

VEGETATION OF THE HANA RAIN FOREST  
HALEAKALA NATIONAL PARK

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As part of the Hana Rain Forest Project in 1973, the vegetation of the rain forest zone of the northeast windward slope of Haleakala was studied. The study area included Kalapawili Ridge from below Wai'anapanapa to 1610 m (5400 ft), and part of the Ko'olau Forest Reserve northeast of Pu'u Alaea. The vegetation consisted of 'ohi'a (Metrosideros collina) montane rain forest, with occasional bogs and shrub stands.

At bogs, frequency and cover were measured. At forest sites, the vegetation was sampled separately in three different strata. For trees, densities and basal areas were measured; for saplings and arborescent shrubs, densities and frequencies; for understory, frequencies in 1 m<sup>2</sup> quadrats. The data were processed by computer. Bray and Curtis ordination was used to interpret the relations between the sites, and a clustering program was used to group the sites into sites according to similarity.

Data for the tree layer were used to divide the sites into four types, arbitrarily called Types 1-4. Understory data were similarly used to identify four site types, called Types a-d. These were related to the site types for trees. For all types, Metrosideros collina was the dominant tree; Cheirodendron trigynum was usually second.

Type 1 included the lowest sites, from about 1670 m (5500 ft), near the Park boundary on Kalapawili Ridge. These were poorly drained, with scrubby forest alternating with open bogs. The tree layer consisted mainly of low (ca. 4 m) Metrosideros collina with a few Cheirodendron trigynum and Ilex anomala. Other tree species, though present, seldom reached full tree size. Tree density, basal area, and cover were low compared to the other types. The understory in some spots was transitional to bogs, at other spots it was of the type described below as Type a.

Type 2 occurred on better drained uplands, mainly from 1710 m to 2010 m (5600-6600 ft) on Kalapawili Ridge. The tree layer consisted mainly of 5 m to 9 m tall Metrosideros collina. Cheirodendron trigynum or, less frequently, Ilex anomala were second in density. Myrsine lessertiana was less abundant than at Type 3 sites. The arborescent shrub layer consisted of Coprosma

spp., Pelea sp., and Vaccinium calycinum. Where the tree layer was open, a layer of large bushes consisting of Broussaisia arguta, Clermontia sp., Labordia sp., and, in places, Rubus hawaiiensis was often present. The understory was mainly Type a. At higher elevation sites the understory was transitional to Type b.

Type 3 sites occurred on well drained uplands from 2010 m to 2070 m (6600-6800 ft) along Kalapawili Ridge, and in most of the Ko'olau sites. The tree layer was 5 m to 8 m tall along Kalapawili Ridge and 8 m to 13 m tall in the Ko'olau Forest Reserve (KFR). The basal areas were generally greater, and the canopies more closed, than in Type 2 sites. Metrosideros collina was the dominant tree, followed by Cheirodendron trigynum or, less often, Myrsine lessertiana. Ilex anomala was less abundant than at Type 2 sites. Coprosma spp., Pelea spp., and Vaccinium calycinum often reached tree size. The understory was more open and poorer in species than at Type 2 sites. Astelia sp., Clermontia sp., Gouldia terminalis, Labordia sp., and Phyllostegia sp. were uncommon or absent. Pteris excelsa, Carex alligata, and Rubus hawaiiensis were more common than at Type 2 sites. At Kalapawili Ridge Type 3 sites, the understory was generally Type b. At lower KFR Type 3 sites, the understory was Type b or Type d; at upper KFR Sites, Type c.

Type 4 included the uppermost sites on Kalapawili Ridge, from 2060 m to 2110 m (6800-6900 ft). The canopy was low, ca. 5 m, and dense. The tree layer consisted of Metrosideros collina with occasional Cheirodendron trigynum. Other tree species occur, but do not reach tree size. Small Metrosideros and Coprosma spp. were particularly abundant in the sapling and arborescent shrub layer. The understory was an open version of Type b.

Common to all four types of understory recognized were Athyrium spp. (incl. A. microphyllum and A. sandwicianum), Dryopteris spp. (incl. D. glabra, D. hawaiiensis, and D. wallichiana), Elaphoglossum hirtum and E. wawrae, Polypodium pellucidum, Sadleria sp., Uncinia uncinata, and Peperomia spp.

Type a, usually associated with a Type 1 or Type 2 tree layer, was both the densest and richest in species. Typical of Type a sites was high frequencies of Asplenium spp., Astelia spp., Gouldia terminalis, and Myrsine lessertiana seedlings.

Type b, generally associated with a Type 3 tree layer and a more closed canopy, was poorer in species and usually more open than Type 2. Carex alligata and Rubus hawaiiensis were present more often than in Type a.

Type c, generally associated with Type 3 tree layer at higher elevation KFR sites, was more open and poorer in species than the other three types. The presence of Pteris excelsa, Carex alligata, and Rubus hawaiiensis was characteristic.

Type d was a catch-all category consisting mainly of lower elevation sites occurring under various types of tree layers. Their main similarity is presence of Carex alligata, Ilex anomala seedlings, Nertera granadensis, Styphelia tameiameia, and Vaccinium berberifolium.

In general, understories at lower elevation sites have more species than higher elevation sites. There are few species typical of higher elevation sites. Rather than turnover along the gradient, the trend is for species to drop out with increasing elevation, with few new species coming in. For tree species, the trend is different: More arborescent species reach tree size at the higher elevation sites than at the lower ones.

At the time of the study in 1973, there were few if any exotic plants in the understory. Feral pigs were almost absent from Kalapawili Ridge from between 1710 m to 2200 m (5550-7200 ft), although present both above and below those elevations, and in KFR. Since 1973, pigs have become much more common along Kalapawili Ridge. In 1978, the 1973 sites were relocated, marked, and resampled in order to evaluate the pigs' effects on the vegetation. Effects seem small so far; the situation will be monitored to observe any changes as they develop.