

# Caves, Bird Bones and Beetles: New Discoveries in Rain Forests of Haleakala

By A.C. Medeiros, L.L. Loope, and H.F. James

The Hawaiian Islands are noted for high levels of terrestrial biological diversity and local endemism (organisms found only in a particular area or region). Prior to arrival of humans, 95 percent of all flowering plants and 99 percent of insect species were endemic. The native birds of Hawaii such as the passerine honeycreepers (*Fringillidae: Drepanidinae*) are renowned as spectacular examples of adaptive radiation. However, by the time the first European naturalists arrived in the late 1700s, the Hawaiian avifauna was already declining rapidly. The extent of the loss of native Hawaiian bird species was not fully realized until the recent work of Smithsonian scientists Dr. Storrs Olson and Helen James. By exploring the sand dunes, sink holes, and lava tubes of the islands and collecting and examining bones found there, they have clarified not only the status of the Hawaiian bird fauna before the arrival of humans, but also the role that the first Polynesian colonizers, arriving in the 5th century, had in decimating that fauna (Olson and James 1982a, 1982b, 1984; James et al. 1987).

Field work by Olson and James in 1984 in a single cave at 305m elevation on ranch land had yielded sufficient bones for study to increase the known endemic land bird fauna of the island of Maui from 10 (the number known historically, of which 9 survive) to 29 species. Their field work during 1988 has yielded many additional undescribed species, some known from other islands and others only from Maui. Since all work on Maui to date by Olson and James had been in dry areas at low to middle elevations, the possibility of exploring caves in high-elevation rain forest appeared to offer potential for further finds.

Verdant, steep-walled Kipahulu Valley of Haleakala NP contains some of the least disturbed rain forest in the Hawaiian Islands. This valley is known for its diversity of endemic fauna and flora. Kipahulu and the adjoining upper northern slope of Haleakala volcano (including the state-owned Hanawi Natural Area Reserve and The Nature Conservancy's Waikamoi Preserve) are the last stronghold for many of Hawaii's remaining honeycreeper species. In 1984, a deep pit cave was discovered by park personnel in dense upper-elevation rain forest in Kipahulu Valley. Preliminary investigation of this cave was made by Dr. Frank Howarth, Paul Banko and Dr. Charles Stone. The initial results were extremely promising, revealing numerous sets of bones of bird species that did not survive into the historical period in Hawaii.

Later, park personnel discovered the entrance to a second cave that remained unexplored until this expedition.

Haleakala is an ancient shield volcano formed by lava flows starting about 800,000 years ago, but in modern times has remained quiescent (the last eruption occurred about 1790 on the SW flank). Massive erosion carved large steep-walled valleys 1000m deep in Haleakala volcano, especially on its northern and eastern flanks. Secondary eruptions from vents on the eastern rift flowed through some of these deep valleys, filling in their V-shaped bottoms (including Kipahulu).

Both Kipahulu caves are sections of lava tubes with collapsed "skylight" openings that connect them to the surface. Lava tubes are characteristic of fast moving pahoehoe lava flows where rivers of lava crust over at their surface while a central core of still molten lava continues its downhill course, but now underground. When the eruption finishes, these tubes are often emptied, forming long dome-roofed tunnels, which may in some instances extend for several kilometers.

On April 27-29, 1988, members of an interagency team headed by Helen James (Smithsonian Institution) and Frank Howarth (B.P. Bishop Museum of Honolulu) with an NPS support crew entered both caves, treated and removed bird bones, and made collections of cave invertebrates. The NPS group included Legario "Hanky" Eharis, Anne Marie La Rosa, Terrance Lind and Arthur Medeiros. The Kipahulu caves were given Hawaiian names by the expedition, the first as Luamanu (literally 'bird pit') and the second more recently discovered one as Pukamoa ('chicken-like bird hole').

The 10m wide entrance of Luamanu cave occurs on a forested ridge at 1830m (6000 ft) elevation with a vertical depth of 12m onto a mound of collapsed rock and mud. The lava tube continues only a few meters downslope but upslope extends 35-40m, forming a large dome-roofed room with an upward slope formed by large slabs of lava extending to the back of the room. Eighteen sets of bird bones of at least six species were collected, primarily in the rockfall of the large room.

