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Technical Report 33

UPPER KĪPAHULU VALLEY WEED SURVEY*

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THE PLANT GENUS HIBISCADELPHUS IN HAWAI'I

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ABSTRACT

This study reports the distribution and status of introduced vascular plants in Kīpahulu Valley between 610 m and 2020 m (2000 & 6630 ft). Fifty-five exotic weed species and weedy natives were located, including 30 which have not been reported previously in the area. The most serious threat to the Valley ecosystem is the strawberry guava (Psidium cattleianum). Rose apple (Eugenia jambos), Hilo grass (Paspalum conjugatum), guava (Psidium guajava), and African tulip tree (Spathodea campanulata) also pose a significant threat. Most of the invading exotics are of tropical origin. The main source of potential invading species is the warm lowlands at the bottom of the Valley, which are rich in exotics. Immediate resource management recommendations are the control of feral pigs (Sus scrofa), the elimination of the strawberry guava, and the establishment of a management buffer zone between the lower and upper Valley.

RECOMMENDATIONS

1. Feral pigs are a serious disruptive force in the lower koa (Acacia koa) forest where they uproot large areas of the forest floor and create a habitat for exotics. They are also the principal vector spreading the strawberry guava throughout this ecosystem. Pigs should be controlled.
2. Strawberry guava has the potential to disrupt the natural regeneration of the koa forest. It should be eradicated as part of the feral pig management program. To do one without the other would serve no useful purpose.
3. The area below 610 m (2000 ft) is the source of most exotic species. It is recommended that a buffer zone be established between the upper and lower Valley. The goal of the buffer zone management program should be the elimination of troublesome exotic species and their subsequent replacement by native species.

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INTRODUCTION

A survey of the distribution and status of introduced vascular plants in Kīpahulu Valley was conducted as part of the Kīpahulu Feral Pig Project. The boundaries of the area under discussion are the upper edge of the closed canopy forest around 2020 m (6630 ft) at the head of the Valley, the 610 m (2000 ft) contour line on the Valley floor, the base of Kaumakani Ridge to the northeast, and the edge of Koukouai Gulch to the southwest. The Valley runs from northwest to southeast, and is split lengthwise into two levels, the southwestern level being about 200 m (660 ft) higher than the northeastern level (Fig. 1). These will be referred to as the Upper Floor and Lower Floor, respectively.

No long-term climate records exist for any part of the Valley. However, the average annual rainfall in mid-Valley is estimated to be around 4000 mm (160 in). Average temperature at sea level is about 24°C (74°F) (Blumenstock & Price 1967). Below 610 m (2000 ft), the forest communities consist of a mixture of native and exotic plants. From 610 m to 1000 m (2000-3280 ft), the dominant tree is koa (*Acacia koa*). From 1200 m (3940 ft) to the upper edge of the forest it is 'ōhi'a (*Metrosideros*). The area from 1000 m to 1200 m (3280-3940 ft) is a transition zone. This report describes the distribution and ecological characteristics of introduced plants in Kīpahulu Valley as of mid-1979.

HISTORICAL BACKGROUND

The earliest botanist believed to have visited Kīpahulu Valley is Forbes in 1919. He left only a few notes about the vegetation (Lamoureux 1967). In 1936 and 1945, St. John made botanical collections in and just outside the current study area (Lamoureux 1967). Hjort (1945) and Fagerlund (1945) made a trip through the Valley from the head to the mouth along the Koukouai side of the Upper Floor. The most thorough previous botanical studies of Kīpahulu Valley are those of de Wreede (1967), Lamoureux (1967), and Smathers (1967), who accompanied The Nature Conservancy Expedition. In 1970, Becking made an inspection trip of lower and middle elevations (Lamoureux & Stemmermann 1976). Lamoureux and Stemmermann (1976) inspected the Upper Floor from the upper edge of the forest to 610 m (2000 ft) in 1976.

Fagerlund (1945) reported that the forest was in pristine condition. Only one exotic, *Maui pā'makani (*Eupatorium adenophorum*), was common and only in openings. Smathers (1967)

* Exotic species.

