A SURVEY OF HAWAIIAN MEDICINAL PLANTS IN THE EAST RIFT ZONE OF KĪLAUEA VOLCANO

by

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INTRODUCTION

At the request of True Geothermal Energy Company we conducted a survey to determine which plants used in Hawaiian medicine were found in the Puna Geothermal Area along the East Rift Zone of Kīlauea volcano. This is the geographic area in the Puna District of the island of Hawai'i which was surveyed in 1984/1985 with the results reported by Char and Lamoureux (1985a). This area is delineated on the map identified as Fig. 1. The sources of information were the lists of plants included in Char and Lamoureux (1985a) and in the several supplemental reports which have been been prepared subsequently for True Geothermal and/or Mid-Pacific Geothermal, and submitted by them to the State Board of Land and Natural Resources: Char and Lamoureux (1985b); Lamoureux, *et al* (1987, 1990a, 1990b), Lamoureux (1990c).

METHODS

The lists of plants in all these reports were examined by the first author, and species known to have been used by the Hawaiian people for medicinal purposes were identified. Based on her studies of the important articles on Hawaiian medicinal plants, and on a new manuscript on these plants (*Lā'au Lapa'au*) which she is preparing, the list of plants included in the section **Major Hawaiian Traditional Medicinal Plants in East Rift Zone of Kīlauea** was developed. This list includes the best authenticated and most widely used Hawaiian medicinal plants. They would have been expected to be part of the pharmacopoeia of every traditional *Kahuna Lapa'au*.

Other plants have been reported to be used in Hawaiian medicine. Some of these are of more recent use, some are less well authenticated, some are used more locally. These plants have been listed in a separate section of this report as: **Other Plants Reportedly Used for Hawaiian Medicine in East Rift Zone of Kīlauea.**

For each of these plants information on their distribution worldwide and in the Hawaiian Islands was compiled. Further information was gathered on the distribution of each species within the Geothermal Resource Subzone designated in the Middle East Rift Zone of Kīlauea by the Board of Land and Natural Resources, which comprises part of the land unit known as Wa'o Kele O Puna.

RESULTS

The results of this survey are given in the two lists which follow:

Major Hawaiian Traditional Medicinal Plants in East Rift Zone of Kîlauea

Other Plants Reportedly Used for Hawaiian Medicine in East Rift Zone of Kîlauea.

In each list families are arranged alphabetically within each of three groups: Pteridophytes - Ferns and Fern Allies; Angiosperms - Monocotyledons, and Angiosperms - Dicotyledons. Taxonomy and nomenclature of the Ferns and Fern Allies follow Lamoureux's unpublished checklist of Hawaiian ferns; taxonomy and nomenclature of the flowering plants (Angiosperms) follow Wagner, Herbst, and Sohmer (1990). Within each of these three subgroups the scientific names are listed alphabetically by family, by genus, and by species names. Hawaiian and English common names of flowering plants used in the checklist are also in accordance with Wagner, Herbst, and Sohmer (1990), those for ferns are from the checklist of Lamoureux. For each species the following information is provided:

1. Scientific name with author citation.
2. Common Hawaiian or English name, when known.
3. Distribution of the species within the world and the Hawaiian Islands. Information on ferns is from Lamoureux. Information on flowering plants is from Wagner, Herbst, and Sohmer (1990); in most cases the information is in the form of direct quotes from that source.
4. Distribution of the species within the BLNR Designated Geothermal Resource Subzone, Middle East Rift Zone of Kîlauea, which comprises a portion of the land unit known as Wa'o Kele O Puna, and is referred to hereafter simply as the subzone. Information on all species is based on surveys conducted by Lamoureux and associates from 1984 through 1990, and reported by Char and Lamoureux (1985a, 1985b), and by Lamoureux, *et al* (1987, 1990a, 1990b, 1990c)

MAJOR HAWAIIAN TRADITIONAL MEDICINAL PLANTS IN EAST RIFT ZONE OF KĪLAUEA

PTERIDOPHYTES - FERNS AND FERN ALLIES

BLECHNACEAE
Sadleria cyatheoides Kaulf. — ama'u

DISTRIBUTION: Abundant in a wide variety of habitats, including wet coastal, wet and mesic lowlands, dry, wet and mesic montane, dry and mesic subalpine, and new lava flows, from near sea level to over 3,000 m, on all main islands except Ni`ihau and Kaho`olawe. In subzone uncommon except on newer lava flows, where it is common.

DICKSONIACEAE
Cibotium glaucum (J. Sm.) Hook. & Arnott — hāpu'u

DISTRIBUTION: Abundant in wet forests from sea level to over 2000 m, on all main islands except Ni`ihau and Kaho`olawe. In subzone common to abundant.

GLEICHENIACEAE
Dicranopteris linearis (Burm.) Underw. — uluhe

DISTRIBUTION: Abundant in a wide variety of mesic and wet habitats from near sea level to over 2500 m, on all main islands except Ni`ihau and Kaho`olawe. In subzone abundant.

PSILOTACEAE
Psilotum nudum (L.) Beauv. — moa, pipi

DISTRIBUTION: Abundant in a wide variety of dry, mesic, and wet habitats from near sea level to over 2500 m, on all main islands except Kaho`olawe; also on Midway and Mokoli`i islands. In subzone common to abundant.

ANGIOSPERMS - MONOCOTYLEDONS

AGAVACEAE
Cordyline fruticosa (L.) A. Chev. — kī, ti

DISTRIBUTION: "A Polynesian introduction, extensively cultivated and occurring widely in *hala* forest, mesic valleys, and mesic forest, 5-610 m, on all the main islands except Kaho`olawe." In subzone uncommon, although a few have been recently planted along the access road.

