



Botanical Inventory of Board of Water Supply
Lands, Waihe'e and Kahalu'u Valleys,
Windward O'ahu

Hawaii
Biological
Survey

Final Report

December 2007

**Botanical Inventory of Board of Water Supply Lands,
Waihe'e and Kahalu'u Valleys, Windward O'ahu**

Final Report prepared for:

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EXECUTIVE SUMMARY

The Hawaii Biological Survey of Bishop Museum (BISH) conducted a vegetation reconnaissance of approximately 800 acres of undeveloped lowland watershed land in windward O'ahu for landowner Board of Water Supply (BWS), City and County of Honolulu, in cooperation with the Ko'olau Mountains Watershed Partnership (KMWP). The project area comprises Waihe'e and Kahalu'u Valleys, two northeast-facing valleys nestled between Ka'alaea, Wai'ahole, and Waikāne Valleys to the northwest and 'Ioleka'a and Ha'ikū Valleys to the southwest. The makai (seaward) boundary follows the State forest reserve boundary in Waihe'e, and lies above it in Kahalu'u. The survey area itself was restricted to the navigable, gently to moderately sloped terrain in the parcel, up to an elevation of 600–1,000 feet.

The survey took place on eight day-trips between March and November 2007, with the primary goals of assessing the vegetation, providing an inventory of all vascular plants, noting major resource concerns, documenting locations of rare and endangered vascular plants, creating generalized plant community maps, and providing recommendations for conservation practices.

A total of 243 taxa were noted during the survey, including 47 endemic, 28 indigenous, 139 naturalized, 15 Polynesian-introduced, and 14 cultivated plants. Thus, only 31% (75 of 243) of all plant taxa seen were native, a low percentage attesting to the disturbed nature of the vegetation. Three vegetation types were mapped. Most of the valley floors and side-slopes are clothed in variations of Alien Wet Forest, dominated by *Schefflera actinophylla*, *Citharexylum caudatum*, *Cecropia obtusifolia*, *Psidium guajava*, *P. cattleianum*, *Syzygium cumini*, *S. malaccense*, and *Aleurites moluccana*. Native remnant forest elements were concentrated on moist streambanks in the backs of narrow gulches, on the upper slopes of uluhe-covered ridges, and on steep, rocky slopes approaching the valley rims.

No federally listed endangered or threatened species were noted during the survey, primarily due to the focus of the survey effort on the valley floors and gentler slopes, which historically have been much modified by intensive agricultural production and grazing by ungulates. One Species of Concern was located during the survey on a steep northern slope in Waihe'e—*Bidens populifolia* (ko'oko'olau). Endangered bird sightings—that of *Chasiempis sandwichensis ibidis* ('Oahu 'Elepaio), an endemic flycatcher—were also noted.

The main current biological threat to the vegetation of the BWS parcel is the spread of invasive alien plant species. The focus of eradication efforts should concentrate on weedy species that are just starting to become established, such as *Rhodomyrtus tomentosa* (rose myrtle), *Cinnamomum burmanii* (Padang cassia), *Clusia rosea* (autograph tree), *Medinilla magnifica* (medinilla), *Arthrostemma ciliatum* (arthrostemma), *Acacia confusa* (Formosan koa), *Solanum torvum* (turkeyberry), *Pueraria phaseoloides* (tropical kudzu), *Tabebuia heterophylla* (pink tecoma), and *Alpinia mutica* (small shell ginger). Secondarily, invasive species such as *Melastoma septemnerium*, *Pittosporum pentandrum*, and *Angiopteris evecta* (mule's-foot fern) would require much more effort to eliminate. Future surveillance efforts in the parcel should also be cognizant of the historic presence of *Miconia calvescens*, once cultivated in a Kahalu'u nursery makai of the survey area. Pig damage in the parcel is moderate, and in view of the absence of protectable native habitat, there seems to be no need for a pig reduction program at this time. However, a rat control program might help to preserve nesting habitat for the 'Oahu 'Elepaio in its restricted Waihe'e Valley habitat.

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I. INTRODUCTION

A vegetation reconnaissance of approximately 800 acres of undeveloped lowland watershed land in Waihe'e and Kahalu'u Valleys, O'ahu (TMK 4-7-8:002, 4-7-6:023), was conducted by Bishop Museum (BISH) for landowner Board of Water Supply, City and County of Honolulu, in cooperation with the Ko'olau Mountains Watershed Partnership (KMWP). Eight days of fieldwork were conducted between March and November 2007. The primary purposes of the survey were to assess the vegetation, provide an inventory of all vascular plants, note major resource concerns, document locations of rare and endangered vascular plants, create generalized plant community maps, and provide recommendations for conservation practices.

Ia. Setting

The project area comprises Waihe'e and Kahalu'u Valleys, two lushly vegetated, northeast-facing amphitheater-headed valleys located on the windward side of the Ko'olau Mountain range, nestled between Ka'alaea, Wai'ahole, and Waikāne Valleys to the northwest and 'Ioleka'a and Ha'ikū Valleys to the southwest (see Map 1, p. 21). The makai (seaward) boundary follows the State forest reserve boundary in Waihe'e, and runs mauka (mountainward) of it in Kahalu'u; the mauka boundary follows the Ko'olau summit ridge. Elevations in the Waihe'e parcel range from 200 feet on the valley floor up to the 2654 foot high 'Eleao summit on the northwest side of the valley. In Kahalu'u they range from 320 feet up to 2200 feet at the summit. Like much of the central windward O'ahu landscape, the parcel is characterized by a sheer vertical curtain of fluted, sparsely vegetated basaltic rock, at the base of which are steep talus slopes of loose rubble. Extending makai are a series of dissected gulch/ridge systems supporting lush vegetation growth. The lower halves of these valleys, below the survey area, are fertile flatlands that have been, both prehistorically and currently, prime agricultural lands and habitation sites. The survey area itself was restricted to the navigable, gently to moderately sloped terrain in the parcel, up to an elevation of 600–1,000 feet. The orographic effect of moisture-laden northeast tradewinds being forced up the steep palis provides ample rainfall in these valleys, which ranges from 80–120 inches per year (Juvik & Juvik 1998).

Five different soil types occur in the survey area (Foote et al. 1972). The vertical, fluted pali forming the back and side walls of the two valleys is classified as Rock Outcrop (rRO), described as areas where more than 90% of the surface consists of exposed bedrock, primarily basalt or andesite. While rRO-classified lands in this parcel are quite precipitous, they can also be gently sloping, and can be found at elevations ranging from near sea level up to 10,000 feet. The Soil Conservation Service classified all described soil series into capability groupings reflecting their suitability for growing agricultural crops, accounting for not only their physical characters but also erosional problems that might result from their use. Rock Outcrop lands are assigned a capability classification of VIIIe, which, because they comprise steep, shallow-soiled, rough mountainous land, are subject to severe erosion if the existing groundcover is removed. Suggested land use for rRO lands is for watershed protection, wildlife habitat, and recreation.

Alluvial and colluvial lands immediately below the rRO pali on 40–70% slopes form a collar around the back of Waihe'e amphitheater and the northern ridge of Kahalu'u. These are classified as Waikane silty clays (WpF), which are well-drained derivatives from alluvium and colluvium deposits from basaltic rock, 30–60 inches deep. These soils range from 200–1,000 feet elevation. Rainfall is evenly distributed and ranges from 50–70 inches/year. Typical vegetation on these soils include alien plants such as Christmasberry (*Schinus terebinthifolius*), common guava (*Psidium guajava*), Hilo grass (*Paspalum conjugatum*), and ricegrass (*Paspalum scrobiculatum*). The steep slopes of WpF mean that runoff is very rapid and the erosion hazard very severe, and they are thus assigned capability classification VIIe, which restricts their usability largely to pastureland or rangeland, woodland, or wildlife habitat.

A less steeply-sloped (25–40%) Waikane silty clay (WpE) in Waihe'e comprises soils between the Waihe'e Stream drainage and steeper WpF lands to the north. The primary difference with WpF is the less steep profile, making it more useful for pastureland. The capability classification of VIe means they are still subject to severe erosion, limiting their usefulness largely to pastureland or rangeland, woodland, or wildlife habitat.

Somewhat poorly drained to poorly drained soils on gentle slopes (2–6%) on the banks of the Waihe'e Stream drainage are comprised of Hanalei silty clays (HnB). These soils are derived from alluvial deposits and are generally more than 60 inches deep. Soil runoff is slow and the erosion hazard negligible. These soils are suitable for taro (*Colocasia esculenta*), sugarcane (*Saccharum officinarum*), or pastureland. Typical vegetation on these soils include alien plants such as California grass (*Brachiaria mutica*), sensitive plant (*Mimosa pudica*), honohono (*Commelina diffusa*), sedges, Java plum (*Syzygium cumini*), koa haole (*Leucaena leucocephala*), and common guava (*Psidium guajava*). The capability classification of IIw means that HnB soils are moderately limiting for crops due to their poor drainage and susceptibility to seasonal flooding.

A fifth soil type occurs in Kahalu'u Valley. Closely related to WpF soils are the Lolekaa silty clays on 40–70% slope (LoF). This soil type occurs along drainages and in old, gravelly alluvial fans at the base of the Ko'olau Mountains. These soils range from near sea level to 500 feet elevation. Rainfall is evenly distributed and ranges from 70–90 inches/year. Typical vegetation on these soils include alien plants such as Christmasberry (*Schinus terebinthifolius*), common guava (*Psidium guajava*), California grass (*Brachiaria mutica*), Hilo grass (*Paspalum conjugatum*), and ricegrass (*Paspalum scrobiculatum*). Because the slopes are steep, runoff is rapid and the erosion hazard severe. As with WpF, the suitability classification is VIIe, and usability is restricted to pastureland.

Ib. Prehistorical and historical land use in Waihe'e and Kahalu'u Valleys

The stretch of windward O'ahu coast from Wai'āhole ahupua'a to the north through Ka'alaea, Waihe'e, Kahalu'u, and He'eia are topographically and environmentally very similar. These amphitheater-headed valleys are all fronted by broad coastal plains. "These contiguous flats, all sectioned with terraces, make one of the largest single areas of wet-taro land on the Koolau coast. Waihee ahupua'a included the terraces watered by Waihee Stream which has its headwaters in the Koolau Range where the small mountain stream (called Waihee) is joined by Hamama Stream and waterfall and, lower, by Kalia Stream. The old terraces, now abandoned, ran back into these valleys for about 1.5 miles. From there on they were developed, when level land permitted, down the main valley" (Sterling & Summers 1978). Similarly, in Kahalu'u

“There must have been terraces throughout the broad part of the valley for several miles inland” and “the total area under cultivation in ancient times must have been very considerable” (ibid.). Springs and permanent streams in these valleys were a source of plentiful water. The intensive cultivation of these lands would have completely altered the pre-existing native vegetation. Most of the wetland taro-producing lands, though, were restricted to coastal lowlands and flat areas adjacent to streams, the vast majority of which occurred makai of the current forest reserve line and the BWS parcel. In Waihe'e, this claim is supported by the lack of archaeological evidence of irrigation ditches on elevated terraces, suggesting that they were not used for intensive farming, although dryland crops were likely grown there (Chun 1954). Handy & Handy (1972) speculate that, apart from the flatlands suitable for taro, “great quantities of sweet potato, yam, banana, upland taro, wauke, olona, and awa” were probably produced.

The population supported by this agricultural breadbasket was undoubtedly large. It is estimated that the census of the Kāne'ohe Bay area from Kualoa to Kāne'ohe in 1779 ranged between 15,000 and 17,000 (Devaney et al. 1982). Depopulation, primarily due to the introduction of epidemic diseases such as measles, whooping cough, and influenza, precipitously reduced the count to 2,028 by 1872 (ibid.). In 1835, a population census counted only 135 people in Waihe'e and 242 in Kahalu'u (Chun 1954). During this time, much of the taro-growing areas fell into disuse and reverted to marshlands. Also during this time, the social and economic impact of the Great Mahele (1848) and the Kuleana Act (1850) effectively dispossessed many Hawaiian commoners from their farming plots, and laid the foundation for the modern plantation agricultural system in the Hawaiian Islands by placing large amounts of land in the hands of a few (Devaney et al. 1982).

Sugar cane was the first of the plantation crops tried in the Kāne'ohe Bay area, primarily in Kāne'ohe and He'eia from the 1860s to the 1880s. Kahalu'u Plantation included 1,850 acres, only 50 of which were planted in sugar in 1880; Waihe'e had only about 10 acres planted (Devaney et al. 1982). Cultivation of sugar was probably restricted to the lowlands in the survey area.

From 1880 to the 1920s, rice became a major crop in the Kāne'ohe Bay area. Chinese businesses bought or leased vast acreages and constructed extensive networks of irrigation ditches for intensive cultivation of rice. The distribution of rice paddies in Waihe'e and Kahalu'u mirrored that of the wetland taro it replaced, and would not have extended much into the survey area, except perhaps along alluvial streambanks in the lower part of the BWS parcel.

Pineapple was a major economic crop in the Kāne'ohe Bay area between 1910 and 1925, and because it could be grown in upland areas where taro and rice could not, some of the gentler-sloping lands included in the BWS survey might have been planted. Chun (1954) reports that Japanese farmers raised pineapple on 44 acres of Waihe'e Valley uplands between 1920 and 1926. Kahalu'u Valley was also widely planted with pineapple.

Cattle were introduced into Hawai'i by Captain George Vancouver in 1793, but it is not until the mid-1840s that reports were received of roaming cattle belonging to large landholders destroying croplands farmed by commoners in the Kāne'ohe Bay region. In Devaney et al. (1982), Robert Wyllie is quoted in 1848: “These herds are allowed to increase altogether beyond the capacity of the lands leased by the owners, for pasturing them. Potatoe fields are destroyed, kalo grounds trodden up, and very much mischief done in other ways.” “These cattle, by which the agricultural interests of this whole district are entirely prostrated, are on the whole, the greatest evil from which we are now suffering as a people.” In Kahalu'u in 1880, there were “herds of wild cattle and numberless goats” reported in the hills, and in

Waihe'e, nearly 150 acres of lowland was used for grazing (Devaney et al. 1982). It is probable that freely roaming wild ungulates are primarily responsible for the disturbed nature of the steeper, non-cultivable lands in the BWS parcel. Today, wild pigs are the primary ungulate roaming the backcountry, and during the survey many signs of pig damage were noted.

The extensive system of tunnels and wells developed in the valleys between Ha'ikū and Wai'āhole-Waikāne between 1916 and 1960 served primarily to divert plentiful water of the region to other areas, especially leeward O'ahu. As a result, streamflow in these valleys was reduced, sometimes drastically so. Riparian communities would have been most affected. Species such as *Lysimachia filifolia*, an endangered primrose that grows in the spray zone of waterfalls, would have had their available habitat much reduced. Other riparian species, such as *Touchardia latifolia* (olonā) and *Piper methysticum* ('awa), would also be affected.