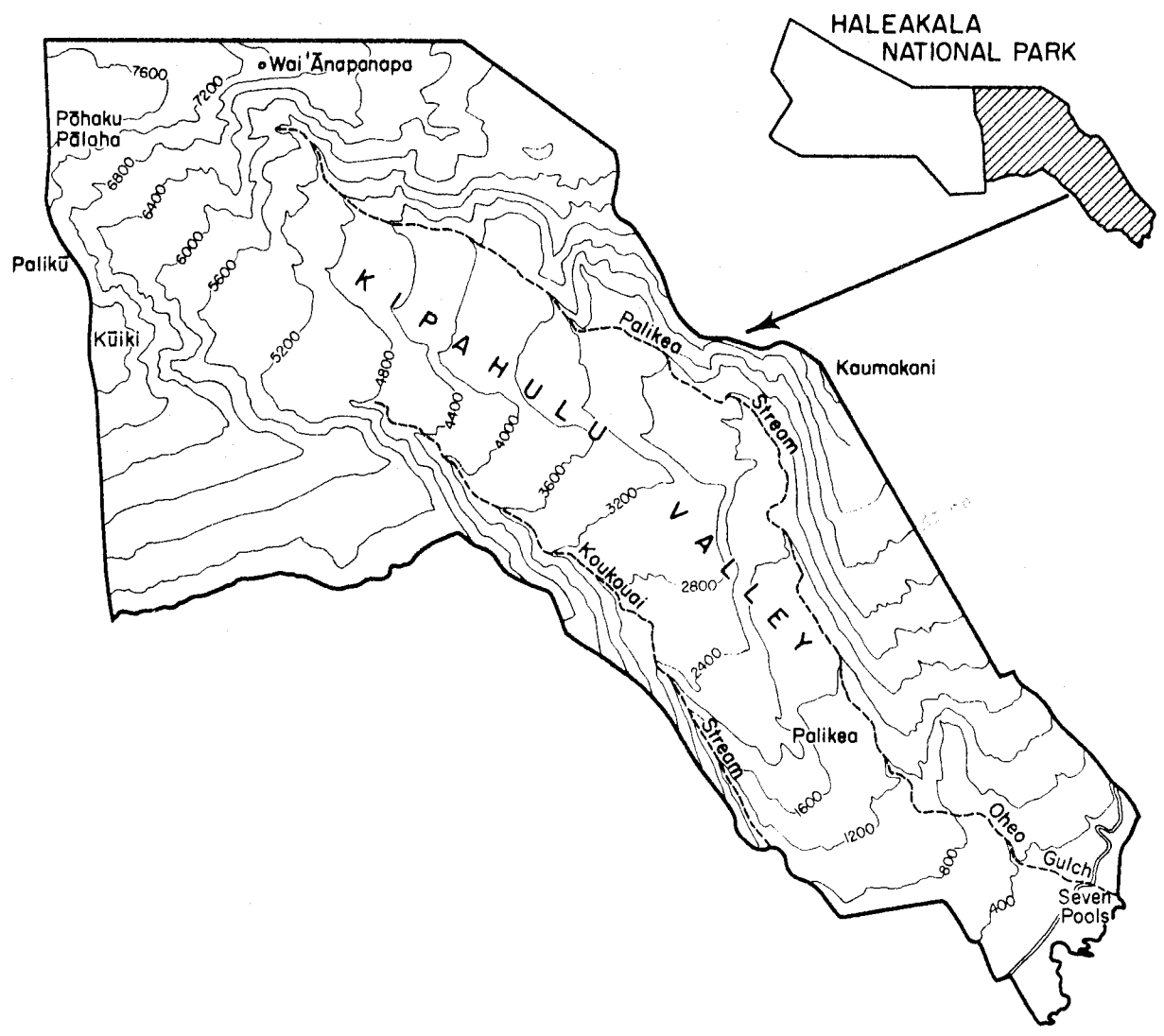


FIGURE 1. Map showing the geography of Kīpahulu Valley, Haleakala National Park, Maui.

described the area of the Upper Floor between 700 m and 1040 m (2300 & 3400 ft) as follows:

" . . . an open to closed koa forest with some ohia (Metrosideros sp.) and olapa (Cheirodendron trigynum) make up the vegetation cover. Except for pig-disturbed areas . . . it has practically the same species composition as before western man appeared. Certainly, its physiognomy and structure have not been altered."