ARACEAE
Colocasia esculenta (L.) Schott — kalo, taro

DISTRIBUTION: A Polynesian introduction "found persisting outside of cultivation on all the main islands except Kaho`olawe". In subzone uncommon, a few plants found in some places along the access road where there were large pig wallows.

ARECACEAE
Cocos nucifera L. — niu, ololani, coconut palm

DISTRIBUTION: In "Hawai`i a Polynesian introduction, still widely cultivated, persisting, and sparingly naturalized in areas of previous cultivation, primarily coastal sites on all of the main islands and Laysan". Not found in subzone.

Pritchardia beccariana Rock — loulu, hāwane

DISTRIBUTION: "Occurring in wet forest in the region about Kīlauea, especially in the forest near Glenwood, 1,100-1,270 m, Hawai`i." In subzone rare, only in small remnant of 'ōhia-a(1) forest near western boundary of subzone, not found in any surveyed potential construction sites.

MUSACEAE

Musa x paradisiaca L. — mai'a, banana

DISTRIBUTION: A Polynesian introduction, "in Hawai`i widely cultivated, persisting and sparingly naturalized by vegetative reproduction in mesic to wet valleys and wet forest, from near sea level up to ca. 920 m, on all the main islands except Ni`ihau and Kaho`olawe". In subzone rare, found only in buffer zone at east end of subzone.

PANDANACEAE

Pandanus tectorius S. Parkinson ex Z. — hala, pūhala, pandanus

DISTRIBUTION: "In Hawai`i occurring in extensive groves or intermingled with species such as *Aleurites*, *Psidium*, or *Acacia*, in mesic coastal sites, also on low elevation slopes of mesic valleys further inland, 0-610 m, rarely higher, on all of the main islands except Kaho`olawe." Not found in subzone.

POACEAE

Digitaria fuscescens (K. Presl) Henr. — creeping kūkaepua'a

DISTRIBUTION: "Native to India, southeastern Asia and Indonesia, now widely naturalized; in Hawai`i forming mats in disturbed sites in grasslands, mesic shrubland, and mesic forest, 10-520 m, on Hawai`i. First collected in 1916." Not found in subzone.

Saccharum officinarum L. — ko, sugarcane

DISTRIBUTION: Originally brought to Hawai`i by Polynesians, now many modern varieties also grown commercially. In cultivated or formerly cultivated sites. Not found in subzone.

Schizostachyum glaucifolium (Rupr.) Munro — 'ohe, Hawaiian bamboo

DISTRIBUTION: "Reported from Fiji, Samoa, Tahiti, Marquesas, and Hawai`i; in Hawai`i possibly a Polynesian introduction or perhaps indigenous, occurring in shaded sites along streams in mesic valleys, 60-275 m, on Kaua`i, O`ahu, Moloka`i, Maui, and Hawai`i. Locally this is called the 'native bamboo,' but it is believed to be a Polynesian introduction." Rare in 'ōhi'a-a(3) forest just outside southern edge of subzone.

ZINGIBERACEAE

Hedychium coronarium Koenig — 'awapuhi ke'oke'o, white ginger

DISTRIBUTION: "Probably native to the Himalayas and southwestern China, widely cultivated in the tropics and frequently becoming naturalized; in Hawai`i frequently cultivated and naturalized in mesic forest on O`ahu, Moloka`i, Lāna`i, Maui, and Hawai`i. Introduced as ornamental probably by Chinese immigrants and recorded by Hillebrand (1888) as a garden escape." A few patches occur along the northern, eastern, and southern edges of the subzone.

Zingiber zerumbet (L.) Sm. 'awapuhi, shampoo ginger

DISTRIBUTION: "Native range not certain, perhaps India, long cultivated in southeastern Asia and carried by" humans "throughout the Pacific; in Hawai`i a Polynesian introduction, now naturalized and sometimes dominant in disturbed, mesic, shaded areas, on Kaua`i, O`ahu, Moloka`i, Lāna`i, and Maui." In subzone locally common in small patches, as it is throughout much of the Puna forest.

ANGIOSPERMS - DICOTYLEDONS

AQUIFOLIACEAE

Ilex anomala Hook. & Arnott kāwa'u

DISTRIBUTION: "Occurring in Tahiti, Marquesas, and Hawaiian Islands; in Hawai`i common in mesic to wet forest, sometimes in open bogs, (50-)600-1,400(-1,950) m, on all the main islands except Ni`ihau and Kaho`olawe." In subzone occasional.

ARALIACEAE

Cheirodendron trigynum (Gaud.) A. Heller ssp. trigynum 'ōlapa

DISTRIBUTION: "Occurring in mesic to wet forest on all of the main islands except Kaho`olawe." In subzone rare to occasional, more common at higher elevations upslope from the subzone.

ASTERACEAE

Bidens hawaiensis A. Gray ko'oko'olau

DISTRIBUTION: "Scattered in open shrubland on old lava flows to mesic forest, 50-1,400 m, presently in 3 apparently disjunct areas, Kohala, Puna District, and Kīlauea, Hawai`i." Not found in subzone.

CLUSIACEAE

Calophyllum inophyllum L. kamani

DISTRIBUTION: "Native from eastern Africa, India, Taiwan, and Malesia to Australia and the Tuamotus; in Hawai`i a Polynesian introduction that is often planted and sparingly naturalized in coastal and low elevation areas at least on Kaua`i, O`ahu, Moloka`i, Maui, and Hawai`i." Not found in subzone.

CONVOLVULACEAE

Ipomoea batatas (L.) Lam. 'uala, sweet potato

DISTRIBUTION: "Pantropical, but of American origin, widely cultivated; in Hawai`i a Polynesian introduction, escaping cultivation and persisting near abandoned homesites and dumps, probably on all of the inhabited main islands, but documented only from Kaua`i, O`ahu, and Hawai`i." Not found in subzone.

