

Scientists discover that Hawai'i is not an evolutionary dead end for marine life

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The question of why there are so many species in the sea and how new species form remains a central question in marine biology. Below the waterline, about 30% of Hawai'i's marine species are endemic – being found only in Hawai'i and nowhere else on Earth – one of the highest rates of endemism found worldwide. But where did this diversity of species come from? Hawai'i is famous for its adaptive radiations (the formation of many species with specialized lifestyles from a single colonist) above the water line. Still, spectacular examples of adaptive radiations such as Hawaiian honeycreeper birds and fruit flies are not found in Hawaiian waters. Marine species were thought to colonize Hawaii and eventually diverge into an isolated native species, but were doomed to an evolutionary "dead end" with no further specialization and speciation.

Dr. Chris Bird and fellow researchers at the Hawai'i Institute of [Marine Biology](#) (HIMB), however, have shown that Hawai'i hosts three limpets (cone shaped marine snails, locally known as 'opihi) that defy classification as dead-enders. The standard explanation for three [species](#) of 'opihi is that Hawai'i was independently colonized three times; however, using DNA, fossil, and geologic evidence, Dr. Bird has shown that Hawai'i was successfully colonized only once by Japanese limpets, approximately 5 million years ago.

The 'opihi then speciated within the Hawaiian Archipelago along an ecological gradient, as they invaded deeper habitats, forming the three species that we observe today (in order from shallow to deep) 'opihi

makai'auli, 'opihi 'alinalina, 'opihi ko'ele. Bird proposes that differences in the timing of sperm and egg production and the ability to survive at particular shore levels led to the 'opihi radiation. While 'opihi may look similar to the untrained eye, Bird demonstrates that each species possesses novel evolutionary adaptations that confer an advantage at a particular shore level, a hallmark signature of natural selection and adaptive radiation.

Bird states "the research on 'opihi give us better insight to the processes that produce biodiversity, especially in the ocean where the speciation process is not well understood". Prior to this report, no marine radiations had been found in Hawai'i. Bird continues, "these studies reset the bar for what is considered possible in marine speciation." Is Hawai'i an evolutionary dead end for marine speciation? The humble 'opihi say "no".

Collection and monitoring of the 'opihi is the result of a unique partnership bringing together scientists, traditional cultural practitioners, resource managers from the State of Hawai'i, The Nature Conservancy and community volunteers. Working with the community allows scientists to incorporate crucial information passed down through generations of Native Hawaiians. Monitoring sites surveyed to date include the Big Island of Hawai'i, the Maui Nui complex, O'ahu, and several remote sites in the Papahānaumokuākea Marine National Monument, the largest marine protected area under U.S. jurisdiction.

Provided by University of Hawaii at Manoa

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