De Wreede (1967) observed that areas which seemed to have standing water for much of the time supported more or less pure stands of *Hilo grass (Paspalum conjugatum), with some *Maui pā'makani. He noted *thimbleberry (Rubus rosaefolius) in somewhat drier areas.

In 1970, Becking (in Lamoureux & Stemmermann 1976) reported a marked deterioration in the condition of the forest and an increase in the number of exotics. Lamoureux and Stemmermann confirmed the deterioration and brought special attention to the rapid spread of *strawberry guava (Psidium cattleianum) since 1967. The current study has recorded further new establishments by exotics.

In 1945, Fagerlund encountered five exotic plant species between the upper edge of the forest and Palikea Peak. Lamoureux (1967) encountered 22 species and found records for six more in St. John's earlier collections, for a total of 28. If he had followed Fagerlund's route and schedule, Lamoureux probably would have noticed only about 13 species. At present (1980), there are known to be at least 49 exotic plant species within the study area. Someone following Fagerlund's itinerary today probably would notice at least 18 species. This is more than a three-fold increase over 1945.

PRESENT DISTRIBUTION OF EXOTICS

The 'Ōhi'a forest above 1200 m (3940 ft) is still relatively free of exotics. Exotics are practically absent under the canopy above 1450 m (4750 ft). Below that elevation, only *thimbleberry and *Maui pā'makani are common under the canopy. Two species reported by Fagerlund (1945), *Job's tears (Coix lachryma-jobi) and *palmgrass (Setaria palmaefolia), are no longer present. *Velvetgrass (Holcus lanatus) and *gosmore (Hypochaeris radicata) are uncommon. Some exotics, such as *puakamoli (Cuphea carthagenensis); *hino hana (Erechtites valerianaefolia); *self-heal (Prunella vulgaris); and *oriental hawksbeard (Youngia japonica), are locally common in clearings or along streams. A native sedge, Carex alligata F. Boott, occupies boggy openings.

In contrast to the 'Ōhi'a forest, the koa forest has suffered a large-scaled invasion, especially in recent years. As late as 1967, the forest was in excellent condition with only minor signs of feral pig (*Sus scrofa* L.) disturbances (de Wreede 1967; Smathers 1967). By 1970, Becking (in Lamoureux & Stemmermann 1976) noted widespread pig activity and large numbers of exotics. He speculated about the possible role of the 1967 Nature Conservancy Expedition in introducing exotics. In particular, they noted the striking spread of *Hilo grass and *strawberry guava, and the accompanying displacement of native ground cover. Lamoureux and Stemmermann (1976) found major disruptions in the forest below 940 m (3080 ft), which they attributed to intensive pig activities. They described the situation as "probably . . . an emergency" and recommended that the activity of feral pigs be curbed.

Both the number of species and the abundance of exotics increase with decreasing elevation. At the lower edge of the 'Ōhi'a forest, around 1200 m (3940 ft), there are still relatively few exotics. Below 1110 m (3610 ft), boggy openings previously occupied by the native *Carex alligata* (Fagerlund 1945) are now covered with either *Hilo grass or two sedges unreported in 1967, the exotic **Cyperus haspan* and the native kuolohia (*Rhynchospora lavarum*). Native herbaceous species are practically absent from these openings, which now support weedy species. Among the exotic weedy species are *maile honohono (*Ageratum conyzoides*); *puakamoli; *kyllinga (*Cyperus brevifolius*); *pipili (*Drymaria cordata*); *pīpi wai (*Eleocharis obtusa*); *hino hana; *Maui pā'makani; *kāmole (*Ludwigia octivalvis*); *ricegrass (*Paspalum orbiculare*); and *Glenwoodgrass (*Sacciolepis indica*). The forest floor supports fewer species of exotics but some may be abundant, particularly *Maui pā'makani, *Hilo grass, *strawberry guava, *thimbleberry, *Glenwoodgrass, and *oriental hawksbeard. In general, the forest occupies well-drained spots such as ridges, and the grassy or sedge-filled openings occur on local flat spots or pockets of sediment deposited by run-off.