The forest reserve system in Hawai'i was set up in response to the realization that one of the primary values of the forested uplands was for their watershed capacity. With the destruction of forests by grazing ungulates and replacement by faster-growing weeds, harvesting of timber, and clearing for pastureland and agriculture, the water-holding capacity of the uplands was being greatly diminished. In 1903, the state forest reserve system was signed into law, and by 1938 all of the present-day watershed lands between Kualoa and Kāne'ohe had been incorporated (Devaney et al. 1982). Extensive reforestation was undertaken in many forest reserves, but outplanting records between 1910 and 1960 in Wai'āhole Forest Reserve (Skolmen 1980), which stretches from Kualoa to Ha'ikū, were not site-specific enough to attribute to Waihe'e or Kahalu'u. There was little field evidence in the BWS parcel of obvious forestry outplantings.

Ic. Historical plant collections in Waihe'e and Kahalu'u Valleys

Apparently, only a few botanists have collected in the back sections of Waihe'e and Kahalu'u Valleys during the past century, in no cases very extensively, suggesting either that the area is relatively unexplored or that it is so impoverished that botanists could find little of interest to collect, more likely the latter. One collector (W. Takeuchi) notes on a voucher of *Cyrtandra laxiflora* taken at the back of a gulch in Kahalu'u Valley, "This basin is a very poor site for *Cyrtandra* collecting; the shallow set of the gulches into the cliffs do not afford sufficient habitat, found less than 15 plants (all *laxiflora*) the entire day, several channels had extensive pig damage" (Takeuchi 2932, 25 Oct 1986, BISH). A search of the Herbarium Pacificum specimen database for Hawaiian plant vouchers at Bishop Museum (BISH) pulled up about 100 botanical collections from the area (see Appendix B for an edited listing of these). Small numbers of general collections were made in the 1930s (Edwin Y. Hosaka, F. Raymond Fosberg), 1940s (Harold St. John), 1950s (St. John, Otto Degener), and 1980s (Kenneth Nagata, Wayne Takeuchi). Subsequent botanical vouchers from the region have been spotty, in part due to remoteness and difficulty of access.

No current Federally endangered taxa have been vouchered from the survey area, judging from a review of the BISH collection. Unusual, but not currently considered rare, collections include *Bidens populifolia* (Asteraceae) and *Neraudia melastomifolia* (Urticaceae). The Hawai'i Biodiversity and Mapping Program (HBMP) recorded *Bidens populifolia* (Asteraceae) from 1968 on the north slope of Waihe'e Valley, growing on the edge of an *Andropogon virginicus* (broomsedge) community; at that time it was recorded as a common herb. A population on the northern ridgeline was relocated during the BWS survey. *Neraudia melastomifolia* (ma'aloa) was recorded in 1941 in moist woods on a ridge

just south of the southernmost waterfall in Waihe'e (HBMP); the area was revisited but no *Neraudia* were seen. The species is uncommon but not rare.

The closest location of federally listed endangered taxa occur in Waiāhole Valley, north of Waihe'e and separated from it by the intervening Ka'alaea Valley. There, a population of 100+ *Lysimachia filifolia* (Primulaceae) plants exist in the spray zone on five separate waterfall rock faces on the south side of the valley, and another population of 25+ individuals is located in Waianu Valley just to the north. The current inventory numbers have bumped *L. filifolia* off the O'ahu Plant Extinction Prevention (PEP) list, which is restricted to species with fewer than 50 individuals remaining in the wild (Plant Extinction Prevention 2007). All waterfall habitats in the survey area were carefully examined for *L. filifolia*; none were found.

Three endangered *Cyanea* (Campanulaceae) species have also been collected in the Waiāhole-Waianu-Waikāne area: *C. crispa* was last noted in Waiāhole in 1956; *C. lanceolata* was last noted in Waikāne in 1947 (HBMP); and *C. truncata* was last collected on the Waikāne side of the Schofield-Waikāne trail in a native banana patch, 800 feet elevation, in 1931 (*H. St. John 11091*, BISH). None were seen during the survey.

Finally, *Cyrtandra kaulantha* (Gesneriaceae) is an endemic African violet relative on the PEP list, and currently listed as a candidate endangered species. It is currently known from 40 plants (including outplants) in five small gulches in Waianu Valley. No plants were found during the BWS survey. *Cyrtandra calpidicarpa* (Gesneriaceae), notable for its curious elongated fruit, was noted in one Waihe'e gulch and was the most unusual of the gesneriads collected during the survey (see Map 2, p. 22).

Id. Critical habitat designations

In June 2003, the U.S. Fish and Wildlife Service (USFWS) published final designations of critical habitat for 101 endangered O'ahu plant taxa (U.S. Fish and Wildlife Service 2003). The USFWS created 36 critical habitat units for O'ahu, many of them created for multiple endangered species. Board of Water Supply (BWS) lands in Waihe'e and Kahalu'u (TMK 4-7-8:002, 4-7-6:023) are contained within Unit 20, the largest of the units, encompassing the central and northern Ko'olau Mountains. Designation as critical habitat does not necessarily imply that the endangered species is currently or was historically present in the area. In fact, in many cases an area is designated as critical habitat, although currently unoccupied, because it provides a landbank of environmental conditions suitable for the recovery of the species. The long-range goal of the U.S. Fish and Wildlife Service is to designate critical habitat that will eventually support 8–10 discrete, viable, reproducing populations of each endangered taxon in their historically known ranges.

Study of the critical habitat maps indicate that parts of the BWS tract are included as critical habitat for sixteen endangered species. Most of the designated habitats impinge on the BWS parcel only in the summit area. In two species (*Labordia cyrtandrae*, *Plantago princeps*) the critical habitat dips down in elevation to include Ulimakoli peak on the northern side of Waihe'e. Only with *Lysimachia filifolia* does critical habitat extend down to the base of the Ko'olau pali and into the surveyable zone included within this report. The taxa and their critical habitats in the BWS tract are as follows:

- **Chamaesyce rockii** ('akoko, Euphorbiaceae), gulch slopes and bottoms, ridge crests in wet 'ōhi'a

(*Metrosideros* spp.)-uluhe (*Dicranopteris linearis*) forest and shrubland in vicinity of 'Eleao summit. Oahu Unit 20—*Chamaesyce rockii*—c designates 639 acres for one population of 300 reproducing individuals (currently occupied by 1 individual); includes 'Eleao summit area of BWS parcel.

- **Cyanea acuminata** (hāhā, Campanulaceae), north to central Ko'olau summit, slopes, ridges, streambanks in 'ōhi'a-uluhe or 'ōhi'a-koa (*Acacia koa*) wet or mesic forest or shrubland, or lama (*Diospyros* spp.)-'ōhi'a lowland mesic forest, including 'Eleao summit. Oahu Unit 20—*Cyanea acuminata*—b designates 6,231 acres for 3 populations of 300 reproducing individuals mostly north of the BWS parcel (currently occupied by 30 individuals); includes 'Eleao summit area of BWS parcel.
- **Cyanea crispa** (hāhā, Campanulaceae), central, mostly leeward Ko'olau, on slopes, moist gullies, and streambanks in open mesic forest or closed wet forest. Oahu Unit 20—*Cyanea crispa*—b designates 9,529 acres for 3 populations of 300 reproducing individuals mostly south of the BWS parcel (currently unoccupied); includes Kahalu'u summit area of BWS parcel.
- **Cyanea humboldtiana** (hāhā, Campanulaceae), central, mostly leeward Ko'olau in wet 'ōhi'a-uluhe lowland shrubland. Oahu Unit 20—*Cyanea humboldtiana*—b designates 315 acres for one population of 300 reproducing individuals, mostly leeward Ko'olau summit (currently unoccupied); includes Waihe'e summit area of BWS parcel).
- **Cyanea koolauensis** (hāhā, Campanulaceae), central Ko'olau summit, slopes, streambanks, and ridges in wet 'ōhi'a-uluhe forest or shrubland, including 'Eleao summit. Oahu Unit 20—*Cyanea koolauensis*—b designates 799 acres for 2 populations of 300 reproducing individuals (currently occupied by 4 individuals); includes Waihe'e summit area of BWS parcel.
- **Cyanea st.-johnii** (hāhā, Campanulaceae), central Ko'olau summit, wet windswept slopes and ridges in 'ōhi'a mixed lowland shrubland or 'ōhi'a-uluhe lowland shrubland. Oahu Unit 20—*Cyanea st.-johnii*—a designates 1,723 acres for 6 populations of 300 reproducing individuals (currently occupied by 44 individuals); includes summit area of BWS parcel.
- **Labordia cyrtandrae** (kāmakahala, Loganiaceae), central Ko'olau summit, in shady gulches or on slopes in mesic to wet forests or shrublands of 'ōhi'a, koa, and uluhe lau nui (*Diplopterygium pinnatum*). Oahu Unit 20—*Labordia cyrtandrae*—c designates 1,525 acres for 2 populations of 300 reproducing individuals (currently occupied by 1 individual); includes portions of 'Eleao and Ulimakoli summits of BWS parcel.
- **Lobelia gaudichaudii ssp. koolauensis** (no common name, Campanulaceae), north to central Ko'olau summit, moderate to steep slopes in 'ōhi'a lowland wet shrubland or bog. Oahu Unit 20—*Lobelia gaudichaudii* ssp. *koolauensis*—a designates 2,287 acres for 7 populations of 300 reproducing individuals (currently occupied by 247 individuals); includes summit area of BWS parcel.
- **Lobelia oahuensis** (no common name, Campanulaceae), central Ko'olau summit ridge, steep slopes or summit cliffs in cloudswep wet forest or lowland wet shrubland frequently exposed to heavy wind and rain. Oahu Unit 20—*Lobelia oahuensis*—a designates 1,218 acres for 7 populations of 300 reproducing individuals (currently

occupied by 13 individuals); includes summit area of BWS parcel.

- **Lysimachia filifolia** (no common name, Primulaceae), central Ko'olau, on mossy banks at cliff face bases within waterfall spray zones or along streams. Oahu Unit 20—*Lysimachia filifolia*—a designates 3,734 acres for 6 populations of 300 reproducing individuals (currently occupied by 160 individuals); includes lowland gulch faces in BWS parcel.
- **Plantago princeps** (laukahi kuahiwi, Plantaginaceae), upper portions of mainly leeward central Ko'olau Mountains, slopes or ledges in 'ōhi'a lowland mesic forest or shrubland. Oahu Unit 20—*Plantago princeps*—d, e designates 3,179 acres for 2 populations of 300 reproducing individuals (currently occupied by 2 individuals); includes portions of 'Eleao and Ulimakoli summits of BWS parcel.
- **Pteris lidgatei** (no common name, Pteridaceae), upper portions of mainly leeward central Ko'olau Mountains, steep streambanks or cliffs in wet 'ōhi'a-uluhe forest. Oahu Unit 20—*Pteris lidgatei*—c designates 2,084 acres for 1 population of 300 reproducing individuals (currently occupied by 4 individuals); includes 'Eleao summit area of BWS parcel.
- **Sanicula purpurea** (no common name, Apiaceae), central Ko'olau summit, open 'ōhi'a mixed montane bogs or windswept shrubland in the cloud zone. Oahu Unit 20—*Sanicula purpurea*—a designates 1,739 acres for 4 populations of 300 reproducing individuals (currently occupied by 6 individuals); includes summit area of BWS parcel.
- **Tetraplasandra gymnocarpa** ('ohe'ohe, Araliaceae), central Ko'olau, windswept summit ridges, slopes, and gullies in wet to sometimes mesic lowland forest or shrubland. Oahu Unit 20—*Tetraplasandra gymnocarpa*—c designates 1,018 acres for 1 population of 100 reproducing individuals (currently occupied by 2 individuals); includes 'Eleao summit area of BWS parcel.
- **Trematolobelia singularis** (no common name, Campanulaceae), central Ko'olau, steep windswept cliff faces or slopes in 'ōhi'a-uluhe lowland wet shrubland. Oahu Unit 20—*Trematolobelia singularis*—a designates 219 acres for 2 populations of 300 reproducing individuals (currently unoccupied); includes 'Eleao summit area of BWS parcel.
- **Viola oahuensis** (no common name, Violaceae), Ko'olau summit ridge from Pūpūkea to Kalihi, exposed, windswept ridges of moderate to steep slope in wet 'ōhi'a-uluhe shrubland or 'ōhi'a mixed montane bogs in cloud zone. Oahu Unit 20—*Viola oahuensis*—a designates 2,232 acres for 6 populations of 300 reproducing individuals (currently occupied by 67 individuals); includes summit area of BWS parcel.

II. METHODS

Proximity to access roads allowed for ready foot access into the survey areas. The fieldwork strategy was to use a walkthrough method in teams of 2–4 while recording plant species and describing plant communities. GPS points were taken frequently along transects and routes were mapped. Rare plants and communities, as well as weedy species of

management concern, were georeferenced when possible; in some cases, such as in steep-sided gulches or areas with heavy canopy cover, GPS readings were not possible and point localities were approximated on USGS maps. Georeferencing was made using Garmin GPS units with UTM/UPS coordinates and a NAD83 datum.

Trip 1 (1 March 2007). BISH: Danielle Frohlich, Clyde Imada, Barbara Kennedy, Alex Lau; Board of Water Supply (BWS): Amy Tsuneyoshi; Ko'olau Mountains Watershed Partnership (KMWP): Guy Ragosta, Micah Ryder. Orientation reconnaissance into both valleys. Driving and parking, then walking from that point.

Trip 2 (9 April 2007). BISH: D. Frohlich, C. Imada, A. Lau. BWS: A. Tsuneyoshi. KMWP: G. Ragosta, M. Ryder. O'ahu Plant Extinction Prevention Program (PEP): Ane Bakutis, Hina Kneubuhl. Walkthrough survey of southern half of Kahalu'u Valley (south side of Kahalu'u Stream).

Trip 3 (16 April 2007). BISH: D. Frohlich, C. Imada, B. Kennedy, A. Lau. BWS: A. Tsuneyoshi. KMWP: M. Ryder. Walkthrough survey of northern half of Kahalu'u Valley (north side of Kahalu'u Stream).

Trip 4 (23 April 2007). BISH: D. Frohlich, C. Imada, B. Kennedy, A. Lau. BWS: A. Tsuneyoshi. KMWP: G. Ragosta; Also: Cheryl Phillipson, Jeff Preble, Charlotte Yamane. Walkthrough survey of southeastern portion of Waihe'e Valley.

Trip 5 (14 May 2007). BISH: D. Frohlich, C. Imada, B. Kennedy. BWS: A. Tsuneyoshi. KMWP: G. Ragosta. Also: J. Preble. Walkthrough survey of middle portion of Waihe'e Valley surrounding gaging stations.

Trip 6 (21 May 2007). BISH: D. Frohlich, C. Imada, B. Kennedy. BWS: A. Tsuneyoshi. KMWP: G. Ragosta. PEP: Ane Bakutis, Hina Kneubuhl. Also: J. Preble. Walkthrough survey in northern portion of Waihe'e Valley.

