Moth lineage provides a key to species diversification

March 28 2014, by Patrick Schmitz

Hyposmocoma caterpillar casings.

To many, moths are just the dull relatives of butterflies that often startle us in the dark. But for UH Mānoa Junior Researcher Dr. William Haines, former Junior Researcher Dr. Patrick Schmitz and Professor Daniel Rubinoff, these fascinating creatures provide insights into Hawai'i's ancient, vanished ecosystems. The College of Tropical Agriculture and Human Resources entomologists published their findings in an article, "Ancient diversification of Hyposmocoma moths in Hawai‘i," in the March 20 edition of the online journal *Nature Communications*.

The moth genus Hyposmocoma, otherwise known as the Hawaiian fancy case caterpillar for the elaborate silk cases the larvae construct and carry on their backs (see photo), is one of very few lineages that diversified across the entire Hawaiian Archipelago. A single colonist gave rise to

more than 400 species, including many restricted to the tiny, remote northwestern atolls and pinnacles, remnants of ancient, extinct volcanoes.

"Searching for those tiny caterpillars hiding in their fancy cases was like a gigantic egg hunt," Schmitz said. "Finding them under bark and leaves, in rock crevasses and streams, was a long-lasting task. And once you get them, you have to feed them. Many of them are very fond of carrots and fish flakes. But others are more sophisticated and prefer rotten wood or fresh meat!"

Through their research, Haines, Schmitz and Rubinoff report that Hyposmocoma has been in Hawai'i for about 15 million years, contrasting with previous studies of the Hawaiian biota that have suggested that the vast majority of lineages colonized the archipelago after the emergence of the current high islands, around 5 million years ago.

The three researchers used a "molecular clock" based on the ages of the different Hawaiian islands and the moths' DNA to reconstruct a "family tree" going back in time. "We found a recurring pattern where the earliest 'splits' in the family tree occurred on the oldest islands," Haines said. "We made the assumption that these splits occurred as new islands were formed and moths dispersed down the archipelago. This made it possible to use the ages of the islands to estimate rates of mutation for various genes. We then extrapolated backwards to figure out when the first Hyposmocoma colonized Hawai‘i and began evolving into multiple species." They show that Hyposmocoma has dispersed from the remote Northwestern Hawaiian Islands to the current high islands more than 20 times, something that has never been shown in another Hawaiian animal or plant group.

Island biogeography, or the study of geographic distributions of

organisms, is fundamental to understanding colonization, speciation and extinction. Remote volcanic archipelagoes, like Hawai'i, are ideal natural laboratories for studying biogeography because they provide context for how colonization and speciation has occurred in time and space.

"Hyposmocoma, since it still has lots of species, might be our last, best, chance to see how life evolved in the Hawaiian Islands," Rubinoff said. "For most groups, many, if not most of the species are extinct, or there just weren't that many to begin with. But for these moths, we still have enough to paint a picture of how an animal might have arrived in Hawai'i, millions of years ago, and evolved into something diverse and unique."

More information: "Ancient diversification of Hyposmocoma moths in Hawaii." William P. Haines, et al. *Nature Communications* 5, Article number: 3502 DOI: 10.1038/ncomms4502. Received 29 July 2013 Accepted 20 February 2014 Published 20 March 2014

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