CHARACTERISTICS OF EXOTIC INVADERS

Most of the invading exotics are of tropical origin. The main source of potential invading species is the warm lowlands below Kīpahulu Valley, where many exotics are present. The number of potential invaders in the cool heath scrub and grasslands above the Valley is relatively small, and there is no forest there to harbor temperate exotic forest species. The 'Ōhi'a forest, which is in a cooler climate zone than the koa forest, has correspondingly fewer exotic species. Of those, only *Carolina crane's bill (*Geranium carolinianum* var. *australe*); *velvetgrass; *gosmore; *self-heal; *sheep sorrel (*Rumex acetosella*); and *common groundsel (*Senecio vulgaris*) are more common at higher elevations than below. These species are native to temperate climates in contrast to most of the other exotics. None are abundant within the forest.

Most of the more common exotics do well in poorly-drained, sunny habitats and rapidly invade open, disturbed sites. Most have a grassy or herbaceous growth form. Many have light propagules (reproductive structures) which are readily carried by wind or animals.

*Strawberry guava is an important exception to these generalizations. It grows as a small tree, attaining a height of 8 m (24 ft). It is shade tolerant and able to establish itself on undisturbed forest floors. It forms dense stands, especially in well-drained areas where it excludes native species. Although tropical, it is frost-resistant (Popenoe 1935). At present, it has reached 1310 m (3940 ft) in Kīpahulu Valley, but is known from higher elevations elsewhere in the Hawaiian Islands. Its potential for invading other areas in the Valley are high.

THEORETICAL CONSIDERATIONS

Kīpahulu Valley can be considered as analogous to an island of mainly native species, with the adjacent areas forming a mainland with a large number of exotics. The MacArthur-Wilson (1967) theory of island biogeography predicts that as the number of species on the mainland increases, the rate of invasion to the island should increase, raising the equilibrium number of species for the island. The additional new species in the areas adjacent to Kīpahulu Valley are practically all exotics, so the invaders to the Valley will be mainly exotics, and the proportion of exotics in the flora will rise. This would be expected even without disturbance. Disturbance tends to favor the exotics even more. The Hawaiian flora, because of its insular origin, is deficient in some adaptive types (Fosberg 1948). There were no terrestrial mammals in pre-human Hawai'i, and so the native plants, in general, are poorly adapted to grazing and digging. In contrast, many exotics are weedy species which do well in disturbed habitats.

Direct Human Influence

There has been much controversy about what is responsible for introducing exotics into Kīpahulu Valley. Some have accused man, especially The Nature Conservancy's 1967 Kīpahulu Valley Expedition (Becking, in Lamoureux & Stemmermann 1976). This seems unlikely. The habitat modification resulting from the Expedition was small and transient (Lamoureux & Stemmermann 1976). There is no noticeable concentration of exotics in areas used by the Expedition. In the period from 1945 to 1967 when many exotics became established, there was light pig hunting activity below about 940 m (3080 ft). From 1967 to 1978, there was little human activity above 680 m (2230 ft). Most of the exotics which entered during this period can disperse readily without human intervention. It seems that habitat modification

may have been more important in their establishment. Observations of the trails used for the present study show little evidence for wholesale introduction of exotics through human activity. Such activity, however, may be contributing to uphill movement of *maile honohono, *puakamoli, and *Glenwoodgrass.

Feral Pigs

Feral pigs are an obvious agent favoring the dispersal and establishment of exotics. Besides carrying propagules on their coats, they are known to spread *strawberry guava seeds in their droppings. They feed directly on some natives including pa'iniu (*Astelia* spp.); hāpu'u 'i'i (*Cibotium chamissoi* Kaulf.); hāpu'u pulu (*C. splendens* [Gaud.] Krajinā); 'ie'ie (*Freycinetia arborea* Gaud.); and lobeliads. In the course of rooting for worms and wallowing, they turn over much ground and uproot plants. Very few native species are adapted to tolerate such disturbances, since the Hawaiian flora evolved without the influence of rooting animals.

