simulated genomes that evolved relatively dilute nectars. Simulations replicated this evolution only when value functions, which relate the physical stimuli to subjective sensations, were nonlinear. Selection also depended on the supply/demand ratio; bats selected for more dilute nectar when competition for food was higher. We predict such a pattern to generally occur when decision-makers consider multiple value dimensions simultaneously, and increases of psychological value are not fully proportional to increases in physical magnitude.

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