

Technical Report 103

**Distribution and Abundance of Alien and Native Plant  
Species in Kaloko-Honokōhau National Historical Park**

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**Birds of Kaloko-Honokōhau National Historical Park**

COOPERATIVE NATIONAL PARK RESOURCES STUDIES UNIT  
UNIVERSITY OF HAWAI'I AT MĀNOA

Department of Botany  
3190 Maile Way  
Honolulu, Hawai'i 96822  
(808) 956-8218

Clifford W. Smith, Unit Director

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DISTRIBUTION AND ABUNDANCE  
OF ALIEN AND NATIVE PLANT SPECIES  
IN KALOKO-HONOKŌHAU NATIONAL HISTORICAL PARK

Linda W. Pratt and Lyman L. Abbott

National Biological Service  
Pacific Islands Science Center  
Hawaii National Park Field Station  
P. O. Box 52  
Hawaii National Park, HI 96718

University of Hawai'i at Manoa  
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ABSTRACT

The vegetation of Kaloko-Honokōhau National Historical Park was surveyed in 1992-93 as part of a monitoring study of plants, birds, mammals, and invertebrates in three Kona parks. Most previously identified major vegetation types were sampled. An updated vascular plant checklist was prepared; 116 vascular plant species were found within Kaloko-Honokōhau in 1992-93. Eighty (69%) plant species were alien, four (3%) were Polynesian introductions, 27 (23%) were indigenous, and five (4%) were endemic. Fifty-six species (46 aliens, 9 indigenous, and 1 endemic) were additions to the known flora of the Park since the previous plant checklist (Canfield 1990).

The percentage cover of 11 invasive alien plant species was estimated in segments of belt transects and average estimated cover was mapped. Most of the invasive alien species in the Park were shrubs. Klu (Acacia farnesiana) was most abundant in the northern part of the Park, where its cover was usually >25%. Pickleweed (Batis maritima) was found only near the coast and ponds with variable cover; dense concentrations were observed off transect. Ēkoa (Leucaena leucocephala) was the most widespread and abundant shrub in the Park. Ēkoa cover was typically >25% in the northern third of the Park and was variable in the Park's southern reaches. 'Opiuma (Pithecellobium dulce) had little estimated cover and was most often seen in the northern third of the Park. Sourbush (Pluchea symphytifolia) was found near the coast and scattered with little cover on 'a'ā flows in the center of the Park. Kiawe (Prosopis pallida) was widespread with little estimated cover except near fishponds and the coast; in coastal and wetland forests, kiawe had cover of 25-50% or >50%. Christmas berry (Schinus terebinthifolius) was distributed throughout the Park with estimated cover of 1-5% or less; areas of higher concentration were north of Kaloko and northwest of 'Aimakapā Pond.

Fountain grass (Pennisetum setaceum) was nearly ubiquitous in Kaloko-Honokōhau with highest estimated cover (>50%) in the northeastern and southern parts of the Park. Guinea grass (Panicum maximum) occurred primarily southeast of 'Aimakapā Pond and in the coastal forest and shrubland east of 'Ai'ōpio; estimated cover averaged 1-5%, but was locally higher. Two other invasive aliens were uncommon enough to be counted in or near belt transects. Ivy gourd (Coccinia grandis) was found on only one transect near Kaloko Pond, but nine individual vines were seen off transect near 'Aimakapā Pond. Only 10 prickly pear cactus (Opuntia ficus-indica) were sighted from transects or trails. Several other alien plants of note were also mapped.



Thirty-five native and Polynesian plant species were counted and mapped along belt transects, and densities per 1,000 m<sup>2</sup> were calculated. Three candidate endangered species were found in the Park: ko'oko'olau (*Bidens micrantha* subsp. *ctenophylla*), maiapilo (*Capparis sandwichiana*), and *Fimbristylis hawaiiensis*. Only seven live ko'oko'olau shrubs were seen southeast of 'Aimakapā Pond. Three hundred twenty five maiapilo plants were found on transects and trails in Kaloko-Honokōhau; the density of maiapilo on transects was 1.6 plants/1,000 m<sup>2</sup>. *Fimbristylis hawaiiensis* was discovered in only two localities near Kaloko Pond and near the anchialine pool called Kahinahina'ula; only ten individuals were sighted.

### ACKNOWLEDGMENTS

We would like to thank Kaloko-Honokōhau Superintendent Francis Kuailani and his staff, particularly Laura Schuster and Jerry Case, for their assistance and cooperation throughout this study. Dr. Charles Stone planned this project and coordinated research and monitoring in the three Kona Parks. Members of the research staff at both Kaloko-Honokōhau National Historical Park and Hawaii Volcanoes National Park assisted us in the field. Mark Aeder and Jason Texeira established transects for data collection. Michelle Fulton participated in the field survey and helped us with data entry and summarization. Pamela Lockwood documented transect localities with a Global Positioning System (GPS). Marie Morin accompanied us on surveys near 'Aimakapā Pond and shared her knowledge of the Park and its natural resources. We gratefully acknowledge these contributions to the botanical component of the Kona Parks monitoring project. We would also like to thank Dr. Charles Lamoureux of Lyon Arboretum and Dr. George Staples of the Bernice P. Bishop Museum for reviewing an earlier version of this report and providing us with many useful comments. Diane Butler ably assisted us with revisions and produced the final report.