The Polynesians introduced pigs into Hawai'i during the 5th Century A.D., but pigs have become a serious problem in Kīpahulu only in recent years. There are several possible reasons. In 1945, pigs were present at the upper edge of the forest, but were absent below 1370 m (4500 ft) (Hjort 1945). Older residents of Kīpahulu village report that these were small black animals, possibly of Polynesian stock. The pigs which are now in the Valley are larger, with various color patterns. It is believed that they descended from escapees from nearby pig farms which were operating at least since the 1940's. Hunters first noticed these animals during the mid-1950's, when they appeared at lower elevations. These domestic stock pigs may occupy different habitats than the previous pigs of Polynesian stock, and may also be more destructive. In pre-European times, there were few exotic species to colonize pig disturbances; therefore, natives eventually reestablished themselves. Since the incorporation of Kīpahulu Valley into Haleakala National Park in 1968, most pig hunting has been below the wilderness area.

Other Factors

Below 1000 m (3280 ft) on the Lower Floor, uluhe (*Dicranopteris linearis* [Burn.] Underwood) appears to be dying back locally. *Hilo grass and other exotics come up following the dieback. The causes of the dieback are unclear.

In study plots from which all *strawberry guava has been removed, new *strawberry guava seedlings have come up in the absence of pig activity. Birds may be dispersing the seeds or dormant seeds are germinating.

Kīpahulu village residents report there may have been feral cattle (Bos taurus L.) on the Lower Floor as late as the 1940's, but their presence is less well-documented than that of pigs.

Special Problems

Not all exotics are likely to be a threat to native ecosystems. Some are naturally restricted in distribution or occur only as accidentals (not normally resident in the area), such as *maidenhair fern (Adiantum cuneatum); *field Indian paintbrush (Castilleja arvensis); *gosmore; banana (Musa sp.); *self-heal; and *common groundsel. Others, although uncommon, have potential for spreading and should be monitored. Among these are *broad-leaved carpetgrass (Axonopus compressus); *Digitaria sp.; *molassesgrass (Melinis minutiflora); *African tulip tree (Spathodea campanulata); and *Jamaica vervain (Stachytarpheta jamaicensis). A number of exotics are already spreading or abundant. Those of more immediate concern are *Cyperus haspan, *Hilo grass, and *strawberry guava. *Cyperus haspan is one of the first colonists of pig rootings in poorly-drained openings below 900 m (2950 ft) and now, along with the native kuolohia, forms solid carpets in such locations. *Hilo grass also colonizes such sites, as well as better drained and more shaded sites under open canopy. *Strawberry guava is of special concern: It is presently spreading, and, once established, is likely to perpetuate itself since it is shade tolerant and able to germinate on undisturbed ground.

FUTURE OUTLOOK

There is probably little immediate danger of large-scale invasion of exotics into the 'ōhi'a forest. The species pool of potential invaders is relatively small. There are few temperate forest species in the heath scrub and grassland above the forest, and the tropical exotics from lower elevations, in general, are poorly adapted to the cold, wet climate. Pigs appear to be less numerous than in the koa forest. While the short-term threat of their introducing exotics is not as great as it is at lower elevations, the pigs attack certain native plants directly, such as pa'iniu, hāpu'u 'i'i, hāpu'u pulu, and lobeliads.

The condition of the koa forest below 1200 m (3940 ft) is currently deteriorating. Several exotics are increasing in abundance or extending their ranges. This situation is likely to continue if there is no active management, i.e., feral pig control and removal of *strawberry guava. Control of feral pigs is necessary to prevent further deterioration, but by itself it is not adequate to return the forest to its pre-disturbance state. Some exotics, such as *strawberry guava, once established, can probably persist even without the help of pigs.

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ANNOTATED SPECIES LIST

This list includes introduced plants and also certain weedy natives. The asterisks (**) indicate species not listed by Lamoureux (1967). Scientific names follow St. John (1973). Voucher specimens are stored in the University of Hawaii Herbarium. AYY# = Alvin Y. Yoshinaga, collector.

PTERIDOPHYTES

PTERIDACEAE (Fern family)

Adiantum cuneatum Langs. & Fisch. Maidenhair fern

To at least 730 m (2400 ft) on Lower Floor, 760 m (2500 ft) on Upper Floor. Apparently restricted to wet cliffs and steep stream banks.

MONOCOTYLEDONES

POACEAE (Grass family)

**Axonopus compressus (Sw.) Beauv. Broad-leaved carpetgrass

A few small scattered clumps, at 960 m (3150 ft) on Lower Floor and 1040 m (3410 ft) on Upper Floor. May have potential for further spreading.
AYY #339

**Coix lachryma-jobi L. Job's tears

Reported by Fagerlund (1945) in koa (Acacia koa Gray) forest. Now absent above 610 m (2000 ft), but present below that elevation on Lower Floor.