Ipomoea indica (J.Burm.) Merr. koali, 'awahia

DISTRIBUTION: "Pantropical; in Hawai`i common in low elevation, dry, often disturbed areas, usually below 150(1,250) m, on Kure Atoll, Midway Atoll, Lisianski, Laysan, Nihoa, and all of the main islands." Not found in subzone.

CUSCUTACEAE
Cuscuta sandwichiana Choisy — kauna'oa, dodder

DISTRIBUTION: A parasite recorded from many native and naturalized hosts, usually "in coastal areas, often in sandy soil, 0-300 m, on all the main islands except Kaua`i and Kaho`olawe". Not found in subzone.

EBENACEAE
Diospyros sandwicensis (A.DC) Fosb. — lama, ēlama

DISTRIBUTION: "Scattered to dominant in some types of dry to mesic forest, also extending to wet forest, 5-1,220 m, documented from all of the main islands except Ni`ihau and Kaho`olawe." In subzone occasional along southern boundary.

ERICACEAE
Vaccinium calycinum Sm. — 'ōhelo kau lā'au, ōhelo

DISTRIBUTION: "Terrestrial or sometimes epiphytic, in wet forests and bogs, 500-1800 m, on all of the main islands except Ni`ihau and Kaho`olawe." In subzone common.

Vaccinium reticulatum Sm. — 'ōhelo

DISTRIBUTION: "A common shrub of disturbed sites, 640-3,700 m, on Maui and Hawai`i, rare on Kaua`i, O`ahu, and Moloka`i, usually occurring as a member of the pioneer community found on lava flows, ash dunes, and cinder beds, or of exposed sites such as alpine or subalpine shrubland; *V. reticulatum* is much less common in mature or stable plant communities such as grassland, wet forest, or bogs." In subzone primarily on newer lava flows where it is occasional; it is found rarely in 'ōhi'a-uluhe woodland and 'ōhi'a forest near the western boundary of the subzone.

EUPHORBIACEAE
Aleurites moluccana (L.) Willd. — kūkui

DISTRIBUTION: "Native to Malesia, although its precise native range is essentially impossible to determine because of its early spread by" humans, "now widespread in many tropical areas; in Hawai`i a Polynesian introduction, now a conspicuous component of mesic valley vegetation, 0-700 m, on all of the main islands except Kaho`olawe." In subzone uncommon.

FABACEAE
Canavalia sp. (NOT YET DET.)

DISTRIBUTION: One sterile specimen of *Canavalia*, which we were unable to identify to species, was found during the survey of the east rift zone of Kīlauea, but outside the subzone.

GOODENIACEAE
Scaevola sericea Vahl — naupaka kahakai

DISTRIBUTION: "Occurring throughout tropical and subtropical Pacific and Indian Ocean coasts; in Hawai`i common in coastal sites throughout the Hawaiian Archipelago, except not on Gardner Pinnacles, Necker and Nihoa." Not found in subzone.

MALVACEAE

Hibiscus tiliaceus L. hau

DISTRIBUTION: "A polymorphic species widespread in the tropics and subtropics worldwide, especially along coasts; in Hawai`i occurring primarily along coasts, mouths of streams, and other wet areas, 0-300(-1,220) m, on Midway Atoll, French Frigate Shoals, and probably on all of the main islands, but not documented from Ni`ihau or Kaho`olawe." Not found in subzone.

Sida fallax Walp. 'ilima

DISTRIBUTION: "Widespread on Pacific islands to China; in Hawai`i occurring on rocky or sandy coasts or raised limestone reefs, also open arid lava fields and dry forest to diverse mesic forest and rarely low elevation wet forest, 0-1,980 m, on Midway Atoll, Nihoa, and all of the main islands." Not found in subzone.

MORACEAE

Artocarpus altilis (S. Parkinson ex Z) Fosb. breadfruit, 'ulu

DISTRIBUTION: A Polynesian introduction, occurring only where intentionally cultivated. Not found in subzone.

MYRTACEAE

Metrosideros polymorpha Gaud. var. *glaberrima* (H. Lev.) St.John 'ōhi'a lehua

DISTRIBUTION: "Found at middle to higher elevations on all of the main islands except Ni`ihau and Kaho`olawe." Common to abundant in subzone.

Metrosideros polymorpha Gaud. var. *incana* (H. Lev.) St.John 'ōhi'a lehua

DISTRIBUTION: "Found at low to middle elevations on O`ahu, Moloka`i, Lāna`i, Maui, and Hawai`i." Common to abundant in subzone. The dominant form on newer lava flows.

Metrosideros polymorpha Gaud. var. *macrophylla* (Rock) St.John 'ōhi'a lehua

DISTRIBUTION: Found at middle elevations on Hawai`i. Common to abundant in subzone, especially in 'ōhi'a forests.

Syzygium malaccense (L.) Merr. & Perry 'ōhi'a 'ai, mountain apple

DISTRIBUTION: "Native range uncertain, perhaps Malesia to southeastern Asia, widely cultivated and naturalized; in Hawai`i a Polynesian introduction, now widely naturalized in low elevation mesic to wet sites, primarily mesic valleys, 200-310(550) m, at least on Kaua`i, O`ahu, Moloka`i, Maui, and Hawai`i, but reported by Hillebrand" a century ago "as on all the main islands." Not found in subzone.

PIPERACEAE

Peperomia cookiana C. DC 'ala'ala wai nui

DISTRIBUTION: "Terrestrial, on wet banks, rocks, or epiphytic on trees, in wet forest to mesic shrubland, rarely margins of subalpine forest, 460-1980 m, on Kaua`i, Moloka`i, Maui, and Hawai`i." In subzone common.

Peperomia hypoleuca Miq. `ala`ala wai nui

DISTRIBUTION: "Terrestrial or epiphytic on trees, in wet to rarely mesic forest, 580-1,530 m, Hawai`i." In subzone common.