Trip 7 (4 June 2007). BISH: D. Frohlich, C. Imada, A. Lau. BWS: A. Tsuneyoshi, Darrell Wong. KMWP: G. Ragosta. Also: Jeff Preble, Jason Preble. Walkthrough survey in southern portion of Waihe'e Valley.

Trip 8 (20 November 2007). BISH: D. Frohlich, C. Imada, A. Lau. BWS: A. Tsuneyoshi. KMWP: Dave Anderson, G. Ragosta, M. Ryder. O'ahu Invasive Species Committee (OISC): Alike Anixt, Aka Beebe. Also: Joel Lau, Jeff Preble. Walkthrough survey in northern portion of Waihe'e Valley.

III. RESULTS

A total of 243 taxa were noted during the survey, including 47 endemic, 28 indigenous, 139 naturalized, 15 Polynesian-introduced, and 14 cultivated plants. Thus, only 31% of all plant taxa seen were native (75 of 243), a low percentage attesting to the disturbed nature of the vegetation. Appendix A (p. 25) provides a complete list.

Among the 47 endemic species, none could be categorized as commonly occurring in the survey area. The most common natives were the widespread indigenous species *Pandanus tectorius* (hala), *Hibiscus tiliaceus* (hau), and *Dicranopteris linearis* (uluhe), although the native status of hau is still an open question since it was an important ethnobotanical plant and was likely transported from elsewhere by the original Polynesian settlers. Otherwise, natives were scattered in most

of the parcel, and were seen in congregations only in selected moist streambanks in the backs of narrow gulches, on the upper slopes of uluhe-covered ridges, and on steep, rocky slopes approaching the valley rims.

IIIa. Vegetation Zones

The vegetation zones in the surveyed, non-pali portion of Board of Water Supply lands in Kahalu'u and Waihe'e Valleys vary primarily by moisture, slope, and substrate. In a study of land use history in Waihe'e Valley, Chun (1954) mapped five vegetation zones:

- Zone A: Coastal strand zone.
- Zone B: Most of the cultivated lowlands of taro, banana, papaya, truck crops, lychee, etc., along with weedy species growing along streams, irrigation ditches, and uncultivated sites, such as guava, Java plum, hau, grasses, and ferns, with large mango trees dotting the landscape.
- Zone C: A unique, sparsely-vegetated assemblage in the north-central part of the valley, centered around a low spur, consisting of Java plum, guava, and grasses.
- Zone D: Most of the forest reserve in the valley, a dense mix of guava, hau, kukui, hala, ti, ferns, grasses, and vines, often forming impenetrable barriers.
- Zone E: Steep, sparsely vegetated slopes, usually above 900 feet elevation, consisting of ferns, shrubs, grasses, and mosses.

Chun's Zone D broadly describes the vegetation encountered during the BWS survey, and all of the plants mentioned remain prominent elements of the parcel. Here, using the vegetation classification system of Gagné and Cuddihy (1999), three vegetation types within Chun's Zone D are described and delineated, along with associated species (see Map 4, p. 24).

Coastal Wet Shrubland

Hau (Hibiscus) Shrubland: *Hibiscus tiliaceus* (hau) is grudgingly considered a native species; to most, it is an aggressive weedy tree that prefers coastal and streamside habitats, forming impenetrable thickets of prostrate branches. In its best formation, these thickets are monodominant, as nothing can grow in the deep shade created by its canopy of leaves and branches. The uncertainty about its native status is due to its ready ability to disperse naturally via seawater but lack of firm archaeological evidence to confirm its pre-Polynesian arrival. Hau has many ethnobotanical uses, and it is assumed that Polynesian settlers brought propagative material with them on their voyages to Hawai'i. In the BWS parcel, hau dominates in large sections of the flatlands



adjoining stream drainages, and is even found growing up steep sideslopes. Many of the lowland hau habitats may have formerly been under taro cultivation. Species noted within this habitat include *Oplismenus hirtellus* (basketgrass) and *Christella* spp. Hau is also a component of the Alien Wet Forest type.

Lowland Wet Forest

Uluhe Fern Forest: Many of the broad low, open ridges emanating from the steep back wall are dominated by *Dicranopteris linearis* (uluhe) fern thickets, which tend to form a continuous blanket with scattered emergent trees such as the aliens *Cecropia obtusifolia* (trumpet tree), *Schefflera actinophylla* (umbrella tree), *Citharexylum caudatum* (fiddlewood), *Syzygium cumini* (Java plum), *Ficus microcarpa* (Chinese banyan), and *Psidium guajava* (common guava). It is in this habitat that scattered native forest trees stand out, such as *Metrosideros polymorpha* ('ōhi'a), *Acacia koa* (koa), and *Bobea elatior* ('ahakea lau nui). The tangled masses of uluhe can be difficult to move through, especially in steep and uneven terrain. Often pig trails can be found tunneled underneath the thick mats of fern and are not apparent at first glance because the upper levels of the fern mat are not disturbed. Sometimes these tunnels are referred to as "pig highways" because the pigs utilize them to get from one area to another, but rarely use the areas for rooting or bedding down. Thus, evidence of pig damage, other than the tunnels, is usually minimal in this plant community. Non-tree species noted in this community include *Clidemia hirta* (Koster's curse), *Nephrolepis brownii*, *N. exaltata* ssp. *hawaiiensis* (kupukupu), and *Cibotium chamissoi* (hāpu'u).



Alien Wet Forest: The majority of the parcel is a dense mixture of alien tree and shrub species that best fit this catch-all vegetation type. Apart from vegetation zones dominated by hau or uluhe, Alien Wet Forest forms a continuous blanket over the undulating topography. The dominant tree species is a variable mixture that include *Citharexylum caudatum*, *Aleurites moluccana* (kukui), *Psidium guajava*, *Syzygium malaccense*, *S. cumini*, *Ficus microcarpa*, *Schefflera actinophylla*, *Cecropia obtusifolia*, *Dillenia suffruticosa* (shrubby simpoh), and the indigenous *Pandanus tectorius* (hala), with scattered large trees of *Mangifera indica* (mango). Dominant trees along streambanks are a mixture of *Aleurites*, *Psidium guajava*, *Syzygium cumini*, and *S. malaccense* (mountain apple). Native tree species that can still be found scattered in the forest are *Metrosideros polymorpha* and *Pisonia umbellifera* (pāpala kēpau), along with shrubs like *Pipturus albidus* (māmaki) and ferns *Cibotium chamissoi* and *Sadleria cyatheoides* ('ama'u). This region along the main stream is the most impacted by pigs. Hawaiian *Cyrtandra* (ha'iwale) species are extremely vulnerable to pig disturbance and were conspicuously lacking from this habitat.

An Alien Wet Forest subtype dominated by kukui is found in some of the valley bottom and side drainages, made obvious by their distinctive silvery green foliage. A Polynesian introduction, kukui may be a current

inhabitant of sites formerly cultivated by ancient Hawaiians for wetland taro (*Colocasia esculenta*) and long since abandoned. This subtype often consists of 20–50 foot tall kukui forming an open to closed canopy on the banks of boulder-strewn streams. Alien trees typically associated with kukui include *Syzygium malaccense* (mountain apple), *Citharexylum caudatum*, and *Psidium guajava*. Monstrous trees of *Ficus microcarpa* dot the valley bottom and lower slopes. The shrub layer includes *Clidemia hirta* and *Rubus rosifolius* (thimbleberry). *Oplismenus hirtellus* is a common understory grass; common ferns include *Blechnum appendiculatum*, *Christella* spp., *Deparia petersenii*, and *Angiopteris evecta* (mule's-foot fern). Other common Polynesian introductions include *Cordyline fruticosa*, *Zingiber zerumbet*, and *Dioscorea bulbifera* (bitter yam). Fairly common native elements include the tree *Pisonia umbellifera*, the shrub *Pipturus albidus*, the tree fern *Cibotium chamissoi*, and a variety of shade-loving ferns such as *Vandenboschia* spp., *Tectaria gaudichaudii* ('iwa'iwa lau nui), *Gonocormus minutus*, and *Selaginella arbuscula* (lepelepe a moa). This is also the preferred habitat of less common natives such as *Cyrtandra* spp., *Touchardia latifolia* (olonā) (see Map 2, p. 22; Map 3, p. 23), and the Polynesian introduction *Piper methysticum* ('awa). These habitats may all have originally been dominated by *Pisonia* forest. The O'ahu 'Elepaio (*Chasiempis sandwichensis ibidis*) habitat lies within this vegetation type. This zone is often highly disturbed by wild pigs.

Small monodominant patches of the indigenous *Pandanus tectorius* (hala) fit best as a subtype of Alien Wet Forest. Hala is a common coastal tree, especially in windward mesic coastal habitats extending inland to low-elevation slopes of mesic valleys. In its best development, hala forms monodominant stands on steep to gentle slopes and gulch bottoms in the BWS parcel. The dense tufts of spiny, strap-shaped leaves form a thick, semi-closed canopy. The understory is dominated by the stout, prickly prop roots and thick, cushiony masses of fallen hala leaves, with only sparse vegetation within the grove. Associated species include the trees *Schefflera actinophylla*, *Citharexylum caudatum*, *Psidium guajava*, *P. cattleianum* (strawberry guava), *Ficus microcarpa*, *Hibiscus tiliaceus*, and *Metrosideros polymorpha*; shrubs *Ardisia elliptica* (shoebuttan ardisia) and *Cordyline fruticosa* (ti); herb *Zingiber zerumbet* (shampoo ginger); and ferns *Cibotium chamissoi*, *Christella* spp., and *Nephrolepis brownii*. The groundcover is often *Oplismenus hirtellus*.

IIIb. Noteworthy plant discoveries/Taxa of conservation significance

No federally listed endangered or threatened species were noted during the survey, primarily due to the focus of the survey effort on the valley floors, which historically have been much modified by intensive agricultural production. The majority of endangered species historically collected in the BWS parcel have been from the Ko'olau summit area, which was not visited during this survey. Much effort was expended toward searching for rare taxa that prefer the wet, shaded gulch habitats present in the survey areas, especially *Lysimachia filifolia* and *Cyrtandra kaulantha*, which are still extant in Waiāhole Valley to the north. One species currently designated as a Species of Concern (M. Brueggemann, pers. comm.) located during the survey was *Bidens populifolia* (ko'oko'olau). The Species of Concern category is an unofficial one that USFWS uses to designate rare species for which there is currently insufficient evidence on biological status and threats to propose them as Endangered or Threatened. Another taxon of conservation significance noted was an endangered flycatcher bird—the O'ahu 'Elepaio.

- ***Bidens populifolia***—One of 19 species in the genus *Bidens* (Asteraceae) endemic to Hawai'i, *B. populifolia* is a subshrub or herb described by E. E. Sherff in 1928 from a collection made by Otto Degener in Kahana Valley, O'ahu. Wagner et al. (1999) described its known range to be restricted to the windward Ko'olau Mountains from Kaipapa'u south to Ka'a'awa, where it was scattered on exposed ridges in mesic to wet forest from 165–1,970 feet elevation. It is distinguished from other native *Bidens* by its usually simple (rarely trifoliate), ovate-cordate leaves with a subcordate to obliquely truncate base; inflorescences in diffuse compound cymes, both terminal and lateral; peduncles 1.4–4.3 in. long; ray florets (6)7–9 per head with yellow rays 0.8–1 in. long; disk florets 19–28 per head; outer involucre bracts (0.08–)0.1–0.2 in. long; and straight or slightly curved achenes, black, 0.3–0.6 in. long, 0.04–0.05 in. wide, setose at least on the margins (Wagner et al. 1999). A small population was noted on a steep slope and ridge approaching Ulimakoli peak (see Map 2, p. 22). This finding confirms a HBMP report (without voucher specimen) of its presence in Waihe'e Valley, which extends the range of *B. populifolia* south from that listed in Wagner et al. (1999). An assessment of the species is included on the IUCN Red List of Threatened Species website (<http://www.iucnredlist.org/search/details.php/44118/all>, accessed 28 Nov 2007), which records that the species is currently known from 4–5 subpopulations consisting of 5,000+ individuals. Threats to its existence are listed as invasive alien plants and feral pigs. The population seen was in a disturbed forest with remnant native elements that included *Chamaesyce celastroides* var. *amplectans* ('akoko), *Osteomeles anthyllidifolia* ('ūlei), *Diospyros sandwicensis* (lama), and *Myrsine lessertiana* (kōlea lau nui).
- ***Chasiempis sandwichensis ibidis*** (O'ahu 'Elepaio)—Federally listed as endangered in 2000, the O'ahu 'Elepaio was considered the most common native forest bird on O'ahu in the early 1900s, but today its range is estimated to be only 4% of its prehistoric range (Vanderwerf et al. 2001). While much of its range decline can be attributed to habitat loss due to urbanization and agricultural development, plummeting population numbers in the past 25+ years are probably more attributable to nest predation by introduced black rats, and mosquito-borne diseases (ibid.). The total population has been estimated at around 2,000 birds, with three larger populations each in the Wai'anae and Ko'olau Mountains, and several smaller separate subpopulations. Some of these subpopulations are isolated and apparently contain only male birds, so they will probably disappear once the male birds die. A population of five birds in three territories in Waihe'e Valley in a 79 acre habitat was observed between 1992 and 2000, with one breeding pair still extant (ibid.). During the BWS survey, O'ahu 'Elepaio were noted in two different gulches. A call was heard in the back of one disturbed gulch habitat; in another kukui-forested alien gulch, three O'ahu 'Elepaio were seen (see Map 2, p. 22).

IIIc. Weedy plants of concern

The survey enumerated 168 taxa of non-native plants. Many of them are relatively innocuous roadside herbs, but nine plants noted during the survey (*Ageratina riparia*, *Andropogon virginicus*, *Ardisia elliptica*, *Clidemia hirta*, *Melastoma septemnerium*, *Pueraria phaseoloides*, *Rhodomyrtus tomentosa*, *Solanum torvum*, *Urena lobata*) appear on the Hawai'i Department of Agriculture List of Plant Species Designated as Noxious Weeds for Eradication or Control Purposes (Hawaii Administrative Rules, Title 4 Subtitle 6 Chapter 68), which was last updated in June 1992. To merit inclusion on

this list a weed species must meet several criteria involving plant reproduction, growth characteristics, detrimental effects, necessary control measures, and distribution and spread.

A number of weedy species in the parcel are rampant and beyond economical means of control at this point. These include *Caesalpinia decapetala* (Mysore thorn), *Dillenia suffruticosa* (shrubby simpoh), *Schefflera actinophylla* (umbrella tree), *Cecropia obtusifolia* (trumpet tree), *Citharexylum caudatum* (fiddlewood), *Ardisia elliptica* (shoebutton ardisia), *Phyllostachys nigra* (black bamboo), *Ficus microcarpa* (Chinese banyan), *Clidemia hirta*, and *Paederia foetida* (maile pilau). Others would require much effort to eliminate, such as *Melastoma septemnerium*, *Pittosporum pentandrum*, and *Angiopteris evecta* (mule's-foot fern).