**Digitaria sp. (sanguinalis ?) Large crabgrass, kūkaipua'a

Single clump in forest opening with Hilo grass (Paspalum conjugatum) at 700 m (2300 ft) on Lower Floor. May have potential for further spreading.
AYY #348

****Festuca sp. ?**

Fescue

Common along stream banks on Lower Floor up to at least 730 m (2400 ft). Apparently restricted to riparian habitats. Possibly native, listed here pending identification.
 AYY #322, #332, #340

Holcus lanatus L.

Velvetgrass

Along stream banks and occasionally in forest, especially in openings. More common at higher elevations, but occurring as low as 1430 m (4690 ft) along Koukouai Gulch, 1100 m (3600 ft) along Central Pali, and 930 m (3050 ft) on the Lower Floor.
 AYY #287

****Melinis minutiflora ? Beauv.**

Molassesgrass

Clump in vegetative state at 1040 m (3410 ft) along top of Central Pali, probably this species.

Oplismenus hirtellus (L.) Beauv.Basketgrass,
honohono-kukui

Locally common, especially in and near openings. On Upper Floor, to around 670 m (2200 ft); on Lower Floor, to about 730 m (2400 ft).
 AYY #282

Paspalum conjugatum Berg.

Hilo grass

Abundant, especially below 1000 m (3280 ft), where it forms solid stands in openings and under thin canopy. Occasional individuals up to 1020 m (3360 ft) on Lower Floor, 1100 m (3600 ft) along Koukouai Gulch, and 1250 m (4100 ft) along the Central Pali. Reported as high as 1360 m (4450 ft) in 1967 (de Wreede 1967). Increasing in abundance since 1967.

****Paspalum dilatatum Poir.**Paspalum grass,
dallis grass

Seen at two sites along Central Pali, at 1050 m (340 ft) and at 1967 Camp II site around 1250 m (4100 ft). Removed from both sites.
 AYY #278

****Paspalum orbiculare Forst. f.**

Ricegrass, mau'u-laiki

Common in poorly-drained openings around 670 m (2220 ft). Occasional individuals on Lower Floor up to at least 640 m (2100 ft), to 910 m (3000 ft) along Koukouai Gulch, to 990 m (3250 ft) along Central Pali. Appears to be spreading.
 AYY #283

**Paspalum urvillei Steud. Vaseygrass

Up to 900 m (2950 ft) on Lower Floor. Common along stream banks, occasionally found in poorly-drained clearings.
 AYY #321, #328, #343

Sacciolepis indica (L.) Chase Glenwoodgrass

Abundant, both in openings and under canopy. Up to 1000 m (3270 ft) on Lower Floor, 1080 m (3550 ft) along Koukouai Gulch, and 1430 m (4700 ft) along Central Pali.
 AYY #297

**Setaria geniculata (Poir.) Beauv. Perennial foxtail

Locally common in poorly-drained openings below 730 m (2400 ft) on Lower Floor.
 AYY #331, #347

**Setaria palmaefolia (Koen.) Stapf Palmgrass

Reported by Fagerlund (1945) in koa forest. Not seen in 1967 or current surveys. I suspect that Fagerlund may have considered that some sterile specimens of the endemic 'ohe (Joinvillea ascendens Brongn. & Gris.) were palmgrass. 'Ohe is present in the Valley today.

CYPERACEAE (Sedge family)

Cyperus brevifolius (Rottb.) Hassk. Kyllinga

Common in poorly-drained openings on Lower Floor below 840 m (2750 ft).
 AYY #325

**Cyperus haspan L.

Abundant, forming solid stands in poorly-drained openings, especially below 910 m (3000 ft) on Upper Floor. Early colonizer of pig disturbances. Up to 840 m (2750 ft) on Lower Floor, 910 m (3000 ft) along Koukouai Gulch, 1180 m (3870 ft) along Central Pali.