### INTRODUCTION

Honokōhau was designated as a National Historical Landmark in 1962, and Kaloko-Honokōhau was authorized as a National Historical Park (NHP) in 1978. Land acquisition began soon after authorization, and by 1992, the National Park Service had acquired nearly 243 ha (600 acres) for the Park (National Park Service 1992). Additional lands and offshore waters within the authorized Park boundaries are owned by the State of Hawaii and private companies.

While little permanent development has occurred within Kaloko-Honokōhau, much resource management planning has been carried out (National Park Service 1991). Several research or inventory projects have added to knowledge of the area's natural resources, most notably Joan Canfield's 1987 survey of the plants of Kaloko-Honokōhau, which resulted in a plant checklist, descriptions of plant communities, and a park-wide

vegetation map (Canfield 1990). The plant monitoring presented here is part of a larger project designed to sample the plants, birds, mammals, and invertebrates of Kaloko-Honokōhau, as well as those of Pu'uhonua o Hōnaunau National Historical Park and Pu'u Koholā National Historic Site. The results of plant surveys at the two other Kona Parks, as well as bird, mammal and invertebrate monitoring at Kaloko-Honokōhau are presented in separate reports.

## THE STUDY AREA

Kaloko-Honokōhau NHP is located on the western (leeward) shore of Hawai'i Island 6 km (3.6 mi) north of the city of Kailua-Kona (Fig. 1). Within the district of North Kona, the Park includes the coastal portions of two ancient Hawaiian land divisions, Kaloko and Honokōhau ahupua'a. The Park extends from the coast to the Queen Ka'ahumanu Highway (Highway 19), and its current northern boundary is the line that divides Kaloko and Kohanaiki land divisions. The Park is bounded on the south by state lands of Honokōhau Harbor in Kealakehe ahupua'a.

Climate - The Park is in a warm and dry climatic region characterized by seasonal (summer) rains and a pronounced diurnal wind pattern of land and sea breezes (Blumenstock and Price 1967). This region of Kona receives mean annual rainfall between 500 and 750 mm (19.7-29.5 in), with monthly means exceeding 50 mm (2 in) during the spring and summer months (April through September), as well as in January. Mean annual rainfall at the nearby old Kona Airport station is 616 mm (24.3 in) (Giambelluca et al. 1986). Temperatures are warm and do not vary greatly throughout the year. The mean annual temperature is 21.1-24.4° C (70-76° F). Mean monthly maximum temperatures range from 29.3° C (84.8° F) in September to 27.0° C (80.6° F) in February. Mean monthly minimum temperatures follow a similar pattern and are highest in September (20.8° C or 69.5° F) and lowest in January (17.6° C or 63.7° F) (Hawaii State Department of Land and Natural Resources 1970).

Geology and Soils - Kaloko-Honokōhau NHP is on the coastal plain of Hualālai, an inactive volcano approximately 0.4 million years old. In a late stage eruptive cycle, Hualālai last erupted in 1800-01 (MacDonald et al. 1983). Substrates of three age groups are found within the Park (Moore et al. 1987). Most of the Park is covered by lava 3,000-5,000 years old, but the areas around Kaloko and 'Aimakapā Ponds are 5,000-10,000 years old. The youngest substrate of the Park is a flow 1,000-3,000 years old, originating from Hualālai's northwest rift; this is the sparsely vegetated 'a'ā flow in the center of the Park. Past soil surveys at reconnaissance level recognized 'a'ā lava flows, pāhoehoe lava flows, beaches, and an extremely rocky peat soil (Punalu'u Series); the peat soil was mapped in an area northeast of Kaloko Pond (Sato et al. 1973). Canfield (1990) pointed out several inconsistencies in soil survey maps, including the absence of extremely rocky peat northeast of Kaloko Pond and the presence of unacknowledged organic muck soils in marshes near Park fishponds.