Two invasive weeds were not noted in the survey area but have been collected in the past makai of it. *Miconia calvescens* and *Piper auritum* bear watching, as they may be dispersable to the BWS property. *Piper auritum* was noted in a residential backyard in Kahalu'u. This relative of *P. methysticum* ('awa) has sometimes been passed off as 'awa but has none of the kavalactones that give the latter its stupefying effects. Furthermore, *P. auritum* has a well-deserved reputation as a nasty invasive weed, primarily by spread of an aggressive subsurface rhizome system that quickly results in large thickets. The tiny fruit are produced on a spike and are reportedly dispersed by bats in its native habitat (Mexico, Central America, northern South America and the West Indies) (http://www.hear.org/pier/species/piper_auritum.htm), and could possibly be bird-dispersed here. For more on *Miconia*, see Recommendations (p. 17).

- **Acacia confusa** (Formosan koa)—This legume tree grows to 45 feet tall and has been extensively planted as a forestry tree throughout the state; it has since naturalized on all the main islands except Ni'ihau. This species seems to benefit from fire, as trees can resprout and seeds germinate readily after burns. It was seen at only one open location near the makai boundary in Kahalu'u (see Map 3, p. 23).
- **Alpinia mutica** (Small shell ginger)—First recorded as a cultivated ornamental in Hawai'i in 1930 (Wagner et al. 1999), this 3–6 foot tall ginger has only sparingly been recorded as an escape in the state. On O'ahu, the only recorded naturalized populations were in Mānoa Valley in 1964 and Kāne'ohe in 1986 (Staples & Herbst 2005). One small population was recorded in Waihe'e (see Map 2, p. 22). The species is said to be very difficult to remove once established (http://www.weeds.crc.org.au/documents/weeds_in_the_media_proceedings.pdf).
- **Arthrostemma ciliatum** (Arthrostemma)—This sprawling herb in the Melastomataceae can form dense thickets, especially in wet, open gulches. It was located in only one small site each in Kahalu'u and Waihe'e (see Map 2, p. 22; Map 3, p. 23).
- **Begonia vitifolia** (Grape-leaf begonia)—This succulent-stemmed herb was noted on the gulch floor and back wall of a single wet gulch in Kahalu'u, where it formed monotypic stands up to 6 feet tall on a steep basaltic waterfall face over 50 feet tall (see Map 3, p. 23). Originally brought into Hawai'i for cultivation, *B. vitifolia* has since been documented as a roadside weed in South Kona on the Big Island (first vouchered in 1976), and has been documented from O'ahu since 1993, when a collection was made in nearby Waikāne Valley, where it was described as a dominant herb



along the gully floor and steep slopes of a moist gulch at 1,200 feet elevation (*J. Obata s.n.*, BISH #635157). The species is treated in Wagner et al. (1999) under the misapplied name *B. reniformis* (Staples et al. 2002). It is primarily wind-dispersed, although it can also root from stem fragments.

- ***Calathea crotalifera*** (rattlesnake plant)—This tall, clumping, gingerlike herb was well established in Kahalu'u but not noted in Waihe'e. This species is widely cultivated but previously documented in the State as naturalized only from the slopes above Ko'olau Golf Club in Kāne'ohe, below the Pali Lookout (*K. Nagata 3486*, 12 May 1986, BISH). The species is apparently bird-dispersed in the valley, since sightings of individual, widely dispersed plants in out-of-the-way locations were made.
- ***Cestrum nocturnum*** (Night-blooming cestrum)—This bird-dispersed shrub to 12 feet tall is cultivated for its powerful nighttime fragrance and has escaped cultivation on at least Kaua'i, O'ahu, Maui, and the Big Island. In wet gulch slopes it has a toppling habit and can form nearly impenetrable thickets, excluding all other species. Although somewhat common in Waihe'e, its occurrence is currently rare in Kahalu'u.
- ***Cinnamomum burmanii*** (Padang cassia)—Originally planted as a forestry tree, this species forms dense monotypic stands and spreads readily by bird dispersal. This species is known from only one tree in Kahalu'u, which was producing numerous seedlings (see Map 3, p. 23).
- ***Clusia rosea*** (Autograph tree)—A tree up to 50 feet tall, often growing epiphytically as a seedling and sending off aerial roots which strangle and may kill its host tree. This bird-dispersed tree has established itself especially in lowland areas of the state, but was found in only one easily accessible location in Kahalu'u, and was not located in Waihe'e (see Map 3, p. 23).
- ***Falcataria moluccana*** (Albizia)—A very fast-growing, short-lived forestry tree in the Fabaceae that readily spreads from plantings. Its brittle but very large branches can be hazardous during wind and rain storms. It is presently rare in both Kahalu'u and Waihe'e. KMWP has noted scattered trees in Waihe'e on their scoping surveys from the Ko'olau summit (M. Ryder, pers. comm.)
- ***Heliocarpus popayanensis*** (White moho)—This fast-growing forestry tree with usually 3-lobed leaves is spread by its wind-dispersed, plumose-bristly fruit. This species is establishing itself in predominantly native forest at least along the Ko'olau summit ridge. Trees of this species are currently rare in Kahalu'u and occasional in Waihe'e, and seedlings were often pulled where seen.
- ***Lonicera japonica*** (Japanese honeysuckle)—A scrambling shrub with fragrant white flowers, and stems that root at the nodes. This species is a major pest of the southeastern U.S. and in the Pacific including Hawai'i, but was previously not known to be naturalized on O'ahu. Recent observations of fruit production and viable seed (Starr et al. 2002) contradict the notion that Hawaiian plants are sterile clones. *Lonicera japonica* distribution was occasional in the lower areas of Waihe'e Valley only (see Map 2, p. 22).
- ***Medinilla magnifica*** (Medinilla)—This shade-tolerant hemi-epiphytic woody vine, which produces copious bird-dispersed fruit, has been cultivated on O'ahu for nearly a century, but has only very recently been collected as naturalized. It is now known from several locations on the island due to vigilant monitoring



efforts by the O'ahu Invasive Species Committee. The species was located once in Kahalu'u and once in Waihe'e; both were removed (see Map 2, p. 22; Map 3, p. 23).

- **Pueraria phaseoloides** (Tropical kudzu)—This vine has only very recently been collected on O'ahu, and is well established in roadside areas makai of the survey area. Native to Southeast Asia and some Pacific islands, tropical kudzu is listed on the Hawai'i State Noxious Weed List. One small population was located on the access road just makai of the survey boundary in Waihe'e Valley (see Map 2, p. 22).
- **Rhodomyrtus tomentosa** (Rose myrtle)—This small tree in the Myrtaceae has bird-dispersed fruit and grows to 10 feet tall. It has established expansive monotypic stands in nearby Ha'ikū Valley, and is listed as a state noxious weed. This species was found in one location in Kahalu'u Valley and was pulled (see Map 3, p. 23). KMWP has noted scattered dense patches in Kahalu'u on their scoping surveys from the Ko'olau summit (M. Ryder, pers. comm.)
- **Solanum torvum** (Turkeyberry)—This spiny shrub with bird-dispersed fruit is sometimes cultivated for use of its bitter fruit in Southeast Asian curries, salads, and sauces. More often it is found as a naturalized weed of disturbed areas and pastures, established worldwide. A federally listed noxious weed, this species occurred in one very accessible location in Kahalu'u at the end of the BWS access road; the plant was destroyed (see Map 3, p. 23).
- **Spathodea campanulata** (African tulip)—This invasive tree with large, bright orange-red, bell-shaped flowers is a popular cultivated plant but is readily dispersed and naturalized in moist to wet forests by its flat, winged seeds. It has the ability to invade undisturbed native forests. It is presently uncommon in both Kahalu'u and Waihe'e Valleys.
- **Sphaeropteris cooperi** (Australian tree fern)—This invasive tree fern is establishing itself on most of the main Hawaiian Islands, including some of the most pristine native habitats of Kaua'i. It disperses long distances due to windborne spores and can exclude establishment of other species, therefore posing a watershed threat. It is currently rare in both valleys. Adults were sometimes removed when encountered, including one specimen estimated at 20 feet tall in Waihe'e (see Map 2, p. 22; Map 3, p. 23).
- **Tabebuia heterophylla** (Pink tecoma)—This wind-dispersed tree has been cultivated in Hawai'i since at least 1927, but has only recently been collected as naturalized on O'ahu and Maui. Saplings germinate readily even in urban settings, and are often tolerated and trimmed into existing hedges. This species shows potential to be invasive, and should be removed from the single locations in both Kahalu'u and Waihe'e (see Map 2, p. 22; Map 3, p. 23).
- **Toona ciliata** (Australian red-cedar)—This wind-dispersed forestry tree in the Meliaceae grows to 50 feet tall and spreads readily from plantings. It was located along the service road in Kahalu'u as sprouts from several cut tree stumps, as well as one sapling growing on a boulder in a gulch.
- **Trema orientalis** (gunpowder tree)—This weedy tree with pendant branches grows up to 100 feet tall and is naturalized on all of the major Hawaiian islands. The fleshy fruit is bird dispersed. It was rare in Waihe'e and



not noted in Kahalu'u. KMWP has noted its presence in the back of Kahalu'u on its scoping surveys (M. Ryder, pers. comm.).

IV. RECOMMENDATIONS

- Eradication efforts should concentrate on species of high weed threat that are currently rare in either valley, some of which are known from only one location, sometimes only a single plant. These species include *Rhodomirtus tomentosa* (downy myrtle), *Cinnamomum burmanii* (padang cassia), *Clusia rosea* (autograph tree), *Medinilla magnifica*, *Arthrostemma ciliatum*, *Acacia confusa* (Formosan koa), *Solanum torvum* (turkeyberry), *Pueraria phaseoloides* (tropical kudzu), and *Alpinia mutica* (small shell ginger). Other species of high weed threat that could possibly be eradicated, but were more abundant than the previous species, include *Lonicera japonica* (Japanese honeysuckle), *Toona ciliata* (Australian red cedar), *Heliocarpus popayanensis* (white moho), *Falcataria moluccana* (albizia), *Filicium decipiens* (fern tree), and *Sphaeropteris cooperi* (Australian tree fern). One species that has potential to become a pest and currently has a very limited distribution is *Tabebuia heterophylla* (pink tecoma). This species could likely be eradicated from both valleys.
- A rodent control program is recommended in the vicinity of the gulch where the three O'ahu 'Elepaio were spotted. If this is a breeding pair, such measures might succeed in preventing rat predation of nesting birds and their eggs; such programs have met with success in other areas of the State (Vanderwerf et al. 2001).
- *Miconia calvescens*, possibly the most ecologically destructive invasive weed of the Pacific region, was not located in either valley, but has been collected historically in Kahalu'u Valley makai of the BWS property, between Lamaula Road and Ahilama Place in a shady ravine between adjoining properties. A voucher at BISH (*S. Benzon s.n.*, BISH 657218) made in 1999 described the habitat as Java plum overstory, with 14 *Miconia* plants ranging from 5–10 feet in height, all in flower and fruit. All plants were eradicated. Very intensive management for this species is carried out island-wide by the O'ahu Invasive Species Committee (OISC), which likely is the reason it was not located on the survey. This species forms a seed bank, however, and will likely continue to germinate seedlings for at least another 15 years. *Miconia* is easily recognized by its large (up to 28 inches long), elliptic leaves that are velvety pubescent on top and dark purple below. Any time this species is encountered, *it should not be pulled*. Because OISC is tracking its distribution on the island and so that proper removal of the plant can be assured (*Miconia* easily resprouts from root fragments and has even been observed sprouting roots from its leaf tips!), the area should be flagged w/ bright-colored flagging tape and its location marked w/ a GPS point if possible (if not, a detailed description of its location in the valley should be made). Then report the location information



along with any observations of plant size, maturity, and approximate number of individuals to OISC (ph # 286-4616, email oisc@hawaii.edu). Because of the persistent seed bank, composed of very tiny seeds, all footwear and dirty clothing should be scrubbed down and washed after hiking through these valleys to mitigate its spread to other areas.

- While there was ample evidence of wild pig (*Sus scrofa*) presence in the BWS parcel (one of the survey party had a close encounter with a fleeing porker), there seems to be no compelling reason at this time to institute a pig reduction program in the parcel for the purpose of protecting native habitat.
- The survey noted that some weedy species were common in one valley but apparently absent in the other. These lists may help with weed removal management decisions if in the future they are located in a valley they weren't found in during this survey. **In Kahalu'u, not in Waihe'e:** *Acacia confusa* *Begonia vitifolia*, *Calathea crotalifera*, *Cestrum nocturnum*, *Cinnamomum burmannii*, *Clusia rosea*, *Diplazium esculentum*, *Rhodomyrtus tomentosa*, *Solanum torvum*, *Toona ciliata*. **In Waihe'e, not in Kahalu'u:** *Alpinia mutica*, *Dillenia suffruticosa*, *Lonicera japonica*, *Pittosporum pentandrum*, *Pueraria phaseoloides*.

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Figure 1. View looking east in Waihe'e Valley, vegetated by Alien Wet Forest.

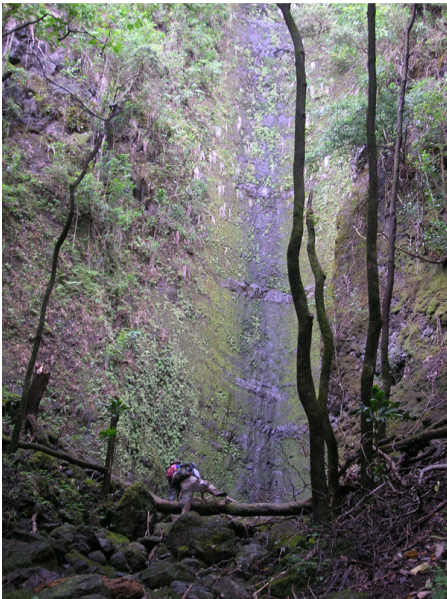


Figure 2. Typical steep gulch back wall in Waihe'e.



Figure 3. Mountain apple/*Pisonia* forest on talus slopes, Waihe'e.



