

THE KALA-PANA EXTENSION:
ITS VARIETY, VEGETATION AND VALUE

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This paper provides a glimpse of the natural history of the eastern third of Hawaii Volcanoes National Park called the Kala-pana Extension. This area of approximately seventy-five square miles was added to Hawaii Volcanoes National Park following a 1938 Congressional authorization. It runs from the rocky coast up to 2500 to 3000 feet elevation, and almost all is east of the boundary between the Puna and Ka'ū districts, near the western edges of the recent Mauna-ulu lava flows.

More interesting than the political limits is the main geographical one--that is, nearly the whole region lies along and down slope of the very active East Rift of Kī-lau-ea. There are two main geological features which are of particular importance to the vegetation distribution of the region: the many lava flows and the Hilina Fault System.

The lava flows exhibit several textural surfaces of 'a'ā and pāhoehoe lavas. In the upper slopes near the rift, most of the surface consists of geologically recent pāhoehoe flows with fairly vesicular rock. Some flows have smooth, shelly surfaces and others are very slabby and rough. A few of these pāhoehoe flows turn into 'a'ā flows downslope, sometimes with a transition of very blocky pāhoehoe.

If an eruptive phase lasts long enough, as in the Mauna-ulu series, then large portions of the original flows may be covered by the denser, degassed pāhoehoe carried by extensive tube systems. Generally, these tube-fed flows extend much farther downslope, making up the bulk of the surface of the lower elevation of the Kala-pana Extension.

Observations of vegetation growing on these different surfaces of a flow or flow series indicate that forest development occurs much more rapidly on the 'a'ā and rough textured pāhoehoe than on the denser, tube-fed pāhoehoe farther from the vent.

An important feature of lava flows is the common occurrence of the kipuka, an island of older substrate and vegetation surrounded by younger lava flows. In such a volcanically active area as the East Rift of Kī-lau-ea, much

of the surface is a patchwork of different aged kipukas. Walking through the area will provide one with examples of steps in the development of forests and the succession of species within them.

The other important geological feature of the area is the Hilina Fault System, which has produced several fault scarps. The numerous earth movements along these scarps have extensively fractured the lava to give it a structure similar to that of 'a'ā. The scarp areas may also have increased moisture due to seepage. Where not covered over by more recent lavas, the scarp areas tend to act as kipukas, very often harboring the best developed forest of the immediate area.

In addition to the lava substrates, there are two cinder cones in the Kala-pana Extension. These have on their slopes ash deposits, which give rise to a different kind of soil and have on at least one of them a few plants not seen elsewhere in the Extension.

Superimposed on the geological setting of the region are two rainfall gradients. In addition to the usual orographic increase in precipitation with elevation, there is a northeast to southwest decrease representing a gradual shift from windward to leeward exposure. The range in precipitation over the Kala-pana Extension allows for eventual development of wet, mesic and dry forest zones, and examples of each can be found here.

All or nearly all of the lava and ash surfaces appear to be young enough that their age is reflected by the degree of development of the vegetation upon them. The influence of the rainfall and elevation gradients on the different kinds and ages of substrate has resulted in a mosaic of various vegetation types. Disturbances from fires, agriculture and introduced plants and animals have added to the region's heterogeneity.

Due to the frequency of newer lava flows at least partially covering the older ones, the exposures of the older ones usually have been reduced to fragments, and the oldest tend to be the least common. It is in these older kipukas and flow segments where the most diverse plant communities are located. As most of the many rare and uncommon plants in this section of the Park are found only in the more mature communities, their distributions are naturally patchy.

As mentioned, dry to wet moisture regimes allow for the eventual development of corresponding forest types. The most prevalent are the rain forest communities distributed in the wetter and higher parts of the region. Of these, the most

diverse and pristine examples in the Park grow in a recent kipuka on and just downslope of an unnamed cinder cone along the East Rift. The dry forest communities are more scattered over the lower to middle reaches of the Kala-pana Extension. Some of the best lowland dry forest left in the Islands occurs on an old 'a'a flow in the Ka-moamoa ahupua'a here.

There are several areas of mesic forest that have developed between some of the previous two types, mostly on the fault scarps above the Kala-pana Trail. Here grow some of the largest trees in the Park--*Metrosideros* well over a meter in diameter and 30 meters tall and, on another substrate, *Tetraplasandra hawaiiensis* up to a meter and a half in diameter. There is also a sizable part of the extension in very open forest, scrub, grassland and barren lava. Those areas probably reflect past disturbances, early plant colonization, and limiting rainfall as well as very recent lava flows.

The quality of these forest types varies greatly with the degree of successional maturity and especially with the amounts of disturbance to which they have been and are being exposed. In some of the lower and middle elevations there has traditionally been some agriculture, and later grazing, practiced. In an area of such volcanic activity, periodic fires have fringed the lava flows. Within the last fifteen years or so, two introduced species of *Andropogon*, a bunch grass, have invaded a large part of the park where the forest has been open enough. Since then, the size and severity of wildfires in this region have greatly increased.

These grasses are just two of the many species of introduced plants and animals which threaten the integrity of the forests of the Kala-pana Extension. Other species include *Myrica faya*, two species of *Psidium*, *Stachytarpheta jamaicensis*, *Leucaena leucocephala*, *Lantana camara*, and *Eugenia jambos*. Establishment of most of these and other problem exotics in the Extension is enhanced by disruptions of the native vegetation from fires and sustained feeding activities of feral mammals. In some of these disturbed areas one can see dense patches of one or more of the previously mentioned plants, and the prospect is for much more of the same.

While they have recently been rendered scarce in the Park, the effects of feral goats can still be seen. In many of the drier scrub and forest areas of the Extension, their selective browsing has all but eliminated the native understory.

Much more of a problem are the hordes of feral pigs, especially in the rain forests, where their ravages are the most evident. As with goats, their selective feeding

has severely depleted certain species. More important is habitat destruction. The pigs disrupt and in large areas have eliminated the *Cibotium* understory by killing the tree ferns in the process of eating the quantities of starch inside them. Where the lava is not too rugged, they have stripped the ground of its naturally dense cover of vegetation by their digging activities, exposing it to invasion by weedy exotics. The spread of exotics in the genera of *Psidium*, *Rubus*, and *Passiflora*, at least, is no doubt accelerated by seed dispersal through their feces.

The consequences of the tremendous numbers of pigs in the Park's forests is a clearing, plowing, and sowing not unlike a primitive agriculture, complete with considerable soil erosion. Even the epiphyte habitats have been altered by this exposure and resultant desiccation. The uncommon epiphytes are lost, and only the hardiest survive.

It is no coincidence that many of the rare and uncommon plants in the Kala-pana Extension, as elsewhere in the Park, are restricted to places where the local geography allows for protection from feral animals. Pit craters, large earth cracks, a few of the recently isolated kipukas, rough 'a'ā and slabby pāhoehoe substrates, and in a few instances proximity to human activities have acted as partial or complete protection from goats or pigs. Comparison of these fragments with their disturbed counterparts provides good examples of these alien animals' enormous influence.

In spite of the considerable problems present in managing its biological resources, the Kala-pana Extension has tremendous value to its natural inhabitants and to the appreciative people who pass through it. The region is dominated by its active geology, and its interaction with life forces. There is no better place in Hawai'i to observe the sequences of forest development on both young and old lava flows. As sanctuaries for many native species it contains the best dry and rain forest habitats in the Park. In some of the few pig-free rain forest areas exists the opportunity to observe relatively pristine forest.