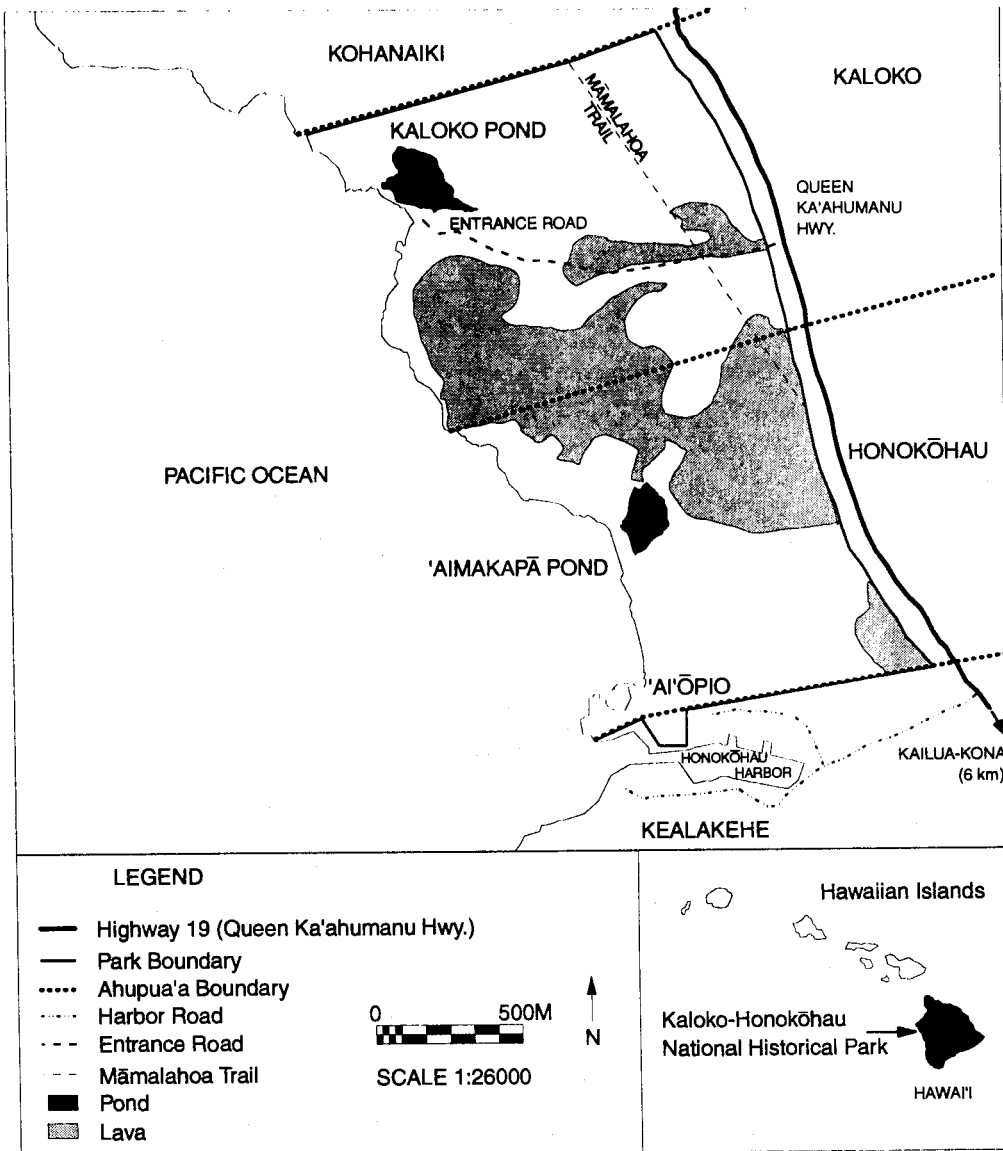


Figure 1. Prominent features of Kaloko-Honokōhau National Historical Park and surrounding land divisions, island of Hawai'i.

Vegetation and Past Land Use - Kaloko-Honokōhau NHP, like most lowland regions of the Hawaiian Islands, is dominated by alien (non-native) plants. While most of the plants present in the Park today have been introduced since 1778, the loss or alteration of original vegetation cover occurred many centuries ago during Hawaiian habitation. The many cultural and archeological sites within the Park are evidence of its past use by Hawaiians. While much of the coast of the Park was not suitable for agriculture (National Park Service 1992), clearing for settlement, use of trees for building and firewood, and burning for clearing or grass stimulation were ways in which Hawaiians altered original vegetation of inhabited areas (Cuddihy and Stone 1990). Kelly (1983) detailed the zones of Hawaiian agriculture in Kona; where soil was sufficient, the dry coastal zone was used to cultivate 'uala or sweet potato (*Ipomoea batatas*) and wauke (*Broussonetia papyrifera*). Kirch (1982) summarized the impacts of Hawaiians on the lowlands in which they lived; fire was the primary tool by which Hawaiians converted dry and moist lowland forest vegetation to anthropogenic grasslands.

Canfield (1990) speculated that vegetation was more open in appearance during the prehistoric period of Hawaiian habitation with a greater abundance of cultivated plants of Polynesian origin. As the Park supports alien-dominated forests and shrublands today, it is likely that forest and open woodland were the original pre-human vegetation cover (in addition to the still present wetland and coastal vegetation). Canfield listed a number of likely and potential species in the original pre-Hawaiian vegetation, including 'ōhi'a (*Metrosideros polymorpha*), 'iliahi or sandalwood (*Santalum* sp.), loulu (*Pritchardia* sp.), wiliwili (*Erythrina sandwicensis*), 'ohe makai (*Reynoldsia sandwicensis*), and pūkiawe (*Styphelia tameiameiae*). To this list could be added several species currently growing in an open 'ōhi'a forest on 'a'ā upslope of both the Park and the Kaloko Industrial area: lama (*Diospyros sandwicensis*), kolomona (*Senna gaudichaudii*), and halapepe (*Pleomele hawaiiensis*).