Peperomia latifolia Miq. 'ala'ala wai nui

DISTRIBUTION: "Epiphytic on rocks or terrestrial, in mesic valleys and mesic to wet forest, 100-1,860 m, on all of the main islands except Ni`ihau and Kaho`olawe." In subzone occasional.

Peperomia leptostachya Hook. & Arnott 'ala'ala wai nui

DISTRIBUTION: "Occurring from Micronesia and Queensland, Australia, through Melanesia to Polynesia. In Hawai`i terrestrial on rocks, ledges, cliffs, and *`a`ā* lava, rarely epiphytic, in dry to mesic forest, rarely in wet forest, 10-610(-1675) m, documented from all of the main islands except Kaho`olawe." Not found in subzone.

Peperomia macraeana C. DC 'ala'ala wai nui

DISTRIBUTION: "Terrestrial or rarely epiphytic, in wet forest, 610-2,080 m, on O`ahu, Moloka`i, Lānai, Maui, and Hawai`i." In subzone rare, in 'ōhi'a-a(1) forest at western boundary of subzone.

Peperomia membranacea Hook. & Arnott 'ala'ala wai nui

DISTRIBUTION: "Epiphytic on trees and rocks or terrestrial in mesic to wet forest, 240-1,740 m, on Kaua`i, O`ahu, Moloka`i, Maui, and Hawai`i." In subzone rare, found only once or twice in 'ōhi'a-a(2) forest.

Peperomia tetraphylla (G. Forster) Hook. & Arnott 'ala'ala wai nui

DISTRIBUTION: "Pantropical; in Hawai`i occurring in diverse habitats including shaded or sometimes open sites, on rocks, these sometimes moss-covered, occasionally epiphytic on moss-covered trees, in mesic to wet forest, subalpine forest, and subalpine desert, 70-2,290 m, documented from all of the main islands except Ni`ihau and Kaho`olawe." In subzone occasional.

Piper methysticum G. Forster 'awa

DISTRIBUTION: "Native range uncertain, but probably indigenous to eastern Malesia or possibly the New Hebrides, widely spread by aboriginal voyagers, now widely cultivated and occasionally naturalized; In Hawai`i introduced by early Polynesians as the source of a special drink and for its medicinal value, widely planted and persisting in shaded mesic sites or more open, windward mesic sites, sometimes spreading vegetatively, 50-500 m, on all of the main islands except Kaho`olawe, but not documented from Ni`ihau or Lāna`i." A few plants persist in the 'ōhi'a-a(3) forest along the southern boundary of the subzone.

PITTOSPORACEAE

Pittosporum confertiflorum A. Gray hō'awa

DISTRIBUTION: "Along with *P. glabrum*, this is the most widespread and common Hawaiian *Pittosporum*, occurring in dry to wet forest and subalpine forest, 180-2,200 m, on O`ahu, Lāna`i, Maui, and Hawai`i." In subzone rare, a few plants in the forest near the entrance gate at the east end of the subzone.

Pittosporum terminalioides Planch. ex A. Gray hō'awa

DISTRIBUTION: "Scattered in dry to mesic forest, sometimes in subalpine woodland, 300-2,010 m, on Lāna`i, Maui, and from Kīlauea around the leeward side to the Kohala Mountains on Hawai`i." Not found in subzone.

PLANTAGINACEAE

Plantago major L. broad-leaved plantain, laukahi

DISTRIBUTION: "Native to Europe and northern and central Asia, now virtually cosmopolitan; in Hawai`i naturalized and often locally common in pastures, lawns, along roadsides, and disturbed parts of virtually all vegetation types from coastal, disturbed forest to wet forest, 0-1,250 m, on Midway Atoll and all of the main islands except Ni`ihau and Kaho`olawe." Not found in subzone.

RUBIACEAE

Bobea timonioides (J.D. Hook.) Hillebr. 'ahakea

DISTRIBUTION: "Occurring in dry to occasionally mesic forest, 250-580 m, occasional in the Puna and South Kona districts of Hawai`i, and on Maui (southern slopes of Haleakala) represented by apparent hybrids with *Bobea sandwicensis*". May also occur on Kaua`i and O`ahu. In subzone rare, a few trees found along the access road, which was rerouted to avoid them.

Morinda citrifolia L. noni, Indian mulberry

DISTRIBUTION: "Native from southeastern Asia to Australia; in Hawai`i a Polkynesian introduction originally cultivated for its medicinal and dye properties, now naturalized in relatively dry to mesic sites, 0-450 m, in solution pits near the coast, disturbed hala forest, dry to mesic forest, and alien grassland, on all of the main islands except not documented from Kaho`olawe." Not found in subzone.

RUTACEAE

Melicope clusiifolia (A. Gray) T.Hartley & B.Stone alani

DISTRIBUTION: "The most widespread and variable species of *Melicope* " in Hawai`i, occurring in mesic to wet forest on all of the main islands except Ni`ihau and Kaho`olawe". In subzone uncommon in `ōhi`a forest.

Melicope radiata (St.John) T.Hartley & B.Stone alani

DISTRIBUTION: "Occurring in dry, mesic, and wet forest and subalpine shrubland, 300-1650 m, from the Kohala Mountains to Puna District, and southwest to the vicinity of Ocean View Estates, Hawai`i." In subzone uncommon.

Melicope volcanica (A. Gray) T.Hartley & B.Stone alani

DISTRIBUTION: "Occurring in mesic to wet forest, 610-2060 m, on Lāna`i, East Maui, and Hawai`i." Not found in subzone.

SANTALACEAE

Santalum paniculatum Hook.& Arnott var. *paniculatum* 'iliahi

DISTRIBUTION: "Scattered in dry woodland on lava or on cinder cones, to higher elevation wet forest or secondary *Metrosideros* forest, 450-2,000(-2550) m on Hawai`i." Not found in subzone.