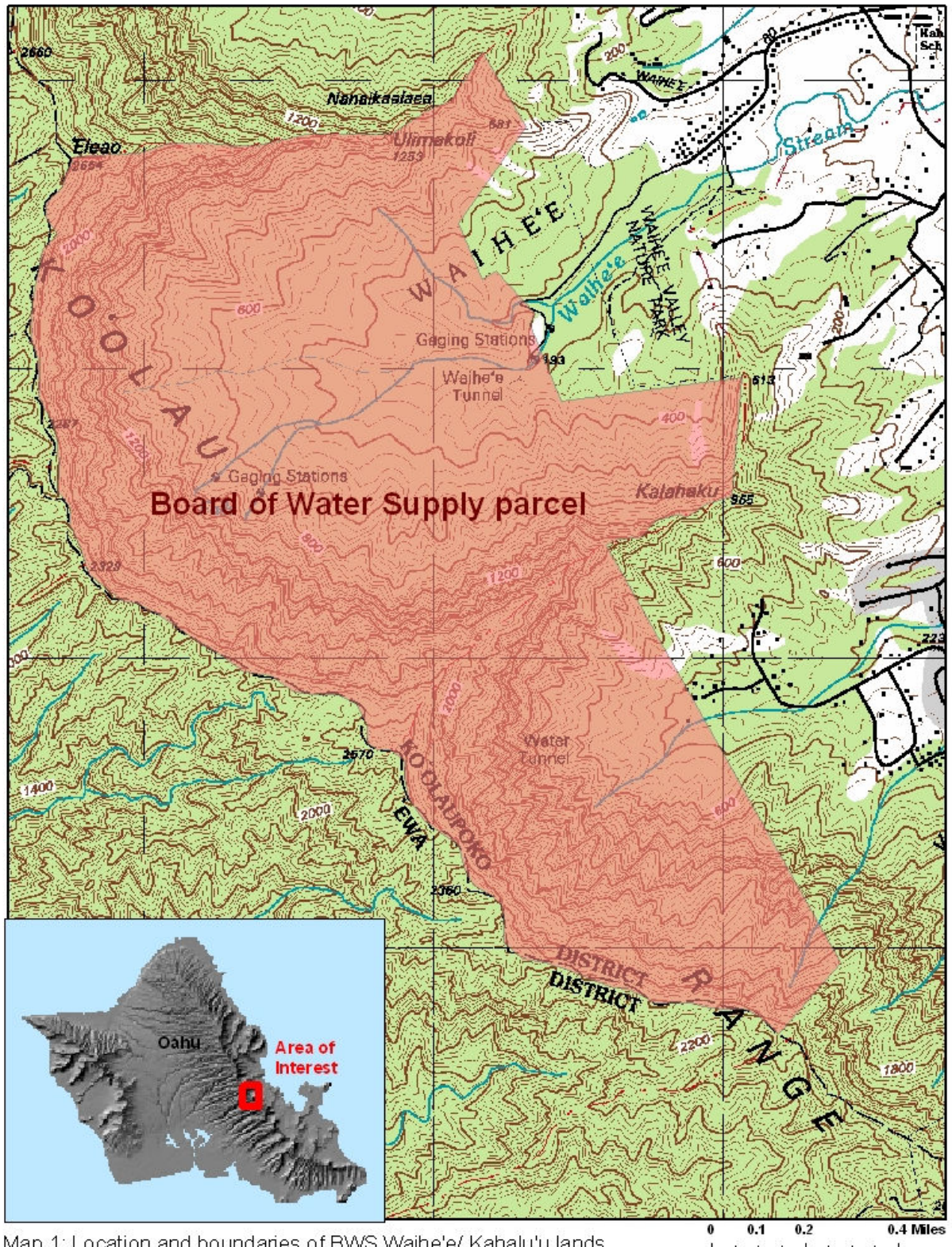
Figure 4. *Touchardia latifolia* (olonā) patch in Waihe'e, with *Piper methysticum* ('awa).



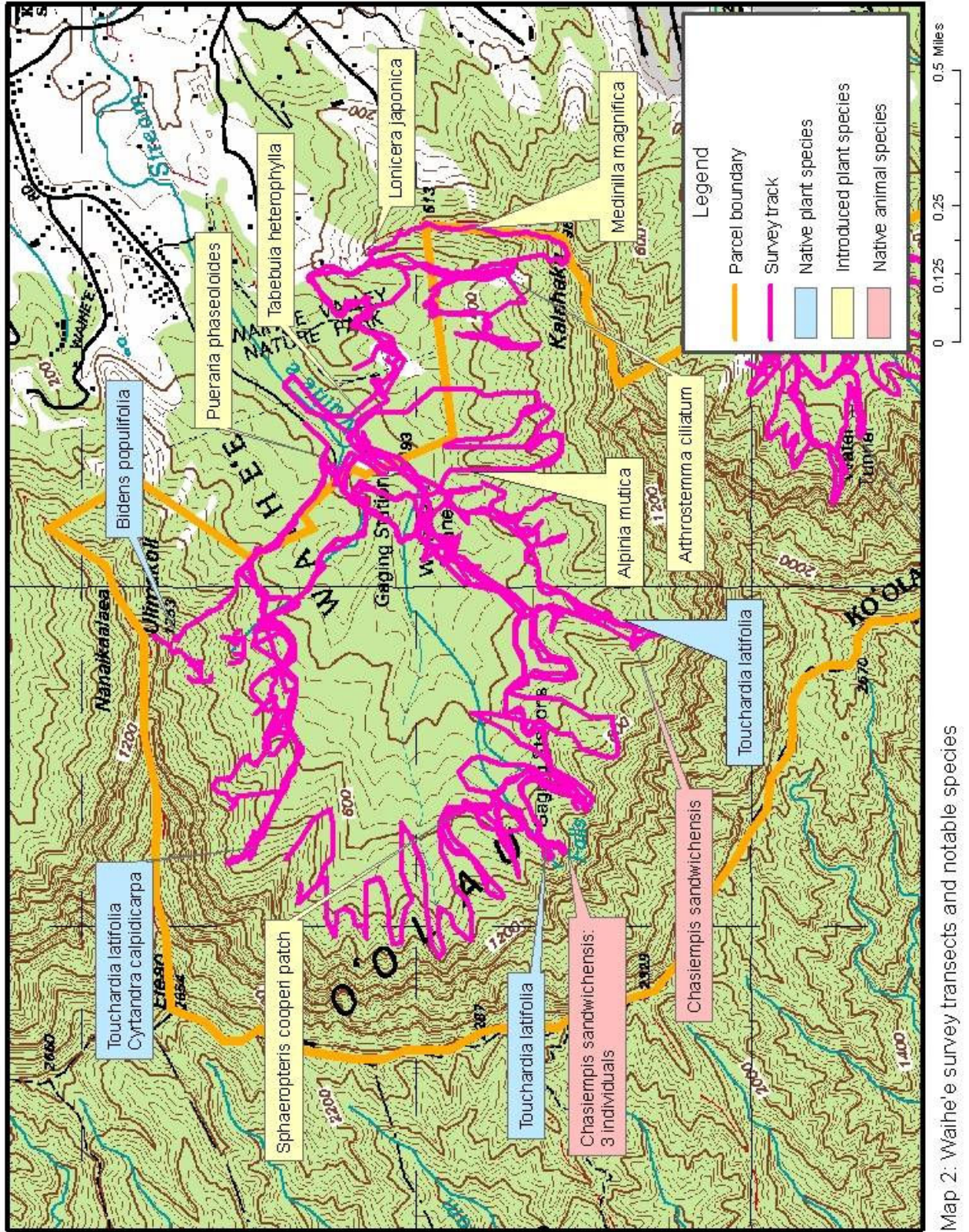
Figure 5. *Cyrtandra laxiflora* stems draping across Waihe'e gulch floor, with B. Kennedy.



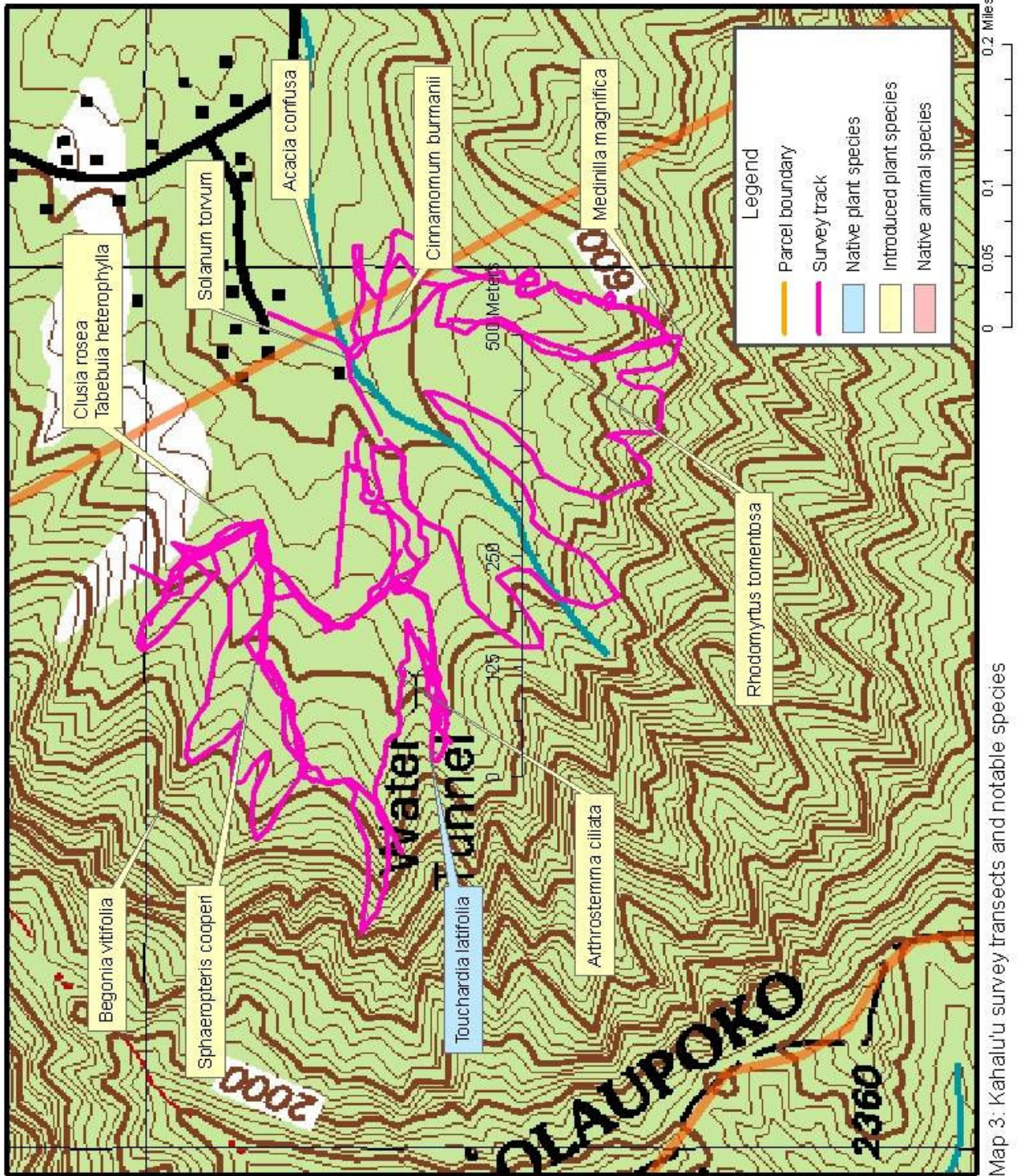
Figure 6. *Cyrtandra hawaiiensis*, occasional endemic gesneriad in wet, dark gulches.



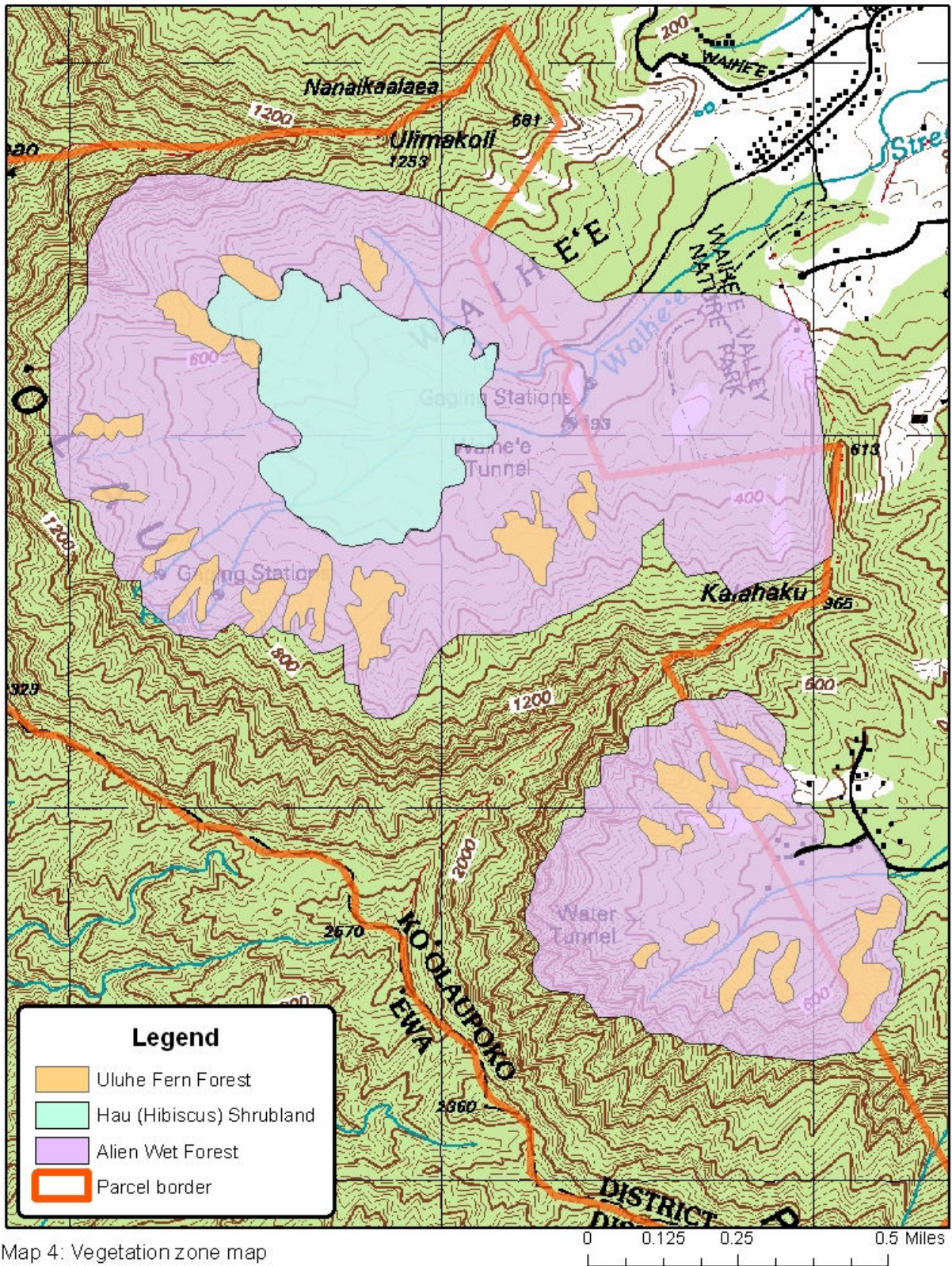
Map 1: Location and boundaries of BWS Waihe'e/ Kahalu'u lands



Map 2: Waihe'e survey transects and notable species



Map 3: Kahalu'u survey transects and notable species



APPENDIX A: Waihe'e and Kahalu'u Valley Plant Checklist

The following is a list of vascular plant species noted during walk-through surveys of approximately 800 acres of Board of Water Supply, City and County of Honolulu, watershed land in Waihe'e and Kahalu'u Valleys, O'ahu (TMK 4-7-8:002, 4-7-6:023), conducted from March to November 2007. A total of 243 taxa were noted during the survey, including 47 endemic, 28 indigenous (including "ind?"), 139 naturalized (including "nat?"), 15 Polynesian-introduced (including "pol?"), and 14 cultivated plants.