## METHODS

To provide a framework for the collection of data on plants (as well as on birds, mammals, and invertebrates) nine transects were placed systematically crossing the Park from the Queen Ka'ahumanu Highway to the coast. The first transect followed the northern Park boundary. Transects 2-4 were placed at 450-m intervals from Transect 1, measured along the Māmalahoa Trail. To ensure that all vegetation types mapped by Canfield (1990) were sampled, subsequent transects (4A, 5, 5A, and 6) were located 225 m apart, measured along the highway near the Park's upslope boundary. Transect 7 followed the southern boundary of the Park with Honokōhau Harbor lands. All transects (except Transect 7 on the southern boundary) followed an azimuth of 258° true. Transects were marked in 10-m intervals.

The botanical component of this survey was carried out between May 1992 and May 1993. Several additional visits were made to the Park in 1994 and 1995.

Approximately 15 days were spent on the systematic field survey. Botanical data collected along transects included distribution, frequency of occurrence, and estimated cover or number of individuals of 11 common or invasive alien plant species in continuous 10- x 10-m segments of the belt transects. Cover of nine of these species was estimated using the Braun-Blanquet cover abundance scale (Mueller-Dombois and Ellenberg 1974); two other less common alien species were counted along transects and in other surveyed areas. For mapping purposes, cover values of alien species were averaged over 100-m-long transect increments. Frequency of occurrence of these 11 alien species was determined along each transect; this was the percentage of transect segments in which the species occurred. Three other rarely-occurring alien species with invasive potential were also mapped on or near transects: silver or silk oak (Grevillea robusta), Asiatic butterfly bush (Buddleia asiatica), and autograph tree (Clusia rosea).

In order to characterize current vegetation and compare with past vegetation mapping, the presence and estimated cover/abundance of all plant species were recorded in 10-m x 20-m plots at 100-m intervals along transects (starting at 0) (Fig. 2). These systematic vegetation plots also facilitated the compilation of an updated vascular plant checklist.

Thirty-five native plant species and Polynesian introductions were counted or observed in 10-m x 10-m segments of the transects. For mapping purposes, native plant numbers (by species) were summed over 100-m increments of the transect. Native plant densities (mean number per 1,000 m<sup>2</sup>) were calculated for each transect and for the entire Park. Some species of sedges, grasses, and mat-forming herbs could not be individually counted; concentrations of these plants were mapped. Native plant individuals sighted off (but near) transect were recorded and mapped, except for those abundant species, such as 'uhaloa (Waltheria indica) and 'ilima (Sida fallax).

Additionally, major trails, roads, pond boundaries, and the coastline were searched for native plants. Countable species were recorded in 100-m increments (either measured or paced) along the Māmalahoa Trail, the unpaved entrance road from the Queen Ka'ahumanu Highway to Kaloko Pond, the periphery of Kaloko Pond, the eastern edge of 'Aimakapā Pond north of Transect 5, and the coastline and coastal road/trail from the northern Park boundary to a point near Transect 5A south of 'Aimakapā Pond. The perimeter of 'Aimakapā Pond could not be completely surveyed because of the depth of water in marsh vegetation and the presence of nesting endangered water birds (the black-necked stilt, Himantopus mexicanus knudseni, and Hawaiian coot, Fulica americana alai). The coast and coastal forest near permittee dwellings in the 'Ai'ōpio area were not systematically surveyed, although a few casual observations were included on native plant maps. Native species sighted off transects or on trails, coastline, or ponds were not included in density calculations.

A checklist was compiled of all vascular species seen within the Park in 1992-95 (Appendix 1). Voucher specimens were made of those species not listed by Canfield