SAPINDACEAE

Dodonaea viscosa Jacq. 'a'ali'i

DISTRIBUTION: "Pantropical; in Hawai`i scattered to dominant, often in open sites such as ridges and lava fields, sometimes successional on lava or in pastures, ranging from coastal dunes, low elevation shrubland communities to dry, mesic, and wet forest, also subalpine shrubland, 3-2,350 m, on all of the main islands except Kaho`olawe." Not found in subzone.

SOLANACEAE

Solanum americanum Mill. pōpolo, glossy nightshade

DISTRIBUTION: "Widely distributed in tropical and warm-temperate areas, generally associated with some man-made disturbance; in Hawai`i possibly naturalized in open sites from coastal to wet forest, subalpine woodland, and disturbed roadsides and pasture., 0-2,380 m, on Kure, Midway, and Pearl and Hermes atolls, Lisianski, Laysan, Nihoa, and all of the main islands." Not found in subzone.

STERCULIACEAE

Waltheria indica L. hi'aloa, 'uhaloa

DISTRIBUTION: "Pantropical; in Hawai`i apparently indigenous, occurring in dry, often disturbed sites, 0-1,220 m, on Midway Atoll and all of the main islands." In subzone a few plants in more open disturbed parts of 'ōhi'a-uluhe woodland, and on recent lava flows.

THYMELAEACEAE

Wikstroemia phillyreifolia A. Gray 'akia

DISTRIBUTION: "Occasional or common, sometimes a dominant element of the vegetation, in open dry forest or shrubland, bare *'a'ā* lava, sometimes in mesic forest, from near sea level up to 2,290 m, Hawai`i." Not found in subzone.

Wikstroemia sandwicensis Meisn. 'akia

DISTRIBUTION: "Rather common in dry to wet forest, 0-1,500 m, on Hawai`i, but not known from the Kohala Mountains". In subzone occasional.

URTICACEAE

Pipturus albidus (Hook. & Arnott) A. Gray māmaki, māmake

DISTRIBUTION: "Scattered to locally common in mesic valleys, mesic to wet forest, and diverse mesic forest, (0-)70-1,870 m, on all of the main islands except Ni`ihau and Kaho`olawe." In subzone occasional, but common as an early invader of roadsides and other clearings.

Urera glabra (Hook. & Arnott) Wedd. ōpuhe, hōpue

DISTRIBUTION: "Occurring on slopes and in gulch bottoms in mesic to wet diverse forest, 150-1,700 m, on all of the main islands except Ni`ihau and Kaho`olawe." In subzone uncommon in 'ōhi'a forests.

OTHER PLANTS REPORTEDLY USED FOR HAWAIIAN MEDICINE IN EAST RIFT ZONE OF KĪLAUEA

PTERIDOPHYTES - FERNS AND FERN ALLIES

ASPLENIACEAE

Asplenium lobulatum Mett. — pi'i lau manamana, 'anali'i

DISTRIBUTION: Native to many Pacific islands; in Hawai`i a common terrestrial fern in wet forests, 150-2000 m on all the main islands except Ni`ihau and Kaho`olawe. In subzone occasional to common.

Asplenium nidus L. — 'ēkaha

DISTRIBUTION: Pantropical; in Hawai`i occasional to common epiphyte in mesic and wet forests, 0-800 m, on all the main islands except Ni`ihau and Kaho`olawe. In subzone occasional.

ATHYRIACEAE

Diplazium sandwichianum (Presl) Diels — hō'i'o

DISTRIBUTION: Common endemic Hawaiian terrestrial fern in mesic and wet forests, 100-2000 m, on all the main islands except Ni`ihau and Kaho`olawe. In subzone common.

LYCOPODIACEAE

Lycopodium cernuum L. — wāwae'iole

DISTRIBUTION: Native to tropical and subtropical areas throughout the world; in Hawaii common in woodlands, grasslands, openings in forests, alongside roads and trails, 10-3000 m, on all the main islands except Ni`ihau and Kaho`olawe. In subzone common on revegetating lava flows, occasional in 'ōhi'a-uluhe woodland, and uncommon in forests, where it is found only at the edges of some of the larger pig wallows.

MARATTIACEAE

Marattia douglasii (Presl) Baker — pala, kapua'i hoki

DISTRIBUTION: An endemic Hawaiian terrestrial fern, rare to common in wet forests, 200-1500 m, on all the main islands except Ni`ihau and Kaho`olawe. This fern is apparently a favorite food of pigs, and disappears quickly when pig populations are high. In subzone rare, only one plant found, along the access road to the drill site.

THELYPTERIDACEAE

Christella cyatheoides (Kaulf.) Holtt. — kikawaiō

DISTRIBUTION: An endemic Hawaiian terrestrial fern, common in wet forests, 200-2000 m, on all the main islands except Ni`ihau and Kaho`olawe. In subzone uncommon.

ANGIOSPERMS - MONOCOTYLEDONS

DIOSCOREACEAE
Dioscorea bulbifera L. hoi, pi'oi

DISTRIBUTION: "Native to Asia and Africa, widely cultivated and now spread from the Atlantic coast of Africa throughout the Pacific and more recently to the Neotropics; in Hawai`i a Polynesian introduction, naturalized primarily in mesic areas, especially shaded mesic valleys and disturbed mesic forest, 5-670 m, probably once occurring on all the main islands but documented by specimens only from Kaua`i, O`ahu, Moloka`i, Maui, and Hawai`i." Not found in subzone.

LILIACEAE
Astelia menziesiana Sm. pa'iniu, kaluaha, pua'akuhinia

DISTRIBUTION: "Epiphytic or terrestrial, in mesic to wet forest and bogs, 610-2,230 m, on all of the main islands except Ni`ihau and Kaho`olawe." In subzone uncommon in 'ōhi'a forest near western boundary.