Plants are divided into four main groups: dicots, monocots, gymnosperms, and pteridophytes. Within these groups, plants are arranged alphabetically by family, genus, and species. Each entry includes scientific name with author citation, biogeographic status, common name (if available), Hawaii State noxious weed status (Hawaii Department of Agriculture), and presence/absence in Kahalu'u and Waihe'e Valleys. Taxonomy, status, and common names are in accordance with Wagner et al. (1999), Palmer (2003), or Staples and Herbst (2005). A number of specimens were collected and deposited in the Bishop Museum Herbarium Pacificum; some unknown species were collected and compared with herbarium collections to secure correct identifications. An explanation of abbreviations used in the list follows.

Noxious Weed Status

An asterisk (*) preceding the scientific name indicates that the species is a noxious weed designated for eradication or control by the Hawaii Department of Agriculture. Nine noxious weed species are included in the following checklist.

Biogeographic Status (from Wagner et al. 1999)

end	Endemic: native, occurring only in the Hawaiian Archipelago
ind	Indigenous: native, occurring naturally in the archipelago but also outside of Hawai'i
ind?	Questionably indigenous: probably indigenous, possibly naturalized
nat	Naturalized: introduced to the archipelago directly or indirectly by humans since Western contact and reproducing and spreading vegetatively or by seed
nat?	Questionably naturalized: probably naturalized, possibly indigenous
pol	Polynesian introduction: introduced by original Polynesian settlers, either intentionally or unintentionally, and now naturalized
pol?	Questionably Polynesian-introduced: perhaps introduced by original Polynesian settlers, but possibly introduced in historic times
cult	Cultivated or a remnant of former cultivation
cult?	Possible escape from cultivation

Presence/absence

x = present; c = common; o = occasional; r = rare; 1 = one of a kind

Board of Water Supply Botanical Survey, Waihe'e and Kahalu'u Valleys

Scientific name	Status	Common name	Kaha	Waih
DICOTS				
Acanthaceae				
<i>Hemigraphis reptans</i> (G. Forst.) T. Anderson	nat			x
Amaranthaceae				
<i>Charpentiera</i> sp.	end	pāpala		1
Anacardiaceae				
<i>Anacardium occidentale</i> L.	cult	cashew	1	
<i>Mangifera indica</i> L.	nat	mango	o	o
<i>Schinus terebinthifolius</i> Raddi	nat	Christmas berry, wilelaiki	x	x
Apiaceae				
<i>Centella asiatica</i> (L.) Urb.	nat	Asiatic pennywort	x	x
<i>Ciclospermum leptophyllum</i> (Pers.) Sprague ex Britton & P. Wilson	nat	fir-leaved celery	x	
Apocynaceae				
<i>Alyxia stellata</i> (J.R.Forst. & G.Forst.) Roem. & Schult.	end	maile	r	r
Araliaceae				
<i>Schefflera actinophylla</i> (Endl.) Harms	nat	octopus tree, umbrella tree	c	c
Asteraceae				
* <i>Ageratina riparia</i> (Regel) R. M. King & H. Rob.	nat	Hāmākua pāmakani, spreading mist flower	x	x
<i>Ageratum conyzoides</i> L.	nat	maile hohono	x	x
<i>Ageratum houstonianum</i> Mill.	nat	maile hohono	x	
<i>Bidens alba</i> (L.) DC. var. <i>radiata</i> (Sch. Bip.) Ballard ex Melchert	nat	Spanish needle, beggartick	x	x
<i>Bidens populifolia</i> Sherff	end	ko'oko'olau, ko'olau		r
<i>Conyza bonariensis</i> (L.) Cronquist	nat	hairy horseweed, ilioha	x	x
<i>Crassocephalum crepidioides</i> (Benth.) S. Moore	nat			x
<i>Cyanthillium cinereum</i> (L.) H. Rob.	nat	little ironweed	x	x
<i>Emilia fosbergii</i> Nicolson	nat	pualele (Ni'ihau)	x	x
<i>Emilia sonchifolia</i> (L.) DC. var. <i>javanica</i> (Burm. f.) Mattf.	nat	Flora's paintbrush		x
<i>Emilia sonchifolia</i> (L.) DC. var. <i>sonchifolia</i>	nat	Flora's paintbrush		x
<i>Erechtites valerianifolia</i> (Wolf) DC.	nat	fireweed		x
<i>Erigeron belliioides</i> DC.	nat	fleabane	x	
<i>Erigeron karvinskianus</i> DC.	nat	daisy fleabane		x
<i>Galinsoga parviflora</i> Cav.	nat		x	
<i>Pluchea carolinensis</i> (Jacq.) G. Don	nat	sourbush, marsh fleabane		x
<i>Pseudelephantopus spicatus</i> (Juss. ex Aubl.) C. F. Baker	nat	elephant's-foot		x
<i>Sphagneticola trilobata</i> (L.) Pruski	nat	wedelia	x	x
<i>Youngia japonica</i> (L.) DC.	nat	Oriental hawksbeard	x	x
Balsaminaceae				
<i>Impatiens walleriana</i> Hook. f.	nat	busy Lizzy, patient Lucy	x	
Begoniaceae				
<i>Begonia hirtella</i> Link	nat		x	x
<i>Begonia vitifolia</i> Schott	nat	grape-leaf begonia	x	
Bignoniaceae				
<i>Spathodea campanulata</i> P. Beauv.	nat	African tulip tree, fountain tree	r	r

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Scientific name	Status	Common name	Kaha	Waih
<i>Tabebuia heterophylla</i> (DC.) Britton	nat	pink tecoma	l	l
Brassicaceae				
<i>Cardamine flexuosa</i> With.	nat	bittercress	x	x
Buddleiaceae				
<i>Buddleia asiatica</i> Lour.	nat	dog tail, butterfly bush	o	o
Caprifoliaceae				
<i>Lonicera japonica</i> Thunb.	nat	Japanese honeysuckle		r
Caryophyllaceae				
<i>Drymaria cordata</i> (L.) Willd. ex Roem. & Schult. var. <i>pacifica</i> M. Mizush.	nat	pipili, pilipili	x	
Cecropiaceae				
<i>Cecropia obtusifolia</i> Bertol.	nat	guarumo, trumpet tree	c	c
Clusiaceae				
<i>Clusia rosea</i> Jacq.	nat	autograph tree, copey	l	
Convolvulaceae				
<i>Ipomoea alba</i> L.	nat	moon flower, koali pehu	x	x
Cucurbitaceae				
<i>Momordica charantia</i> L.	nat	balsam pear, bitter melon	x	
Dilleniaceae				
<i>Dillenia suffruticosa</i> (Griff.) Martelli	nat	shrubby simpoh		o
Ebenaceae				
<i>Diospyros sandwicensis</i> (A. DC.) Fosberg	end	lama	r	r
Elaeocarpaceae				
<i>Elaeocarpus bifidus</i> Hook. & Arn.	end	kalia	r	r
Epacridaceae				
<i>Leptecophylla tameiameiae</i> (Cham. & Schldl.) C. M. Weiller	ind	pūkiawe		r
Euphorbiaceae				
<i>Acalypha hispida</i> Burm. f.	cult	chenille plant	l	
<i>Aleurites moluccana</i> (L.) Willd.	pol	kukui, candlenut	c	c
<i>Chamaesyce celastroides</i> (Boiss.) Croizat & O. Deg. var. <i>amplectens</i> (Sherff) O. Deg. & I. Deg.	end	'akoko		r
<i>Phyllanthus</i> cf. <i>acidus</i> (L.) Skeels	cult?	Otaheite gooseberry	l	
<i>Phyllanthus debilis</i> Klein ex Willd.	nat	niruri	x	x
<i>Ricinus communis</i> L.	nat	castor bean		x
Fabaceae				
<i>Acacia confusa</i> Merr.	nat	Formosan koa	l	
<i>Acacia koa</i> A. Gray	end	koa	o	o
<i>Caesalpinia decapetala</i> (Roth) Alston	nat	wait-a-bit, Mysore thorn	o	o
<i>Centrosema</i> cf. <i>pubescens</i> Benth.	nat			x
<i>Chamaecrista nictitans</i> (L.) Moench ssp. <i>patellaria</i> (DC. ex Collad.) H. S. Irwin & Barneby var. <i>glabrata</i> (Vogel) H. S. Irwin & Barneby	nat	partridge pea, laukī	x	x
<i>Crotalaria retusa</i> L.	nat			x
<i>Desmodium incanum</i> DC.	nat	Spanish clover, ka'imi	x	x
<i>Erythrina crista-galli</i> L.	cult		l	
<i>Falcataria moluccana</i> (Miq.) Barneby & J. W. Grimes	nat	albizia	r	
<i>Leucaena leucocephala</i> (Lam.) de Wit	nat	koa haole	x	x

Board of Water Supply Botanical Survey, Waihe'e and Kahalu'u Valleys

Scientific name	Status	Common name	Kaha	Waih
<i>Macroptilium</i> cf. <i>atropurpureum</i> (DC.) Urb.	nat			x
<i>Mimosa pudica</i> L. var. <i>unijuga</i> (Duchass. & Walp.) Griseb.	nat	sensitive plant, sleeping grass, pua hilahila	x	x
<i>Mucuna sloanei</i> Fawc. & Rendle var. <i>sloanei</i>	ind			x
<i>Neonotonia wightii</i> (Wight & Arn.) Lackey	nat			x
* <i>Pueraria phaseoloides</i> (Roxb.) Benth.	nat	tropical kudzu		r
<i>Strongylodon macrobotrys</i> A. Gray	cult	jade vine	x	
<i>Stylosanthes viscosa</i> Sw.	nat			x
Flacourtiaceae				
<i>Xylosma hawaiiense</i> Seem.	end	maua		r
Gesneriaceae				
<i>Cyrtandra calpidicarpa</i> (Rock) H. St. John & Storey	end	ha'iwale, kanawao ke'oke'o		l
<i>Cyrtandra hawaiiensis</i> C. B. Clarke	end	ha'iwale, kanawao ke'oke'o		r
<i>Cyrtandra laxiflora</i> H. Mann	end	ha'iwale, kanawao ke'oke'o	r	r
Goodeniaceae				
<i>Scaevola gaudichaudiana</i> Cham.	end	naupaka kuahiwi		r
Lamiaceae				
<i>Plectranthus parviflorus</i> Willd.	ind	'ala'ala wai nui, spurflower		r
<i>Solenostemon scutellarioides</i> (L.) Codd.	nat	coleus, weleweka	l	
Lauraceae				
<i>Cinnamomum burmanii</i> (Nees) Blume	nat	padang cassia	r	
<i>Persea americana</i> Mill.	nat	avocado, alligator pear		l
Lythraceae				
<i>Cuphea carthagenensis</i> (Jacq.) J. F. Macbr.	nat	tarweed, Colombian cuphea		x
Malvaceae				
<i>Hibiscus tiliaceus</i> L.	ind?	hau	c	c
<i>Sida fallax</i> Walp.	ind	'ilima		x
<i>Sida rhombifolia</i> L.	nat?			x
* <i>Urena lobata</i> L.	nat	aramina		x
Melastomataceae				
<i>Arthrostemma ciliatum</i> Pav. ex D. Don	nat		r	r
* <i>Clidemia hirta</i> (L.) D. Don var. <i>hirta</i>	nat	Koster's curse	o	o
<i>Dissotis rotundifolia</i> (Sm.) Triana	nat		x	x
<i>Medinilla magnifica</i> Lindl.	nat		l	l
* <i>Melastoma septemnerium</i> Lour.	nat		r	r
<i>Pterolepis glomerata</i> (Rottb.) Miq.	nat		x	
Meliaceae				
<i>Toona ciliata</i> M. Roem.	nat	Australian red cedar	r	
Menispermaceae				
<i>Cocculus orbiculatus</i> (L.) DC.	ind	huehue		x
Moraceae				
<i>Artocarpus altilis</i> (Z) Fosberg	nat	breadfruit		x
<i>Ficus microcarpa</i> L. f.	nat	Chinese banyan, Malayan banyan	c	c
Myrsinaceae				
<i>Ardisia crenata</i> Sims	nat	Hilo holly, hen's eyes	x	x
* <i>Ardisia elliptica</i> Thunb.	nat	shoebuttan ardisia	c	c
<i>Myrsine lessertiana</i> A. DC.	end	kōlea lau nui, kōlea		r