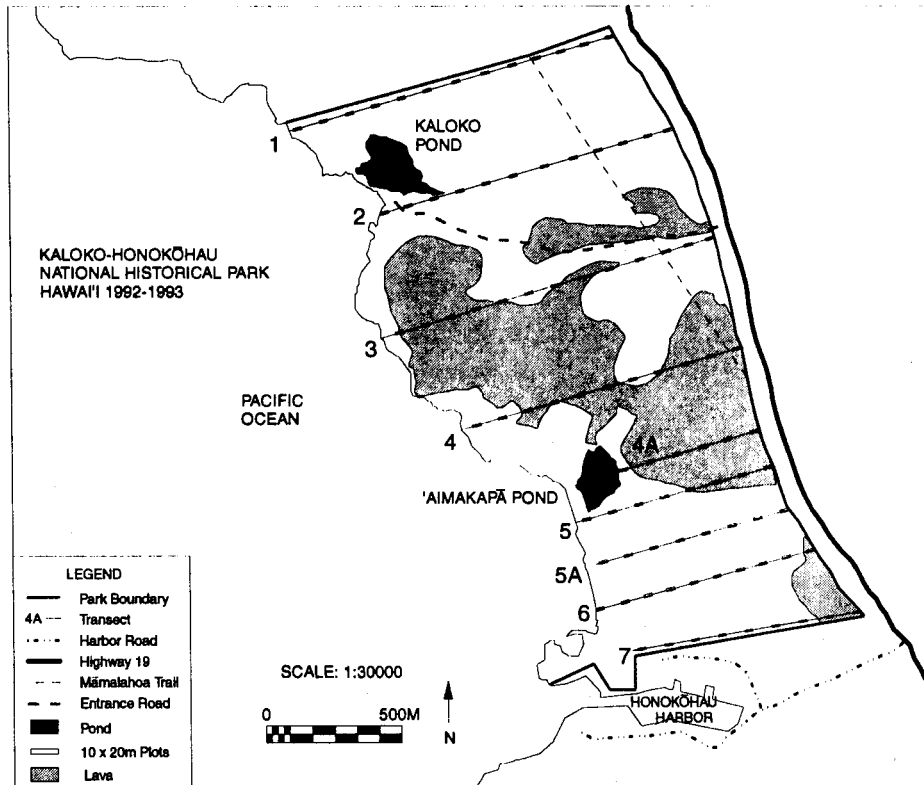


Figure 2. Location of 10 x 20 m plots used to describe vegetation at 100-m intervals along nine transects in Kaloko-Honokōhau National Historical Park.

(1990) and of other plants when needed for identification. Vouchers are lacking for a few uncommon species that could not be relocated and for those ornamentals obviously planted near permittee dwellings. Specimens were deposited at Hawaii Volcanoes National Park Herbarium; they may be transferred to Kaloko-Honokōhau NHP if an herbarium is developed there.

## RESULTS AND DISCUSSION

### Plant Species Composition

One hundred eleven (116) vascular plant species were found within the current boundaries of Kaloko-Honokōhau NHP in 1992-95. Of this total, five (4%) were endemic, 27 (23%) were indigenous, four (3%) were Polynesian introductions, and 80 (69%) were alien (See Appendix 1 for a vascular plant checklist). Only three fern species were seen within the Park, and two of these were aliens. Most (86) of the flowering plant species were dicotyledons; the sunflower and pea families (Asteraceae and Fabaceae) were particularly well represented. The remaining flowering plants (27) were monocotyledons, primarily grasses (Poaceae) and sedges (Cyperaceae).

By contrast, Canfield (1990) found 72 vascular plant species at Kaloko-Honokohau in June 1987 (as well as two lichen species); of this total 39% were either endemic or indigenous, 7% were Polynesian introductions, and 54% were alien species. Her survey included two areas within authorized Park boundaries that were not acquired by the Park Service and were not surveyed in 1992-93: the coastlines south of Honokōhau Harbor to Noio Point and north of Kaloko Pond to Wawahiwa'a Point in Kohanaiki ahupua'a. Seven species on Canfield's checklist were found only in areas not currently within Park boundaries.

Additions to the Park's Flora - There are 56 additions to the Park's known flora from the 1992-93 survey and 1994-95 visits; these are mostly alien species (46), but nine indigenous and one endemic species were also added to the vascular plant checklist of Kaloko-Honokōhau. Among the native plant additions to the checklist are 'a'ali'i (*Dodonaea viscosa*), hau (*Hibiscus tiliaceus*) and pili (*Heteropogon contortus*). 'A'ali'i and pili were found in few sites away from roads and trails. The omission of hau from Canfield's 1990 list may be explained by changes in visibility due to management activities. The largest stand of hau is found near the beach, just north of 'Aimakapā Pond; this hau was likely screened from view by mangrove (*Rhizophora mangle*) thickets that have been removed during the last six years.

Some of the alien species seen in 1992-93 but not recorded in the 1987 survey may be recent invaders in the Park. Species such as ivy gourd (*Coccinia grandis*) and molasses grass (*Melinis minutiflora*), with a few individuals in limited areas, may represent incipient invasions. Others, such as silk or silver oak (*Grevillea robusta*), were

probably present in 1987, but occurred in low numbers in localities away from trails and boundaries. A few of the recent additions are ephemeral species, which may have been unrecognizable during dry periods; examples of such seasonal species are Spanish needle (*Bidens pilosa*) and West Indian beggar's tick (*B. cynapiifolia*). Several ornamental species appeared to have been recently planted at 'Ai'ōpio Heiau. These plants were not introduced by Park personnel but may have been planted by permittees living nearby.

Species Not Found in the Park in 1992-93 - Five plant species noted on the 1987 survey were not seen in 1992-93 despite the systematic sampling approach and inclusion of several seasons in the sampling period. The only alien species not resighted was chandelier plant (*Kalanchoe tubiflora*), an herb seen north of Honokōhau Harbor by Canfield (1990). More troubling are the omissions of two endemic and two indigenous species from the current survey. If these native plant species are no longer in the Park, it is important to document the loss.