PANDANACEAE
Freycinetia arborea Gaud. 'ie'ie

DISTRIBUTION: "Widespread in Polynesia (Hawai`i, Marquesas, Society, Austral, and Cook islands), also occurring in New Caledonia, with a single record for Samoa; in Hawai`i fairly common, occurring primarily in mesic to wet forest, often on exposed ridges and slopes, the stems creeping and rooting or ascending on tree trunks, 300-1,500 m, on all the main islands except not recorded from Ni`ihau or Kaho`olawe." In subzone common.

POACEAE
Cynodon dactylon (L.) Pers. mānienie, Bermudagrass

DISTRIBUTION: "Possibly native to tropical Africa, but now widely cultivated and naturalized; in Hawai`i cultivated and naturalized along roadsides and in exposed rocky or sandy sites, forming a solid mat where seepage may be present, 0-2,270 m, documented from Kure, Midway, and Pearl and Hermes atolls, Laysan, French Frigate Shoals, and all of the main islands except Ni`ihau and Moloka`i. Not found in subzone.

ANGIOSPERMS - DICOTYLEDONS

APIACEAE
Centella asiatica (L.) Urb. Asiatic pennywort, pohe kula

DISTRIBUTION: "Native to Asia; in Hawai`i naturalized in a wide range of habitats including meadows, ditches, bogs, and wet forest, 0-1,700 m, on all of the main islands except Ni`ihau and Kaho`olawe." In subzone occasional, in openings in forest, and especially in wet sites such as pig wallows.

Hydrocotyle verticillata Thunb. pohepohe, pohe

DISTRIBUTION: "Native to North America; in Hawai`i introduced or perhaps indigenous, common in wet places such as pond and stream margins, seeps, and muddy sites, 0-1,600 m, on all of the main islands except Lāna`i and Kaho`olawe." Not found in subzone.

ASTERACEAE

Ageratum conyzoides L. ageratum, maile hohono

DISTRIBUTION: "Native to Central and South America; in Hawai`i a widespread and often common weed, from sea level to at least 1,300 m, on all the main islands." In subzone common in openings in forest.

Ageratum houstonianum Mill. ageratum, maile hohono

DISTRIBUTION: "Native to Mexico, Central America, and the West Indies; in Hawai`i naturalized in a wide variety of disturbed habitats, especially along trails and roadsides, 40-1,300 m, on Kaua`i, O`ahu, and Hawai`i." In subzone often more common than *A. conyzoides*.

Bidens pilosa L. kī, kī nehe, Spanish needle

DISTRIBUTION: "Native to tropical America but now a pantropical weed; in Hawai`i widespread in disturbed areas on Midway Atoll and all of the main islands." Not found in subzone.

CRASSULACEAE

Kalanchoë pinnata (Lam.) Pers. air plant, 'oliwa kū kahakai

DISTRIBUTION: "Native range unknown, now widely established in many tropical and subtropical areas; in Hawai`i naturalized and sometimes very abundant in low elevation, dry to mesic, disturbed areas on all the main islands except Ni`ihau and Kaho`olawe." Not found in subzone.

EPACRIDACEAE

Styphelia tameiameiae (Cham.& Schlechtend.) F.v. Muell. pūkiawe

DISTRIBUTION: "Scattered to often forming a principal component of the vegetation, in mesic forest to open areas of low elevation or montane wet forest, fogswept alpine shrubland, and bogs, rarely windward coastal sites, 15-3,230 m, on all of the main islands, except Ni`ihau and Kaho`olawe, where it may perhaps have occurred in the past; also occurring in the Marquesas Islands." In subzone locally common, primarily in 'ōhi'a-uluhe woodland.

EUPHORBIACEAE

Ricinus communis L. castor bean, koli, pā'aila

DISTRIBUTION: Native to Africa and perhaps India: "in Hawai`i naturalized and sometimes common in low elevation, dry, disturbed habitats, 0-500 m, on all of the main islands". Not found in subzone.

FABACEAE

Caesalpinia major (Medik.) Dandy & Exell kākalaioa, yellow nickers

DISTRIBUTION: "Native from Madagascar throughout tropical Asia,the Pacific, and the Neotropics; in Hawai`i either naturalized or perhaps native, occurring in gulches, on talus slopes, and at the edge of open,mesic, coastal forest, 6-460 m, on Ni`ihau, O`ahu, Moloka`i, Lāna`i, and Hawai`i." Not found in subzone.

Desmodium sandwicense E. Mey. Spanish clover

DISTRIBUTION: "Native to South America, naturalized on some Pacific islands (Hawai`i, Marquesas, and Tonga); in Hawai`i the most common *Desmodium* species, widely naturalized along roadsides, in pastures, and disturbed sites in mesic to wet forest, 3-1,190 m, on Midway Atoll and all of the main islands." In subzone uncommon, primarily in pastures and along roadsides in agricultural land just outside subzone.

Indigofera suffruticosa Mill. indigo, 'inikō, 'iniko

DISTRIBUTION: "Pantropical, but presumably of Neotropical origin, formerly used for indigo production; in Hawai`i naturalized primarily in dry, highly disturbed areas, 3-1,160 m, probably on all the main islands, but not documented from Moloka`i." Not found in subzone.

HYDRANGEACEAE

Broussaisia arguta Gaud. kanawao, pūʻahanui

DISTRIBUTION: "Often common in wet forest, occasionally in mesic forest,(300-)400-1,400(2,050 on Maui) m, on all of the main islands except Niʻihau and Kaho`olawe." In subzone occasional to common.

