# The Senita Cactus and Its Missing Moth

**By Tom Gatz**
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You may have heard of the almost unique relationship between the yucca and its only pollinator, the yucca moth. There is a similar, recently discovered relationship between the senita cactus and its primary pollinator, the senita moth (*Upiga virescens*), one of only a very few documented examples of this relationship, known as a "pollinating seed-eating mutualism" in which an adult insect both pollinates and deposits eggs within flowers of a plant. In this way, both the insect and the plant rely almost exclusively on one another to survive and reproduce. I learned of it in a round about way when a high school student attempting to finish her practical exam at the Desert Botanical garden one Sunday morning asked me why the senita has those hairy tips on the mature stems. I didn't know the answer. I consulted the DBG "Visitor's Guide to 20 Plants on the Desert Discovery Trail" which offered these possible explanations: "Its spines shade the plant from intense sunlight. They also break up the flow of wind, lessening the wind's drying effect on the plant." However, after several hours in the DBG library looking at the technical literature on this cactus and after contacting several cactus experts, I was surprised to learn that even botanists aren't sure about the exact function of these spines. According to Dr. Nat Holland at Rice University, who discovered and has been studying senita pollination for 13 years, "the data are lacking on the significance of the (senita) spines."

Most of the hypotheses raise questions of their own. For example, some suggest that these bristles perhaps provide protection from cold, sun or both. However the senita cactus doesn't grow these long, hairy spines on its young, tender stems; they only appear later when the older, mature stems are close to producing flowers. That would be kind of like us putting off wearing gloves or sunscreen until we were adults, long after much of the frost and sun damage has already occurred.

Maybe the hairy bristles evolved to protect the flower buds and ripening fruits from the hot sun or drying wind? Arguing against this is the fact that other columnar cacti like the bat-pollinated organ pipe cactus grow in the same area as the senita and manage to flower and fruit just fine under the same sun and wind exposure without any extra layer of protective spines. The senita's close relative, the Mexican fence post cactus, pollinated by hummingbirds, also lacks these hair spines.

Perhaps then the downward facing spines protect the buds, flowers, or fruits from crawling predators? However, these brush-like spines are flexible (I was able to push my finger up through them unharmed) raising questions about their effectiveness in deterring a crawling insect or other predator.

While not finding a definitive answer to the question about the function of these shaggy spines, I did learn some fascinating things about the tiny senita moth. In southwestern Arizona and Mexico, female moths actively pollinate and deposit eggs on the nocturnal senita flowers. The larvae feed within the developing fruit and tunnel into the stem to

pupate before the fruit drop from the cactus. They emerge within the same or in the following flowering season. The senita moth is thus both a pollinator and a seed consumer, much like yucca moths and fig wasps are on their particular hosts.

Interestingly, I located notes left behind by Patrick Quirk, former cactus horticulturalist at DBG, indicating that he had found only one fruit ever on any of the Garden's senitas (transplanted here from their habitat further south), leading him to conclude that its primary pollinator (unknown to him at the time) apparently didn't occur here.

Armed (and likely dangerous) with this new information, I thought I would take a stab at developing my own hypothesis to possibly explain the function of these bristles on the reproductive arms of the senita. The senita cactus researchers noted that each life stage of the non-migratory senita moth is intimately associated with the senita cactus. The adult moths spend each day cryptically roosting in the spines, mate on the spines and even transform into the adult stage while perched on the spines. The larvae often over-winter within the stems under the areas where the shaggy spines grow. Perhaps these specially modified spines evolved, at least in part, as habitat to shelter and support the adult stage of its primary pollinator, the senita moth and/or to protect its over-wintering larvae from the cold? Of course, it's just one more untested hypothesis and, according to Dr. Holland, although the evolution of spines in cacti pre-dates the evolution of this specialized pollination mutualism, the spines of senita cacti may be a preadaptation that facilitates the survival of senita moths. Now if a graduate student were looking for an interesting research project…….

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Captions of the two photos by Tom Gatz:

(Hand on Cactus): The senita cactus blooms emerge throughout the warm months among the brush-like spines at sunset, mostly in vain here at the DBG where the senita moth, its primary pollinator, apparently does not occur. Flowers sometimes remain open in daylight for a few hours on cool mornings.

(Two senita cacti) The only fruits I noted on a senita cactus in the entire Garden this year was in November just sough of the old succulent house on this one specimen of the thinner southern coastal form, *Pachycereus schottii australis*. It was likely visited by a halictid bee, an occasional morning pollinator of this species.