

Discovering an Insect Armageddon (and ‘one strange duck’)

by David A. Burney, Director of Conservation

Makauwahi Cave on Kaua‘i’s south shore, not far from NTBG’s headquarters, has provided the setting for uniquely rich fossil discoveries. I’ve been doing research at this location on and off since the early 1990s, and steadily since 2004 when I joined the Garden’s staff and moved to the island. One of my first discoveries there was the shells of extinct land snails; little did I know that this cave would yield up an additional treasure-trove of yet newer discoveries.¹

Throughout my career as a paleoecologist and conservation biologist, I have been very fortunate, and humbled, to work with so many brilliant scientists from a wide range of disciplines. My research is by definition multidisciplinary, but the many important details of a past environment require a wide range of dedicated specialists. About four years ago I began a collaboration with a young postdoctoral associate from Australia, Dr. Nicholas Porch. As a Quaternary Entomologist (an expert on insect fossils of the last two million years – truly a rare profession), he was interested in the abundant insect remains we had reported in previous publications. With support from the National Geographic Society, we have been able to host his visits each summer, generally timed to coincide with the UH/NTBG Archaeological Field School, to systematically extract and identify the abundant and well-preserved insect fossils in Makauwahi Cave sediments.

What Dr. Porch found has exceeded all expectations. The sediments before human arrival about a millennium ago contain a host of

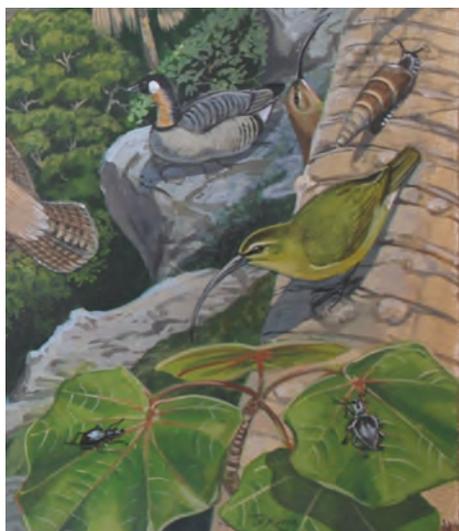
1 Two decades of research is documented for general readers in *Back to the Future in the Caves of Kaua‘i: A Scientist’s Adventures in the Dark* (Yale University Press, April 2010, soon to be released in paperback).



▲ Dr. David Burney shows visitors to Makauwahi Cave a few of the thousands of fossils he has recovered there in nearly two decades of excavation. *Photo from NTBG archives*

insects previously unknown to science and probably extinct, as well as many rare species that survive today only at very high elevations or on remote uninhabited islands. The native insect fauna near the cave was devastated by a combination of processes, we believe, including deforestation, introduction of vertebrates such as chickens and rats, and perhaps some more subtle but profound negative influences, such as the possible introduction of ants and other predatory insects beginning centuries ago. This is a process that has escalated in the last two centuries with a host of Eurasian insect introductions, but it may have begun with the arrival of the first Polynesian canoes.

Much remains to be worked out in this long slow process of identifying and quantifying insect parts, but the message is clear: insects show the same patterns my collaborators and I have



◀ Leaf detail from a painting by Dr. Julian Hume of the Natural History Museum (London) shows two extinct insects found by Dr. Nicholas Porch: a *Blackburnia* beetle (left) and *Rhycogonus* weevil (right). *Used by permission*

documented for other organisms in previous publications about the cave, and indeed on islands in the Atlantic and Indian Ocean as well. The distribution of plants, birds, land snails — and now insects — is today on remote

islands throughout the tropical world, including Hawai‘i, largely a human artifact. These creatures have been eliminated by humans and their camp-followers (plants and animals deliberately or inadvertently introduced by humans) from much otherwise suitable habitat. This has important implications for conservation.

And now...the Weirdest Duck of Them All

Makauwahi Cave, thanks largely to the efforts of Drs. Helen James and Storrs Olson of the Smithsonian Institution’s National Museum of Natural History, is well-known to contain one of the richest assemblages of native bird fossils ever found on any Pacific Island. Two new species of native Hawaiian finches, or honeycreepers (*Loxioides kikuchi* and *Rhodacanthis forfex*) for instance, have been described from the site. Several strange avian beasts from the time before humans still await full description, however. None are stranger than a little duck whose skull and partial skeleton I lifted out of the cave’s sediments over a decade ago, that has puzzled the experts ever since. In a recent publication, the new bird fossils are formally described for the first time, painting a truly odd picture.

Talpana lippa was a small, apparently flightless duck that lived in the primeval forests of Kaua‘i. It probably foraged in a manner similar to the kiwi (the skull has remarkable convergences with these strange nocturnal birds of New Zealand), rummaging for invertebrates in the forest and most likely finding them by touch (and perhaps smell?). The authors describe “a new genus and species of waterfowl...that is unlike any other known member of the order.” The hole in the skull for the nerve carrying the sense of touch is over ten times the diameter measured in ducks of comparable size, suggesting that it may have been more heavily reliant on the sense of touch for foraging than any living species of bird in the world.

The eye sockets, however, are improbably small and located far back on the skull. Storrs Olson thinks these weird little ducks may have been essentially blind, finding their way through the forest at night by touch and smell as a kiwi does. It seems that we have dug up something that nobody would have even remotely imagined to exist, had it not been for the discovery of these bones.

Our group discovered years ago that bird bones and even tree trunks in Makauwahi Cave often preserve ancient DNA samples. This material can help clarify taxonomic relationships of creatures from native palms to introduced rats, but little did we suspect until recently that DNA in the cave

▼ Skull and other bones from *Talpanas lippa*, small nocturnal duck discovered as a fossil at Makauwahi Cave. Photo by David Burney



might provide powerful clues to the mysterious origins of Hawaiians and perhaps Polynesian people in general. This is a long story, and not fully resolved yet, but several large groups of scientists around the world have been sequencing DNA in modern and archaeological chickens to trace the people that brought them. Some claims, such as a recent one by several scientists that chickens that may pre-date Columbus in the New World may show ancient contacts between Polynesians and Native Americans, have not yet been verified. But an Australian group, including Makauwahi Cave collaborator and Field School Research Associate Dr. Alan Cooper, Director of the Australian Center for Ancient DNA at the University of Adelaide, has shown recently that a DNA sequence from pre-Contact chicken bones we excavated at Makauwahi match a unique sequence that has also turned up in Dr. Terry Hunt's¹ archaeological digs in Rapa Nui (Easter Island) and in insular Indonesia. Perhaps this rare strain of chicken was the "canoe chicken" type that traveled from insular southeast Asia with familiar Polynesian plants and animals, along with Austronesian languages and "Lapita" cultural traits well-known to South Pacific archaeology.

Although we have gathered feathers of many chickens in remote parts of Kaua'i for DNA analysis, so far the cave's sequence has not turned up in any modern individuals. Old-timers speak of a "gray chicken" that was seen frequently in Koke'e State Park in the island's interior prior to the devastation of Hurricane 'Iniki in 1992. Perhaps the chicken of the canoe people still lurks in remote Kaua'i, or perhaps its genes are now so mixed with the "KFC sequence" as chicken-DNA experts call it, that it is lost forever.

1 Dr. Hunt is a professor of anthropology at the University of Hawai'i-Mānoa and co-author of "What Happened on Rapa Nui", *The Bulletin* - Fall 2008.