**Cyperus kyllinga Endl. Kyllinga, kili'o'opu

Locally abundant in poorly-drained openings. To 1020 m (3350 ft) on Lower Floor, 1280 m (4200 ft) along Central Pali.
 AYY #279, #317

Eleocharis obtusa (Willd.) Schult. Pīpī wai

Possibly native. Common in wet openings, occasionally also on Lower Floor, to 1310 m (4300 ft) along Koukouai Gulch, 1430 m (4700 ft) along Central Pali.

**Fimbristylis dichotoma (L.) Vahl Tall fringe rush

Indigenous. Common in poorly-drained openings below 880 m (2880 ft) on Lower Floor.
 AYY #302, #306

**Rhynchospora lavarum Gaud. Kuolohia, pu'uko'a

Endemic. Abundant in poorly-drained openings on Upper Floor below 910 m (3000 ft). To 750 m (2450 ft) on Lower Floor, 1070 m (3500 ft) on Upper Floor.

** (Unidentified sedge)

Occasional, up to 940 m (3100 ft) along Central Pali, 1040 m (3400 ft) along Koukouai Gulch. Possibly native.
 AYY #302, #306

** (Unidentified sedge)

Riparian, up to 910 m (3000 ft). Possibly native.
 AYY #313

COMMELINACEAE (Spiderwort family)

**Commelina diffusa Burm. f. Honohono

Single plant, 670 m (2200 ft) along Koukouai Gulch.

LILIACEAE (Lily family)

Cordyline terminalis (L.) Kunth Ti, ki

Occasional individuals, up to 730 m (2400 ft) on Lower Floor.

MUSACEAE (Banana family)

Musa sp. or spp. Banana, mai'a

A few scattered individuals, up to 640 m (2100 ft) along Palikea Stream on Lower Floor, up to 650 m (2150 ft) along Central Pali. Fagerlund (1945) reported them up to 820 m (2700 ft) on Upper Floor. Their presence probably reflects human activity in the past.

ZINGIBERACEAE (Ginger family)

**(Unidentified)

Single clump, past flowering, at 810 m (2650 ft) on Lower Floor.

AYY #346

ORCHIDACEAE (Orchid family)

**Spathoglottis plicata Bl. Malayan ground orchid

Riparian. Lower Floor, below 730 m (2400 ft).

DICOTYLEDONES

POLYGONACEAE (Buckwheat family)

Polygonum glabrum Willd. Kāmole

Occasional, along streams or in poorly-drained openings up to at least 980 m (3200 ft) on Lower Floor.

AYY #330

Rumex acetosella L. Sheep sorrel

Observed only above the upper edge of the forest, around 2150 m (6500 ft).

CARYOPHYLLACEAE (Pink family)

Drymaria cordata (L.) Willd. Pipili
ex R. & S.

Locally common. Up to 730 (2400 ft) on Lower Floor, 850 m (2800 ft) along Central Pali, 990 m (3260 ft) along Koukouai Gulch.

AYY #318

ROSACEAE (Rose family)

Rubus rosaefolius Sm. Thimbleberry

Widespread, locally abundant on forest floor, usually on well-drained sites. Up to at least 1250 m (4100 ft), 1400 m (4600 ft) along Central Pali, 1520 m (5000 ft) along Koukouai Gulch.

GERANIACEAE (Geranium family)

Geranium carolinianum L. Carolina crane's bill
var. australe (Benth.) Fosb.

Reported from above the edge of the forest in 1967.

LYTHRACEAE (Loosestrife family)

Cuphea carthagenensis (Jacq.) Tarweed, puakamoli
MacEride

Common; abundant in poorly-drained openings. To 1180 m (3870 ft), as high as 1520 m (5000 ft) in riparian habitats.

**Lythrum maritimum HBK. Pūkāmole

Known to occur just below study area, may be present within it also.

AYY #323

MYRTACEAE (Myrtle family)

**Eucalyptus robusta ? Sm. Swamp mahogany

Single individual at 760 m (2500 ft) along Central Pali, reported by Becking in 1970.

**Eugenia jambos L. Rose apple

Dense stands just north of Palikea Peak, to around 640 m (2100 ft). Practically no other species grow in the stands, hence, if spreading, they may be a threat to native vegetation.