The entrance of Pukamoa cave at 1860m (6100 ft) elevation is smaller and shallower yet the lava tube itself is comparatively extensive, extending 75m upslope and approximately 300-400m downslope. Three species (dark-rumped petrel, flightless ibis and flightless goose) were represented in the 16 sets of bones collected in this cave.

The Kipahulu lava tubes also yielded exciting finds of



Ranger Terry Lind with *Sadleria* and *Athyrium* ferns, *Broussaisia*, and other native shrubs at the entrance to Luamanu cave, elevation 1830 m, in rain forest of upper Kipahulu Valley, Haleakala NP. (NPS photo by Anne Marie La Rosa)



Bones of an undescribed genus of flightless goose-like birds from a "pitfall" cave in upper Kipahulu Valley, Haleakala. (Photo by Helen James)



Skull of an undescribed flightless ibis, *Apteribis* sp., from a "pitfall" cave in upper Kipahulu Valley, Haleakala. The tip of the bill has been broken so that about one-fourth of the bill's length is missing. (Photo by Helen James)

## List of sub-fossil bird bones found in two lava tubes (Luamanu and Pukamoa), upper Kipahulu Valley, Haleakala National Park (HALE):

| Family            | Genus                        | Status                  |
|-------------------|------------------------------|-------------------------|
| 1) Procellariidae | <i>Pterodroma phaeopygia</i> | Endangered <sup>1</sup> |
| 2) Plataleidae    | <i>Apteribis</i> sp.         | Extinct <sup>2</sup>    |
| 3) Anatidae       | <i>Branta</i> sp.            | Extinct <sup>3</sup>    |
| 4) Anatidae       | undescribed genus            | Extinct <sup>4</sup>    |
| 5) Rallidae       | <i>Porzana</i> sp.           | Extinct <sup>5</sup>    |
| 6) Fringillidae   | aff. <i>Chloridops</i> sp.   | Extinct <sup>6</sup>    |

**Footnote legend:** 1) currently recognized as federal endangered species, has never been recorded nesting in Haleakala rain forests. 2) unrecorded until the 1970s when a species of this flightless ibis from Molokai was described, based on fossils. 3) similar to the extant nene (*B. sandwicensis*); the leg bones found in Kipahulu appear heavier and stouter and wing bones shorter, perhaps indicating reduced flight ability. 4) undescribed genus of flightless goose-like birds, to be described based on bone collections made in the 1980s. 5) cosmopolitan genus of rail in which all Hawaiian species are flightless; two Hawaiian species survived into the historical period, one species last seen in 1884 and the other in 1945; perhaps two species represented in Kipahulu material. 6) present only as a single associated set of bones found in Luamanu cave, this thick-billed honeycreeper is most similar to the Grosbeak finch found in the Kona district of Hawaii island, last seen around 1894.



**Expedition members** (James, Lind, Medeiros, and Howarth) at the entrance to Pukamoa cave, elevation 1860 m, in Kipahulu Valley of Haleakala NP. *Metrosideros polymorpha* rain forest with fern understory in background. (NPS photo by Anne-Marie La Rosa)

living cave-adapted organisms. Each of the two lava tubes contains its own unique troglotic ground beetle (*Coleoptera: Carabidae*). Each of these carabid beetles is so distinctive in fact that Dr. Al Samuelson, B.P. Bishop Museum coleopterist, considers the beetle population of each cave to represent the sole species of its own endemic genus. An earthworm collection made in Pukamoa cave is a new family record for the Hawaiian Islands. Other arthropod species collected, including a millipede and collembola, await identification. Introduced rats, now common in Kipahulu Valley and found in both lava tubes, may threaten the long-term survival of some of these unique species.

Haleakala NP is an international Biosphere Reserve, recognized for unique and diverse ecosystems. As a protected refuge for otherwise threatened species, the remote reaches of the park in many cases provide the last chance for survival for many native Hawaiian organisms. The caves of upper Kipahulu represent one more example of the park's remarkable resources, some of which remain undiscovered and/or uninvestigated. The caves harbor the sole populations of unique living resources and provide an invaluable window into the

past through which we can glimpse some of Hawaii's former treasures.

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