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Scientific name	Status	Common name	Kaha	Waih
Myrtaceae				
<i>Metrosideros polymorpha</i> Gaudich. var. <i>glaberrima</i> (H. Lév.) H. St. John	end	'ōhi'a, 'ōhi'a lehua, lehua	o	o
<i>Metrosideros polymorpha</i> Gaudich. var. <i>incana</i> (H. Lév.) H. St. John	end	'ōhi'a, 'ōhi'a lehua, lehua	o	o
<i>Metrosideros polymorpha</i> Gaudich. var. <i>polymorpha</i>	end	'ōhi'a, 'ōhi'a lehua, lehua		r
<i>Psidium cattleianum</i> Sabine	nat	strawberry guava, waiawī 'ula'ula	o	o
<i>Psidium guajava</i> L.	nat	common guava, kuawa	c	c
* <i>Rhodomyrtus tomentosa</i> (Aiton) Hassk.	nat	downy myrtle, rose myrtle	l	
<i>Syzygium cumini</i> (L.) Skeels	nat	Java plum, jambolan plum	o	o
<i>Syzygium jambos</i> (L.) Alston	nat	rose apple, 'ōhi'a loke		x
<i>Syzygium malaccense</i> (L.) Merr. & L. M. Perry	pol	'ōhi'a 'ai, mountain apple	c	c
<i>Syzygium sandwicensis</i> (A. Gray) Nied.	end	'ōhi'a hā		r
Nyctaginaceae				
<i>Pisonia umbellifera</i> (G. Forst.) Seem.	ind	pāpala kēpau, pāpala	o	o
Onagraceae				
<i>Ludwigia octovalvis</i> (Jacq.) P. H. Raven	pol?	primrose willow, kāmole	x	x
Oxalidaceae				
<i>Averrhoa carambola</i> L.	cult?	star fruit		l
<i>Oxalis corniculata</i> L.	pol?	yellow wood sorrel, 'ihi 'ai	x	x
<i>Oxalis debilis</i> Kunth var. <i>corymbosa</i> (DC.) Lourteig	nat	pink wood sorrel, 'ihi pehu	x	x
Passifloraceae				
<i>Passiflora edulis</i> Sims	nat	passion fruit, purple granadilla, liliko'i	x	
<i>Passiflora laurifolia</i> L.	nat	yellow granadilla, yellow water lemon	x	x
<i>Passiflora suberosa</i> L.	nat	huehue haole	x	x
<i>Passiflora subpeltata</i> Ortega	nat	white passion flower	x	x
Piperaceae				
<i>Peperomia sandwicensis</i> Miq.	end	'ala'ala wai nui	x	
<i>Peperomia tetraphylla</i> (G.Forst.) Hook. & Arn.	ind	'ala'ala wai nui		x
<i>Piper methysticum</i> G. Forst.	pol	'awa, kava		r
Pittosporaceae				
<i>Pittosporum glabrum</i> Hook. & Arn.	end	hō'awa, papahekili		r
<i>Pittosporum pentandrum</i> (Blanco) Merr.	nat			r
Plantaginaceae				
<i>Plantago major</i> L.	nat	broad-leaved plantain, laukahi	x	x
Polygalaceae				
<i>Polygala paniculata</i> L.	nat	milkwort		x
Rosaceae				
<i>Osteomeles anthyllidifolia</i> (Sm.) Lindl.	ind	'ūlei, u'ulei		r
<i>Rubus rosifolius</i> Sm.	nat	thimbleberry	o	o
Rubiaceae				
<i>Bohea elatior</i> Gaudich.	end	'ahakea lau nui	r	r
<i>Coffea arabica</i> L.	nat	Arabian coffee	r	r
<i>Morinda citrifolia</i> L.	pol	noni, Indian mulberry		r
<i>Paederia foetida</i> L.	nat	maile pilau	c	c

Board of Water Supply Botanical Survey, Waihe'e and Kahalu'u Valleys

Scientific name	Status	Common name	Kaha	Waih
<i>Psychotria kaduana</i> (Cham. & Schltld.) Fosberg	end	kōpiko kea	r	
<i>Spermacoce</i> sp.	nat		x	
Rutaceae				
<i>Citrus</i> sp.	cult		l	
Sapindaceae				
<i>Filicium decipiens</i> (Wight & Arn.) Thwaites	nat		r	r
<i>Litchi chinensis</i> Sonnerat	cult?	lychee	l	
Solanaceae				
<i>Cestrum nocturnum</i> L.	nat	night cestrum, 'ala aumoe	r	
* <i>Solanum torvum</i> Sw.	nat	turkeyberry	r	
Sterculiaceae				
<i>Waltheria indica</i> L.	ind?	'uhaloa, hi'aloa		x
Thymelaeaceae				
<i>Wikstroemia oahuensis</i> (A. Gray) Rock var. <i>oahuensis</i>	end	'ākia, kauhi	o	o
Tiliaceae				
<i>Heliocarpus popayanensis</i> Kunth	nat	moho, white moho	r	r
Ulmaceae				
<i>Trema orientalis</i> (L.) Blume	nat	gunpowder tree, charcoal tree		r
Urticaceae				
<i>Boehmeria grandis</i> (Hook. & Arn.) A. Heller	end	'ākōlea		r
<i>Pilea microphylla</i> (L.) Liebm.	nat	artillery plant, rockweed	x	x
<i>Pilea peploides</i> (Gaudich.) Hook. & Arn.	ind		x	x
<i>Pipturus albidus</i> (Hook. & Arn.) A. Gray	end	māmaki, waimea (Kaua'i)	o	o
<i>Touchardia latifolia</i> Gaudich.	end	olonā	r	r
Verbenaceae				
<i>Citharexylum caudatum</i> L.	nat	fiddlewood	c	c
<i>Lantana camara</i> L.	nat	lākana	o	o
<i>Stachytarpheta australis</i> Moldenke	nat	ōwī, oī		x
<i>Stachytarpheta cayennensis</i> (Rich.) Vahl	nat	ōwī, oī	x	x
MONOCOTS				
Agavaceae				
<i>Cordyline fruticosa</i> (L.) A. Chev.	pol	kī, ti	x	x
<i>Pleomele halapepe</i> H. St. John	end	hala pepe		r
Araceae				
<i>Alocasia macrorrhizos</i> (L.) G. Don	pol	'ape, elephant's-ear plant	x	x
<i>Colocasia esculenta</i> (L.) Schott	pol	kalo, taro		x
<i>Dieffenbachia seguine</i> Jacq.			l	
<i>Epipremnum pinnatum</i> (L.) Engl.	nat	taro vine, pothos	x	x
<i>Syngonium podophyllum</i> Schott	nat	nephthytis	x	x
<i>Xanthosoma robustum</i> Schott	nat	'ape		x
Arecaceae				
<i>Cocos nucifera</i> L.	pol	niu, lolani, coconut	r	r
<i>Pritchardia martii</i> (Gaudich.) H. Wendl.	end	loulu hiwa, loulu	r	
<i>Roystonea regia</i> (Kunth) Cook	nat	royal palm		l
<i>Veitchia merrillii</i> (Becc.) H. E. Moore	cult	Manila palm	l	
Commelinaceae				
<i>Commelina diffusa</i> Burm. f.	nat	honohono, dayflower	x	x

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Scientific name	Status	Common name	Kaha	Waih
Costaceae				
<i>Costus woodsonii</i> Maas	nat		x	x
<i>Tapeinochilos ananassae</i> (Hassk.) K. Schum.	cult	Indonesian ginger, pineapple ginger	1	
Cyperaceae				
<i>Carex meyenii</i> Nees	ind		x	
<i>Carex wahuensis</i> C. A. Mey. ssp. wahuensis	end		x	x
<i>Cyperus polystachyos</i> Rottb.	ind		x	x
<i>Fimbristylis dichotoma</i> (L.) Vahl	ind			x
<i>Kyllinga nemoralis</i> (J. R. Forst. & G. Forst.) Dandy ex Hutch. & Dalziel	nat	kili'o'opu, mau'u mokae	x	x
<i>Machaerina angustifolia</i> (Gaudich.) T. Koyama	ind	'uki	x	x
<i>Machaerina mariscoides</i> (Gaudich.) J. Kern ssp. <i>meyanii</i> (Kunth) T. Koyama	end	'ahaniu, 'uki		x
<i>Rhynchospora caduca</i> Elliott	nat	beak-rush		x
Dioscoreaceae				
<i>Dioscorea bulbifera</i> L.	pol	hoi, bitter yam, air potato	x	x
<i>Dioscorea pentaphylla</i> L.	pol	pi'a, pi'a Hawai'i	x	x
Heliconiaceae				
<i>Heliconia bihai</i> (L.) L.	nat	lobster claw	x	x
Marantaceae				
<i>Calathea crotalifera</i> S. Watson	nat	rattlesnake plant	o	
Musaceae				
<i>Musa xparadisiaca</i> L.	pol	mai'a, banana	1	1
Orchidaceae				
<i>Arundina graminifolia</i> (D. Don) Hochr.	nat	bamboo orchid	x	x
<i>Phaius tankervilleae</i> (Banks ex L'Hér.) Blume	nat	Chinese ground orchid, nun's-hood	x	x
<i>Spathoglottis plicata</i> Blume	nat	Malayan ground orchid, Philippine ground orchid	x	x
Pandanaceae				
<i>Freycinetia arborea</i> Gaudich.	ind	'ie'ie, 'ie	x	x
<i>Pandanus tectorius</i> Parkinson ex Z	ind	hala, pū hala, screwpine	c	c
Poaceae				
* <i>Andropogon virginicus</i> L.	nat	broomsedge	x	x
<i>Brachiaria mutica</i> (Forssk.) Stapf	nat	California grass, Para grass		r
<i>Digitaria</i> sp.	nat			x
<i>Eleusine indica</i> (L.) Gaertn.	nat	wiregrass, mānienie ali'i		x
<i>Isachne pallens</i> Hillebr.	end		r	r
<i>Oplismenus hirtellus</i> (L.) P. Beauv.	nat	basketgrass, honohono kukui	c	c
<i>Panicum maximum</i> Jacq.	nat	Guinea grass		r
<i>Paspalum conjugatum</i> P. J. Bergius	nat	Hilo grass, sour paspalum	x	x
<i>Paspalum scrobiculatum</i> L.	ind?	ricegrass, mau'u laiki		x
<i>Phyllostachys aurea</i> Carriere ex Riviere & C. Riviere	nat		o	o
<i>Sacciolepis indica</i> (L.) Chase	nat	Glenwood grass	x	x
<i>Schizostachyum glaucifolium</i> (Rupr.) Munro	pol?	'ohe	r	
<i>Setaria parviflora</i> (Poir.) Kerguelen	nat	yellow foxtail		x
<i>Sporobolus</i> sp.	nat			x

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Scientific name	Status	Common name	Kaha	Waih
Zingiberaceae				
<i>Alpinia mutica</i> Roxb.	nat	small shell ginger		1
<i>Alpinia purpurata</i> (Vieill.) K. Schum.	nat	red ginger, 'awapuhi 'ula'ula	x	
<i>Hedychium coronarium</i> J. König	nat	white ginger, 'awapuhi ke'oke'o	x	x
<i>Zingiber zerumbet</i> (L.) Sm.	pol	'awapuhi, 'awapuhi kuahiwi, shampoo ginger	o	o
GYMNOSPERMS				
Araucariaceae				
<i>Araucaria columnaris</i> (G. Forst.) Hook. f.	nat	Cook-pine		1
PTERIDOPHYTES				
Aspleniaceae				
<i>Asplenium excisum</i> C. Presl	ind	pāmoho	x	x
<i>Asplenium nidus</i> L.	ind	'ēkaha, bird's-nest fern	x	x
Athyriaceae				
<i>Deparia petersenii</i> (Kunze) M. Kato	nat		x	x
<i>Deparia prolifera</i> (Kaulf.) Hook. & Grev.	end		x	
<i>Diplazium esculentum</i> (Retz.) Sw.	nat	paca, hō'i'o	x	
<i>Diplazium sandwichianum</i> (C. Presl) Diels	end	hō'i'o	r	
Blechnaceae				
<i>Blechnum appendiculatum</i> Willd.	nat		c	c
<i>Sadleria cyatheoides</i> Kaulf.	end	'ama'u	r	r
Cyatheaceae				
<i>Sphaeropteris cooperi</i> (Hook. ex F. Muell.) R. M. Tryon	nat	Australian tree fern, scaly tree fern	r	r
Davalliaceae				
<i>Davallia cf. fejeensis</i> Hook.	nat	lacy hare's-foot fern	r	
Dennstaedtiaceae				
<i>Pteridium aquilinum</i> (L.) Kuhn var. <i>decompositum</i> (Gaudich.) R. M. Tryon	end	kīlau, bracken fern		r
Dicksoniaceae				
<i>Cibotium chamissoi</i> Kaulf.	end	hāpu'u	o	o
Dryopteridaceae				
<i>Tectaria gaudichaudii</i> (Mett.) Maxon	end	'iwa'iwa lau nui	r	r
Elaphoglossaceae				
<i>Elaphoglossum crassifolium</i> (Gaudich.) W. R. Anderson & Crosby	end	hoe a Māui, 'ēkaha	r	
Gleicheniaceae				
<i>Dicranopteris linearis</i> (Burm f.) Underw. f. <i>linearis</i>	ind	uluhe	c	c
Grammitidaceae				
<i>Grammitis tenella</i> Kaulf.	end	kolokolo, mahinalua	x	
Hymenophyllaceae				
<i>Gonocormus minutus</i> (Blume) Bosch	ind		x	x
<i>Vandenboschia cyrtotheca</i> (Hillebr.) Copel.	end		x	x
<i>Vandenboschia davallioides</i> (Gaudich.) Copel.	end	palai hihi, kīlau	x	x
<i>Vandenboschia draytoniana</i> (Brack.) Copel.	end		x	
Lindsaeaceae				
<i>Lindsaea ensifolia</i> Sw.	nat			x
<i>Sphenomeris chinensis</i> (L.) Maxon	ind	pala'ā	o	o

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Scientific name	Status	Common name	Kaha	Waih
Lycopodiaceae				
<i>Lycopodiella cernua</i> (L.) Pic. Serm.	ind	wāwae'iole, hulu 'iole	x	x
Marattiaceae				
<i>Angiopteris evecta</i> (G. Forst.) Hoffm.	nat	mule's-foot fern, giant fern	o	o
Nephrolepidaceae				
<i>Nephrolepis exaltata</i> (L.) Schott ssp. <i>hawaiiensis</i> W. H. Wagner	end	ni'ani'au, 'ōkupukupu, kupukupu		x
<i>Nephrolepis multiflora</i> (Roxb.) F. M. Jarrett ex C. V. Morton	nat		x	x
Ophioglossaceae				
<i>Ophioderma pendulum</i> (L.) C. Presl ssp. <i>pendulum</i>	ind	puapua moa, laukahi		r
Polypodiaceae				
<i>Lepisorus thunbergianus</i> (Kaulf.) Ching	ind	pākahakaha	x	x
<i>Microsorium cf. punctatum</i> (L.) Copeland	nat	climbing bird's-nest fern	l	
<i>Phlebodium aureum</i> (L.) J. Sm.	nat	laua'e haole, rabbit's-foot fern	x	x
<i>Phymatosorus grossus</i> (Langsd. & Fisch.) Brownlie	nat	laua'e, maile-scented fern	x	x
Psilotaceae				
<i>Psilotum nudum</i> (L.) P. Beauv.	ind	moa, upright whiskfern	x	x
Pteridaceae				
<i>Adiantum hispidulum</i> Sw.	nat	rough maidenhair fern	x	
<i>Adiantum raddianum</i> C. Presl	nat		x	x
<i>Pityrogramma austroamericana</i> Domin	nat	goldfern		x
<i>Pityrogramma calomelanos</i> (L.) Link	nat	silverfern		x
Selaginellaceae				
<i>Selaginella arbuscula</i> (Kaulf.) Spring	end	lepelepe a moa	x	x
<i>Selaginella cf. willdenowii</i> (Desv.) Baker	cult	electric fern	x	
Thelypteridaceae				
<i>Christella cyatheoides</i> (Kaulf.) Holttum	end	kikawaiō	r	r
<i>Christella dentata</i> (Forssk.) Brownsey & Jermy	nat	pai'i'ihā	o	o
<i>Christella parasitica</i> (L.) H. Lév.	nat		c	c
<i>Christella xincesta</i> (W. H. Wagner) Nakaike & Kawabata	end		x	x
<i>Pneumatopteris hudsonianus</i> (Brack.) Holttum	end	laukahi	r	
Vittariaceae				
<i>Haplopteris elongata</i> (Sw.) E. H. Crane	ind	'ohe'ohe, mana		r

APPENDIX B: Historical vouchers at Bishop Museum collected in Waihe'e and Kahalu'u Valleys

The Herbarium Pacificum at Bishop Museum houses over 650,000 preserved plant specimens from all over the world, but primarily focused on the Hawaiian Islands and the Pacific Basin. The Hawaiian vascular plant collection itself numbers about 135,000 specimens, and data entry into a relational database has been completed for all attached label information, thus allowing for queries of geographical distribution based on place name localities provided by the collector. Such a query, based on the keywords "Waihe'e" and "Kahalu'u," produced the following list of vouchers, which has been distilled to exclude duplicates and collections obviously made outside the project area.