Psidium cattleianum Sabine Strawberry guava

Up to 1140 m (3750 ft) on Upper Floor, 760 m (2500 ft) on Lower Floor. Forms dense stands below 850 m (2800 ft) on Upper Floor, somewhat less abundant on Lower Floor. Both red and yellow varieties present.

Psidium guajava L. Guava

Occasional, up to about 720 m (2350 ft). Single individual at 940 m (3080 ft) along Central Pali.

ONAGRACEAE (Evening primrose family)

Ludwigia octovalvis (Jacq.) Raven Kāmole

Common in poorly-drained openings, up to 980 m (3220 ft) along the Central Pali, 930 m (3050 ft) on the Lower Floor.

APIACEAE (Carrot family)

Hydrocotyle verticillata Thunb. Whorled marsh pennywort,
pohepohe

In poorly-drained openings, up to 790 m (2600 ft) on Upper Floor, 1010 m (3300 ft) on Lower Floor.
AYY #320

CONVOLVULACEAE (Morning-glory family)

**Ipomoea sp.

Up to 730 m (2380 ft) along Koukouai Gulch. Possibly native.
AYY #285

VERBENACEAE (Verbena family)

**Stachytarpheta jamaicensis Jamaica vervain, oi
(L.) Vahl

In openings, to 620 m (2050 ft) along Koukouai Gulch and 730 m (2400 ft) along Central Pali. First reported by Becking in 1970. May be spreading.

LAMIACEAE (Mint family)

Prunella vulgaris L. Self-heal

More common at higher elevations, occurring as low as 850 m (2800 ft) on the Lower Floor and 800 m (2540 ft) along Koukouai Gulch. Restricted mainly to riparian habitats.
AYY #290

SOLANACEAE (Nightshade family)

Solanum nigrum L. Black nightshade, pōpolo

Lower Floor only, below 910 m (3000 ft). Possibly native.
AYY #354

SCROPHULARIACEAE (Figwort family)

**Castilleja arvensis Schlecht. Field Indian paintbrush
& Cham.

Single individual at 920 m (3030 ft) along Central Pali.
Probably an accidental, with no permanent population in Valley.

BIGNONIACEAE (Bignonia family)

**Spathodea campanulata Beauv. African tulip tree

Scattered individuals below 670 m (2200 ft) along Koukouai
Gulch.

ASTERACEAE (Sunflower family)

**Ageratum conyzoides L. Maile honohono

Common in openings at lower elevations. Up to 930 m
(3050 ft) on Lower Floor, 980 m (3200 ft) along Koukouai Gulch,
1040 m (3400 ft) along Central Pali. Appears to be spreading.
AYY #299

Erechtites valerianaefolia (Wolf) DC. Hino hana

Widespread, especially common in openings but also found un-
der canopy. Up to 1130 m (3700 ft) along Koukouai Gulch, 1250 m
(4100 ft) on Lower Floor, 1430 m (4700 ft) along Central Pali.
AYY #300

**Erigeron canadensis (L.) Cronq. Canada fleabane, ilioha

Scattered individuals around 880 m to 990 m (2900-3250 ft)
on Lower Floor.
AYY #334

Eupatorium adenophorum Spreng. Maui pā'makani

Widespread and abundant since at least 1945. Occurs under
canopy up to 1460 m (4800 ft), to at least 1580 m (5200 ft) in
openings and riparian habitats. Considered noxious by the State.

**Eupatorium riparium Regel Spreading mist flower

Occasional, in riparian habitats around 610 m (2000 ft).

Hypochaeris radicata L.

Gosmore

More common at higher elevations, especially in riparian habitats, occasionally in forest. As low as 980 m (3220 ft) on Lower Floor, 1070 m (3500 ft) along Koukouai Gulch, 1130 m (3700 ft) along Central Pali.

**Senecio vulgaris L.

Common groundsel

Scattered individuals in an opening at 1920 m (6300 ft) along Koukouai Gulch. Probably confined to high elevation openings.

Youngia japonica (L.) DC.

Oriental hawksbeard

Common; occurs under canopy as high as 1080 m (3550 ft) along Koukouai Gulch, 1130 m (3700 ft) on Lower Floor, 1330 m (4350 ft) along Central Pali; in clearings and riparian habitats, up to at least 1720 m (5650 ft).
AYY #289, #296