Canfield (1990) reported the endemic grass *Panicum faurei* var. *latius* (then known as *P. nubigenum*) from "barren 'a'ā near Queens's Bath"; her survey was done in June. The area near this anchialine pool, also known as Kahinahina'ula, was searched unsuccessfully for the grass three times during the current survey (October, April, and June). *Panicum fauriei* var. *latius* is an annual and may have disappeared from the Park in the last five years. Alternatively, the grass may eventually re-establish itself from existing seeds; the best time of year to search for this annual would be early in the rainy season.

'Ae (*Polypodium pellucidum*), an endemic fern, was not seen during the 1992-93 survey, even though the area where Canfield found it ("sparsely vegetated fountaingrass grassland upland in central Kaloko ahupua'a") was covered by Transect 2, the Māmalahoa Trail, and the road to Kaloko Pond. Scaly swordfern (*Nephrolepis multiflora*), an alien species that was not noted in Canfield's 1987 survey, was seen growing on lava outcroppings in central Kaloko in 1992-93.

Hinahina (*Heliotropium anomalum* var. *argenteum*) was found by Canfield on the beach halfway between Wawahiwa'a Point and Kohanaiki-Kaloko boundary and in strand forest at the Kaloko-Honokohau boundary. The first locality is outside the current Park boundaries to the north, and was not surveyed in 1992-93. The second locality, described by Canfield as a sandy opening in milo forest, was walked during our coastline survey, but hinahina was not seen. The coastal forest near the Kaloko-Honokohau boundary should be searched during future surveys to establish the status of this indigenous plant in the Park. A related plant, kīpūkai or nena (*H. curassavicum*), was found in the Park in both 1987 and 1992-93.

The indigenous sedge *Fimbristylis dichotoma* was listed by Canfield as "widespread in all ahupua'a at Kaloko, usually where cover is sparse along coast." This describes the current distribution of the indigenous sedge ma'u 'aki'aki or *Fimbristylis*



cymosa. Fimbristylis cymosa is a relatively common plant of rocky shorelines, and F. dichotoma is more typically found in moist to wet vegetation away from the coast. Fimbristylis dichotoma may have been growing mixed with F. cymosa, but was not seen in 1992-93.

Because of the difference in the number of vascular plant species reported from Kaloko-Honokōhau NHP in 1987 and 1993 and the addition of so many alien species, it is possible that the flora of this lowland region is subject to relatively rapid change and frequent new introductions of alien plants. It also appears that a systematic botanical survey is more likely to encounter uncommon alien species than is a search of developed sites. Future botanical surveys to help Park staff evaluate biological resources and potential problem plants would be most effective if designed as a combination of systematic survey and a search of areas likely to harbor native plants (beaches, coastlines, pond margins) and newly introduced aliens (roadsides, trails, parking areas).

### Alien Plants

Eighty alien plant species were found within Kaloko-Honokōhau NHP in this survey. Of these, 11 species (discussed below) seemed to be particularly invasive and likely to have a serious negative impact on Park vegetation. Most of these pest species were discussed as noxious weeds by Canfield (1990), but are (with the exception of ivy gourd and fountain grass) not currently listed as noxious by the Hawaii State Department of Agriculture (1991).

Klu (Acacia farnesiana) - This shrub, native to the Neotropics, was introduced to Hawai'i before 1864. It is now distributed in dry lowland areas on all the main islands except Ni'ihau and Lāna'i (Wagner et al. 1990). A member of the pea family (Fabaceae), this plant is notable for its fragrant, bright yellow, globose heads of tiny flowers. These flowers were used in the past to make perfume, but the industry was not successful in Hawai'i. The foliage of the species is much like kiawe, composed of compound leaves with many tiny leaflets. Long spines are prominent at the bases of leaves. Fruits are thick, brown pods about 5 cm (2 in) long. This species has been considered noxious because of its spinness and propensity to displace more palatable plants in pastures.

Klu was found on all but two transects in Kaloko-Honokōhau NHP, but was most abundant in the northern half of the Park. Frequency of occurrence of klu was highest on Transects 1 and 2 (75-81%), and about 30% on Transects 5A and 7 near the Honokōhau Harbor boundary (Fig. 3). The greatest cover of klu was found northeast of Kaloko Pond, where the shrub made up 25-50% of the plant cover (Fig. 4). Elsewhere in the northern half of the Park, klu was typically 1-25% of the plant cover. Klu was very sparse on lava flows, and was not prominent near 'Aimakapā Pond. In the southern part of the Park, klu composed approximately 1-5% of the cover in shrublands on pāhoehoe.