LAURACEAE

Cassytha filiformis L. kauna'oa, kauna'oa-pehu

DISTRIBUTION: "Pantropical; in Hawai`i reported on a variety of hosts, usually growing in coastal habitats, documented from all of the main islands except Kaho`olawe." Not found in subzone.

MYRTACEAE

Melaleuca quinquenervia (Cav.) S.T.Blake paperbark

DISTRIBUTION: "Native to eastern Autralia, New Guinea, and New Caledonia; in Hawai`i over 1.7 million trees have been planted in forestry plots, it is now naturalized in disturbed mesic forest, 30-890 m, on Kaua`i, O`ahu, Moloka`i, Maui, and Hawai`i". Not found in subzone.

OXALIDACEAE

Oxalis corniculata L. yellow wood sorrel, 'ihi 'ai

DISTRIBUTION: "Cosmopolitan species of unknown origin; in Hawai`i occurring in open, disturbed sites in coastal to subalpine habitats, 0-2,300 m, on Midway Atoll and all of the main islands." Not found in subzone.

ROSACEAE

Osteomeles anthyllidifolia (Sm.) Lindl. 'ūlei, u'ulei

DISTRIBUTION: "Occurring in the Cook Islands, Tonga, and Hawai`i; in Hawai`i scattered or sometimes locally common in a wide variety of habitats such as coastal cliffs, open lava fields, dry shrubland, and dry to mesic forest, often persisting even in highly disturbed habitats, 2-2,320 m, on all of the main islands except Ni`ihau and Kaho`olawe." Not found in subzone.

RUBIACEAE

Psychotria hawaiiensis (A. Gray) Fosb. var. *hawaiiensis* kōpiko 'ula, 'ōpiko

DISTRIBUTION: "Occurring in wet forest, sometimes in dry to mesic forest, (50-)150-1590 m, on Moloka`i, Maui, and most common on Hawai`i." In subzone, as on most of the island of Hawaii, a very common understory tree in wet 'ōhi'a forests.

VERBENACEAE

Verbena litoralis Kunth verbena, ōwī, oī

DISTRIBUTION: "Native from Mexico through Central America to South America, widely naturalized; in Hawai`i the most common naturalized Verbena, occurring in dry to wet,disturbed habitats, 10-2,280 m, on Midway Atoll and all of the main islands." In subzone only found at drill site.

DISCUSSION

There were 59 major Hawaiian medicinal plants found in the east rift zone of Kīlauea, of which 34 have been found in the subzone in which geothermal development is now underway. Of these 34 plants, 22 are endemic, (occurring naturally only in the Hawaiian Islands), 5 are indigenous, (occurring naturally both in the Hawaiian Islands and in other parts of the world), 5 were apparently introduced to the Hawaiian Islands by early Polynesian settlers, and 2 were probably introduced to Hawaii only after European contact. Five of the endemic plants occur naturally only on the island of Hawai'i, where they are found both inside and outside the subzone; all are more common outside the subzone than within it. The other 29 found in the subzone occur both elsewhere on the island of Hawai'i and on other Hawaiian islands.

There were 28 other plants reportedly used in Hawaiian medicine found in the east rift zone of Kīlauea, of which 16 have been found in the subzone in which geothermal development is now underway. Of these 16 plants, 6 are endemic to the Hawaiian Islands, 5 are indigenous and 5 were probably introduced to Hawai'i only after European contact. All 16 of these plants are found both elsewhere on the island of Hawai'i and on other Hawaiian islands.

The currently proposed scheme for geothermal development in the subzone which has been approved by BLNR appears to have no significant impact on Hawaiian medicinal plants. All are available elsewhere on the island of Hawai'i; all but 5 are also available on other Hawaiian islands as well; the numbers of medicinal plants which would be removed by clearing between 100 and 300 acres of the subzone for geothermal development would constitute only a small fraction of 1% of the total number of plants in each species now existing on the island of Hawai'i. Given the remote nature of the subzone, it is likely that most collections of plants for medicinal use have occurred, at least in recent decades, in more accessible sites outside the subzone.