None of the vouchers listed below represent rare or endangered taxa. On the other hand, several of the non-native taxa collected are highly invasive, such as *Miconia calvescens*, *Dillenia suffruticosa*, *Caesalpinia decapetala*, *Melastoma septemnerium*, *Ardisia elliptica*, and *Piper auritum*.

FAMILY	SCI NAME	DESCRIPTION	COLLECTOR	COLLDATE
DICOTS				
Asteraceae	<i>Blumea laciniata</i> (Roxb.) DC.	Kahalu'u, N ridge. Weed on dry grassy slope. 900 ft elev.	Hosaka, E.Y. 1288	4 Jul 1935
Asteraceae	<i>Eclipta prostrata</i> (L.) L.	Bottom of Kahalu'u Valley. 100 ft elev.	Fosberg, F.R. 12205	4 Jul 1935
Bignoniaceae	<i>Tabebuia heterophylla</i> (DC.) Britton	Waihe'e Valley. Dry-mesic roadside area with <i>Syzygium malaccense</i> , hau. 20–30 ft tall tree.	Leech, M. 3	22 Aug 2002
Brassicaceae	<i>Rorippa sarmentosa</i> (G.Forst. ex DC.) J.F.Macbr.	Waihe'e. Uncommon near stream in moist gully with <i>Dicranopteris-Pipturus-Syzygium malaccense</i> . ca. 300 ft elev. Glabrous herb with leaves mostly in rosette.	Nagata, K.M. 2485	27 Jun 1982
Convolvulaceae	<i>Ipomoea indica</i> (Burm.f.) Merr.	Kahalu'u. Stems fasciated. Sap milky.	Reppun, R.	16 Sep 1957
Convolvulaceae	<i>Ipomoea ochracea</i> (Lindl.) G.Don	Kahalu'u, farm belonging to S. Yogi. Infesting trees and shrubbery, covering hau. Vine, flower buds white; corolla yellow, purple on base inside tube.	Hamasaki, R. s.n.	11 Jan 1999
Convolvulaceae	<i>Merremia umbellata</i> (L.) H.Hallier	Kahalu'u, farm belonging to S. Yogi. Growing on bananas, infesting trees and shrubbery. Vine, flowers yellow; capsules brown.	Heu, R. s.n.	11 Jan 1999
Dilleniaceae	<i>Dillenia suffruticosa</i> (Griff.) Martelli	Waihe'e Valley. Naturalized in moist disturbed forest. Tree 7–10 ft tall. Ca. 25 plants seen.	Fraiola, H. s.n.	29 Aug 1997
Ebenaceae	<i>Diospyros sandwicensis</i> (A.DC.) Fosberg	N ridge of Kahalu'u Valley. Dry forest on ridge. 1,150 ft elev. Tree 16 ft tall.	Fosberg, F.R. 12190	4 Jul 1935
Ebenaceae	<i>Diospyros sandwicensis</i> (A.DC.) Fosberg	Mauka of Ahuimanu Rd, Kahalu'u Valley. In gulch at foot of cliff. Tree 15 ft tall, spreading.	Degener, O. 24985	24 Nov 1958
Euphorbiaceae	<i>Aleurites moluccana</i> (L.) Willd.	Kahalu'u, near auwai, near house, in quiet area. One of 2 drooping trees, nearby one with rising branches. Tree 15 ft high, ca. 10 years. old.	Mitchell, D. s.n.	15 Feb 1960

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FAMILY	SCI NAME	DESCRIPTION	COLLECTOR	COLLDATE
Euphorbiaceae	<i>Chamaesyce multiformis</i> (Hook. & Arn.) Croizat & O.Deg. var. <i>microphylla</i> (Boiss.) O.Deg. & I.Deg.	N ridge, Kahalu'u Valley. Bottom of side gulch, moist forest. 900 ft elev. Shrub 6.5 ft tall.	Fosberg, F.R. 12199	4 Jul 1935
Euphorbiaceae	<i>Phyllanthus distichus</i> Hook. & Arn.	N ridge, Kahalu'u Valley. Dry rock ledges.	Fosberg, F.R. 12189	4 Jul 1935
Fabaceae	<i>Alysicarpus vaginalis</i> (L.) DC.	Waihe'e. 656 ft elev. Low, spreading, deep taproot.	Nagata, K.M. 2486	27 Jun 1982
Fabaceae	<i>Caesalpinia decapetala</i> (Roth) Alston	Kahalu'u, along road. 328 ft elev. Brambling shrub climbing over neighboring vegetation.	Nagata, K.M. 2594	30 Jan 1983
Gesneriaceae	<i>Cyrtandra calpidicarpa</i> (Rock) H.St.John & Storey	Waihe'e Valley, S ridge, moist forest. 1,000 ft elev. 13 ft tall shrub.	St.John, H. 20235	11 May 1941
Gesneriaceae	<i>Cyrtandra calpidicarpa</i> (Rock) H.St.John & Storey	N Kahalu'u Valley, small gulch. Moist forest. 900 ft elev. 3.3 ft tall shrub.	Fosberg, F.R. 12196	4 Jul 1935
Gesneriaceae	<i>Cyrtandra calpidicarpa</i> (Rock) H.St.John & Storey	Waihe'e Valley, head of NW gulch. Moist, wooded. 900 ft elev. 6.5–13 ft tall shrub.	St.John, H. 20249	1 Jun 1941
Gesneriaceae	<i>Cyrtandra grandiflora</i> Gaudich.	N ridge, Kahalu'u, steep slope, moist. 1,000 ft elev. Shrub.	Hosaka, E.Y. 1283	4 Jul 1935
Gesneriaceae	<i>Cyrtandra laxiflora</i> H.Mann	Waihe'e Valley, head of NW gulch. Wet shady mossy cliff. 400–1,000 ft elev. Plants both cauliflorous and/or axiliflorous.	St.John, H. 20250	1 Jun 1941
Gesneriaceae	<i>Cyrtandra laxiflora</i> H.Mann	Kahalu'u, waterfall at head of valley. This basin is a very poor site for <i>Cyrtandra</i> collecting; the shallow set of the gulches into the cliffs do not afford sufficient habitat, found less than 15 plants (all <i>laxiflora</i>) the entire day, several channels had extensive pig damage. Lowest elev. cf. 460 ft elev.	Takeuchi, W.N. 2932	25 Oct 1986
Gesneriaceae	<i>Cyrtandra laxiflora</i> H.Mann	N ridge, Kahalu'u. Moist slope. 1,000 ft elev.	Hosaka, E.Y. 1284	4 Jul 1935
Gesneriaceae	<i>Cyrtandra laxiflora</i> H.Mann	Waihe'e, moist gully. 300 ft elev. 3–5 ft tall shrub.	Nagata, K.M. 2483	27 Jun 1982
Gesneriaceae	<i>Cyrtandra laxiflora</i> H.Mann	Small gulches on N slope of Kahalu'u Valley. Moist open forest - steep side of ridge. 985 ft elev. Shrub up to 8 ft tall, flowering from top almost to base.	Fosberg, F.R. 12200	4 Jul 1935
Gesneriaceae	<i>Cyrtandra laxiflora</i> H.Mann	Waihe'e Valley, S Ridge. Wooded ridge and gulch. 500–1,000 ft elev. Shrubs up to 10 ft tall; inflorescence either axillary or cauliflorous.	St.John, H. 20236	11 May 1941

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FAMILY	SCI NAME	DESCRIPTION	COLLECTOR	COLLDATE
Goodeniaceae	<i>Scaevola gaudichaudiana</i> Cham.	Kahalu'u. Guava, rose apple. 335 ft elev. 6.5–10 ft tall shrub.	Takeuchi, W.N. 2934	25 Oct 1986
Malvaceae	<i>Hibiscus furcellatus</i> Desr.	End of Ahuimanu Road, Kahalu'u Valley, sunny, wet meadow. 4–8 ft tall tree, little branched.	Degener, O. 24982	24 Nov 1958
Malvaceae	<i>Sida fallax</i> Walp.	Narrow ridge dividing 'Ioleka'a and Kahalu'u valleys. Collected in area past powerline poles to base of Ko'olau cliffs. Mostly low, scrubby vegetation - <i>Bidens</i> , <i>Osteomeles</i> , <i>Stachytarpheta</i> , Christmas berry, <i>Metrosideros</i> , <i>Diospyros</i> . 850 ft elev. Upright, few branches 1–4 ft tall.	Davis, J.A. 2	21 Jan 1977
Melastomataceae	<i>Melastoma septemnerium</i> Lour.	Waihe'e Valley, past second gate on left off of jeep trail. Mesic. Vegetation: <i>Dillenia suffruticosa</i> , <i>Citharexylum</i> . ca. 400 ft elev. 10 ft shrub with flowers and immature fruit.	Leech, M. 1	22 Aug 2002
Melastomataceae	<i>Miconia calvescens</i> DC.	Kahalu'u, between Lamaula Rd. and Ahilama Pl. Shady ravine between adjoining properties; Java plum overstory. One of 14 plants ranging from 5–10 ft tall. All in flower/fruit. Many leaves heavily eaten by insects.	Benzon, S. s.n.	7 Jun 1999
Moraceae	<i>Ficus stricta</i> (Miquel) Miquel	Kahalu'u; Palama Road. 490 ft elev.	Phillips, T. s.n.	20 Jul 1994
Myrsinaceae	<i>Ardisia elliptica</i> Thunb.	Kahalu'u. Occasional on ohia-uluhe hillside. 310 ft elev.	Takeuchi, W.N. 2935	25 Oct 1986
Nyctaginaceae	<i>Pisonia umbellifera</i> (G.Forst.) Seem.	NE Kahalu'u, head. <i>Coffea</i> , <i>Cordyline</i> . 460 ft elev.; odor similar to mango, heavy, oppressive.	Takeuchi, W.N. 2933	25 Oct 1986
Piperaceae	<i>Piper auritum</i> Kunth	Kahalu'u. Residential backyard. Planted intentionally for screening sound from the highway ca 2 years ago. Shrub up to 9 ft tall. Flowering, no fruit.	Matayoshi, N. s.n.	15 Dec 2004
Piperaceae	<i>Piper methysticum</i> G.Forst.	Beyond end of Ahuimanu Rd., Kahalu'u Valley. Single plant in dense gulch.	Degener, O. 24982	24 Nov 1958
Rubiaceae	<i>Bobea elatior</i> Gaudich.	Waihe'e Valley, S ridge. Koa, hala. 600 ft elev. 26 ft tall tree.	St.John, H. 20232	11 May 1941
Rubiaceae	<i>Hedyotis acuminata</i> (Cham. & Schltdl.) Steud.	S ridge, Waihe'e Valley, head of gulch, moist thicket. 1,000 ft elev. Shrub, arching or sprawling.	St.John, H. 20234	11 May 1941
Rubiaceae	<i>Morinda citrifolia</i> L.	Kahalu'u. Roadside above ocean. 33 ft elev. Tree 3m tall.	Fosberg, F.R. 8945	10 Feb 1932
Rubiaceae	<i>Psychotria kaduana</i> (Cham. & Schltdl.) Fosberg	N ridge, Kahalu'u, Ko'olau Mts. Dry. 1,500 ft elev. 20 ft tall tree.	Hosaka, E.Y. 1286	4 Jul 1934
Thymelaeaceae	<i>Wikstroemia oahuensis</i> (A.Gray) Rock	Mauka of Ahuimanu Road, Kahalu'u Valley. In partial shade at foot of cliff. Loosely branched shrub or small tree with glaucous leaves.	Degener, O. 24983	24 Nov 1958

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FAMILY	SCI NAME	DESCRIPTION	COLLECTOR	COLLDATE
Urticaceae	<i>Neraudia melastomifolia</i> Gaudich.	Waihe'e Valley, S ridge. moist woods, head of gulch. 1,000 ft elev. shrub 13 ft tall	St.John, H. 20233	11 May 1941
MONOCOTS				
Pandanaceae	<i>Pandanus tectorius</i> Parkinson ex Z	Waihe'e. Lower edge of forest; with <i>Psidium guajava</i> , <i>Wikstroemia oahuensis</i> , <i>Sphenomeris chinensis</i> . 400 ft elev. Tree 23 ft tall.	St.John, H. 26064	14 Aug 1957
Pandanaceae	<i>Pandanus tectorius</i> Parkinson ex Z	Kahalu'u Valley, NW corner, open stand on steep slope near head wall with <i>Aleurites</i> , <i>Psidium guajava</i> , <i>Panicum maximum</i> . 350 ft elev. Tree 30 ft tall. with prop roots.	St.John, H. 26059	14 Aug 1957
Pandanaceae	<i>Pandanus tectorius</i> Parkinson ex Z	Waihe'e, wooded gulch with <i>Psidium guajava</i> , <i>Acacia koa</i> , <i>Syzygium cumini</i> . 400 ft elev. Tree 33 ft tall.	St.John, H. 26065	14 Aug 1957
Poaceae	<i>Isachne pallens</i> Hillebr.	Waihe'e Valley, NW gulch at head of. 1,000 ft elev.	St.John, H. 20248	1 Jun 1941
Poaceae	<i>Paspalum urvillei</i> Steud.	Ko'olau Mts, along crest, looking directly down into Kahalu'u Elementary School. 2,350 ft elev. Over 5 ft tall, growing very robustly in a patch.	Obata, J.K. JO(85)-606	11 Aug 1985
Poaceae	<i>Schizostachyum glaucifolium</i> (Rupr.) Munro	Kahalu'u. Thin-walled bamboo growing in clumps.	Mitchell, D. s.n.	Dec 1954
FERNS				
Athyriaceae	<i>Deparia prolifera</i> (Kaulf.) Hook. & Grev.	Kahalu'u Valley, mauka of Ahuimanu Rd., partly shaded gulch.	Degener, O. 24995	24 Nov 1958
Dicksoniaceae	<i>Cibotium chamissoi</i> Kaulf.	Mauka of Ahuimanu Road; Kahalu'u Valley. In dark gulch near cliff. Trunk 2 ft high.	Degener, O. 24989	24 Nov 1958
Hymenophyllaceae	<i>Gonocormus minutus</i> (Blume) Bosch	Kahalu'u Valley, covering 10 ft long boulder in dense forest near cliff base.	Degener, O. 24992	24 Nov 1958