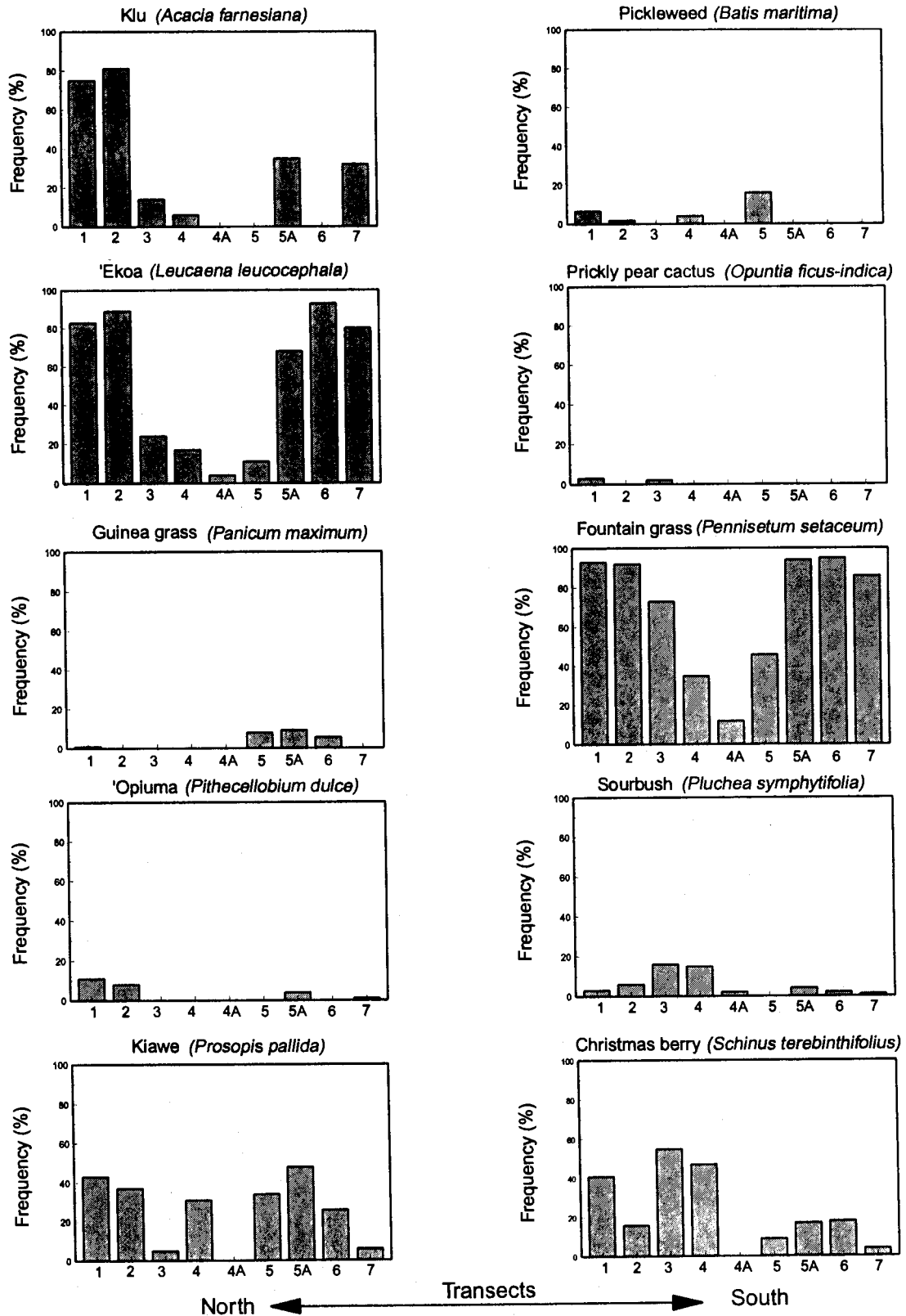


Figure 3. Frequency of occurrence of ten alien plants along continuous belt transects in Kaloko-Honokōhau National Historical Park (% of total transect segments in which species was present).

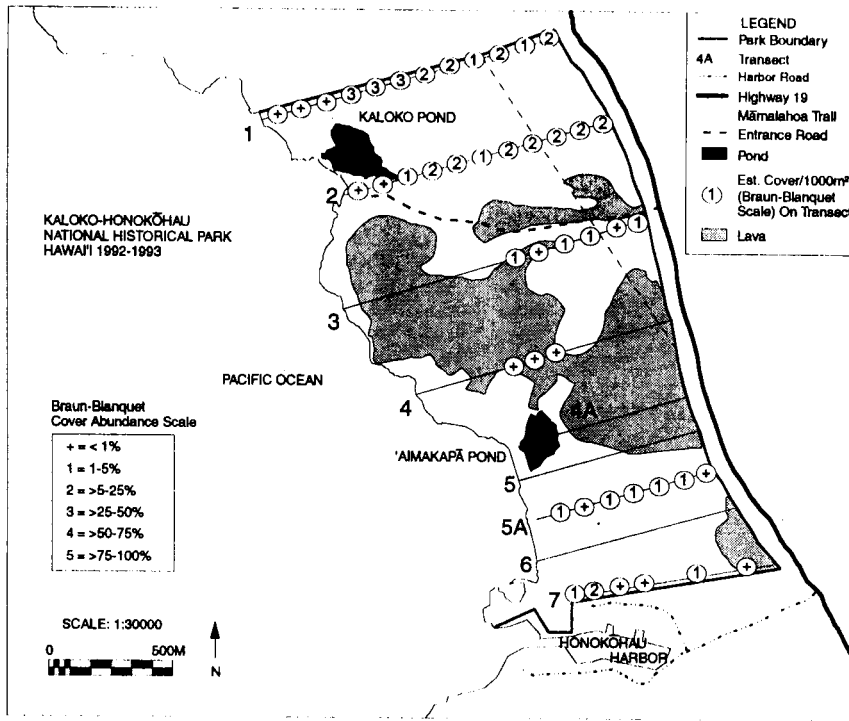


Figure 4. Estimated cover of klu (*Acacia farnesiana*) on transects in Kaloko-Honokōhau National Historical Park.