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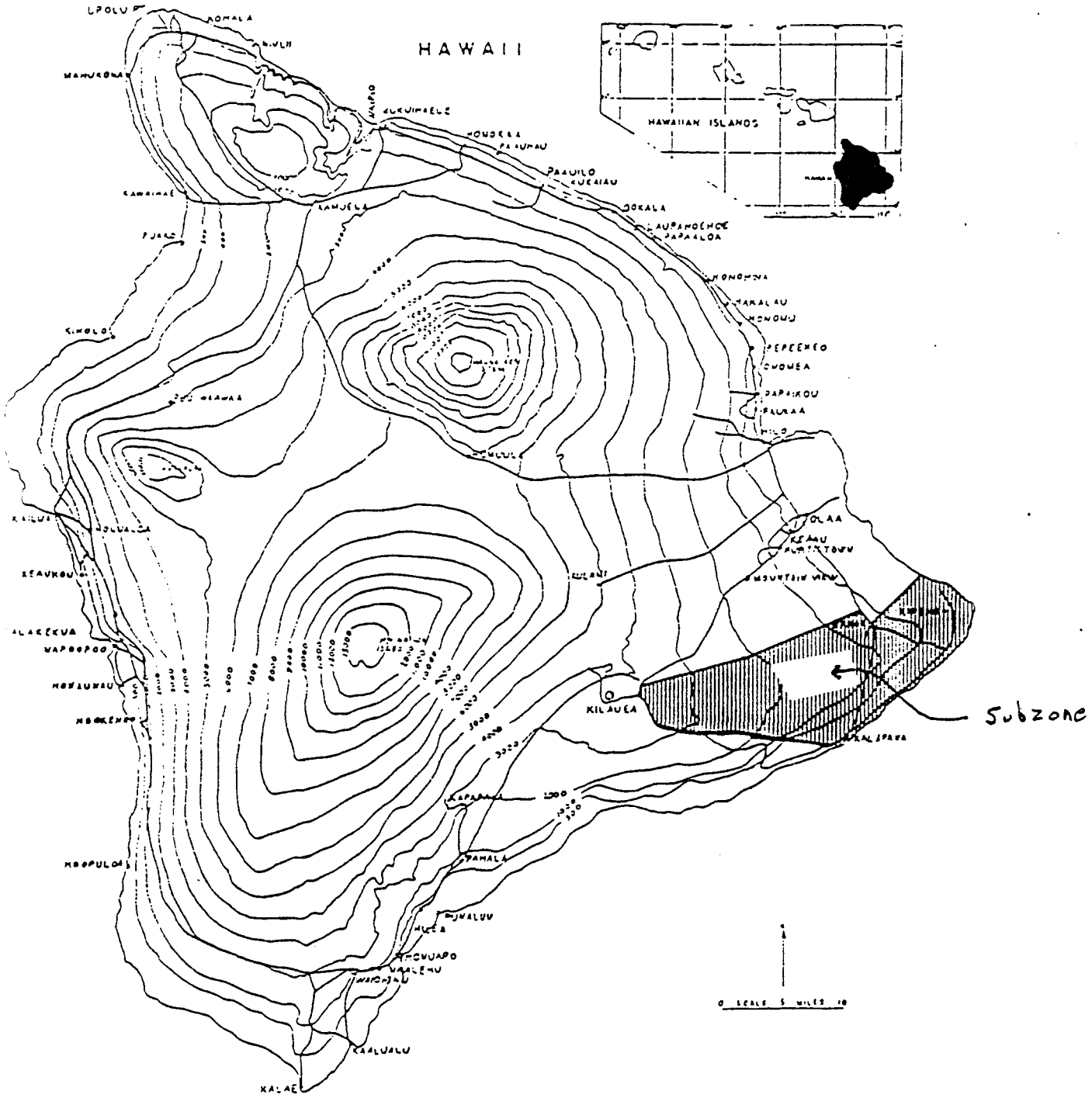

Fig. 1. Project location. Island of Hawaii.

Curriculum Vitae

ISABELLA AIONA ABBOTT

G. P. Wilder Professor of Botany, University of Hawaii, Manoa; Professor of Biology, emerita, Stanford University

Born: Hana, Maui Island, Hawaii.

Education: University of Hawaii, A. B. 1941; University of Michigan, M. S. (Botany) 1942; University of California, Berkeley, Ph. D. (Botany) 1950.

Research and teaching fields: Phycology, mainly marine algae; Ethnobotany of Polynesia

Research competence: Morphology and taxonomy of marine algae; reproduction of red algae; phytoplankton identification; uses of seaweed as food; plants used by Polynesians.

Teaching and research experience:

Research biologist and lecturer, Hopkins Marine Station of Stanford University, 1960-1972. Professor of Biology, Stanford University, 1972-1982. Professor of Botany, University of Hawaii, 1968 (Spring); 1976-83 (Fall semesters); G. P. Wilder Professor of Botany since 1984.

Research biologist and U. S. Organizer, U. S.-Japan Cooperative Science Program 1965-66; 1971. Visiting Investigator, West Indies Laboratory (St Croix, Virgin Islands), January intersessions, 1973-75. Visiting Professor of Biology (January) 1976, 1983, Universidad Catolica de Chile (Santiago, Chile). Guest Professor, Institute of Oceanology, Academia Sinica, Qingdao (Summer, 1987).

Awards and Recognition

Darbaker Prize of the Botanical Society of America (1969)
New York Botanical Garden Book Prize (with G. J. Hollenberg) 1978
Phycological Society of America--Distinguished Phycologist (1980)
C. S. Wo Foundation Travel Award to China for lectures (1986)
Ford Foundation Award for Research in China (1987)
Fellow, AAAS

Membership in Scientific Organizations

Botanical Society of America; International Phycological Society (Treasurer, 1967-1972; Exec. Comm. 1987--1990); Phycological Society of America; International Association of Plant Taxonomists; Hawaiian Botanical Society (Vice President, 1987); Western Society of Naturalists (Secretary, 1961-1964; President, 1977); Sigma Xi.

Board of Editors: Journal of Phycology; Aquatic Botany; J. Cryptogamic Botany.

Grants: PI for California Sea Grant Program Plant Aquaculture Studies, 1977-82; PI for Hawaii Sea Grant Program 1985-86. National Science Foundation grant for research on Hawaiian Marine Algae (with W. H. Magruder) 1988-1991. Pending: (with W. Iwaoka, DLNR Aquatic resources: A new toxin found in Hawaiian reef fishes).

Current Funding: NSF: $150,000. Office of Hawaiian Affairs: $4000; Committee for the Preservation of Hawaiian Language, Art and Culture $3500. Toxins of Hawaiian fishes $8000.

Convenor of International Workshops

1984. Workshop on Taxonomy of Economic Seaweeds at University of Guam (Co-editor of Results of Workshop)

1986. Workshop on Taxonomy of Economic Seaweeds at Institute of Oceanology, Academia Sinica, Qingdao, China. (Editor of Results of Workshop)

1989. Workshop on Taxonomy of Economic Seaweeds at Scripps Institution of Oceanography, La Jolla, California. (Current Editor of Workshop Results)

Invitee to International Symposia

1985. Coral Reef Symposium, Papeete, Tahiti

1985. International Phycological Congress, Copenhagen

Publications (over 100, 5 of them books).

Best known international publication: Marine Algae of Califonia (with G. J. Hollenberg), 1976. Stanford University Press, 827 pp.

Current books in press or preparation:

Marine Algae of Hawaii
Hawaiian Cultural Uses of Plants: An Ethnobotany
Lā'au Lapa'au (Hawaiian Medicinal Plants)