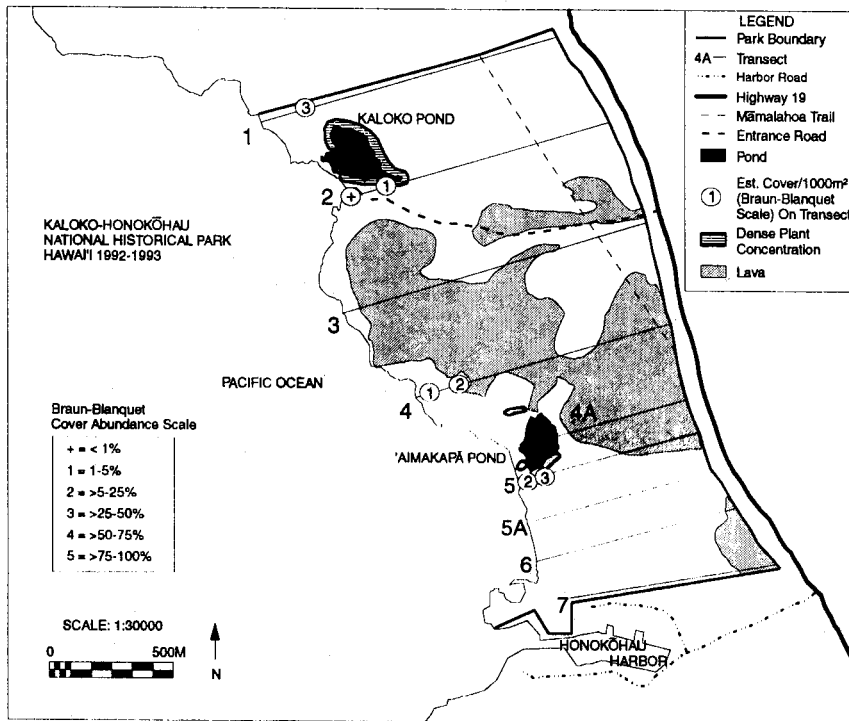


Figure 5. Estimated cover of pickleweed (*Batis maritima*) on transects and dense plant concentrations sighted off transect in Kaloko-Honokōhau National Historical Park.

Pickleweed (*Batis maritima*) - A sprawling succulent shrub, pickleweed is highly tolerant of salt water and is typically seen on sea shores and the margins of brackish ponds. It is sometimes called 'ākulikuli kai, although it is not related to the native 'ākulikuli (*Sesuvium portulacastrum*). Pickleweed was first noted in Hawai'i in 1859, near Honolulu (Wagner et al. 1990). The plant is now found on coasts of all the main islands. Spikes of small, yellow-green flowers are borne in the axils of narrow, fleshy leaves. This alien spreads easily because of its buoyant small fruits.

Pickleweed was found on transects in only a few areas near Kaloko and 'Aimakapā Ponds and near the ocean (Fig. 5). Only near the two large ponds was the cover of pickleweed estimated as >25% of the belt transect segments. Frequency of pickleweed on transects was very low; highest frequency of occurrence was 16% of transect segments on Transect 5, just south of 'Aimakapā Pond (Fig. 3). However, the survey of pond perimeters found a dense concentration of pickleweed encircling Kaloko Pond and at least two large patches of the succulent plant on the south shore of 'Aimakapā Pond and on the edge of marsh vegetation to the north.

Ivy gourd (*Coccinia grandis*) - A vine or climbing herb in the gourd family (Cucurbitaceae), ivy gourd is native to Africa, Asia, and Australia (Wagner et al. 1990). In Asia the young fruits and shoot tips are eaten (Linney 1986). Linney (1986) reported that ivy gourd was introduced to O'ahu in 1969 as an ornamental and was first collected as a naturalized plant from Kailua, O'ahu in 1985. Currently, ivy gourd is found on O'ahu and Hawai'i, particularly near Kailua-Kona, where it was first noted in 1986 (Linney 1986). In 1989, ivy gourd was found in the Kona Acres and Kona Palisades subdivisions, six miles upslope of Kailua-Kona (Linney 1989). Although the plant has a rank growth habit and smothers trees and shrubs into which it climbs, its bell-shaped, white flowers and small, red, berry-like fruits are considered attractive and ornamental.

Ivy gourd was not known from Kaloko-Honokōhau NHP until the 1992-93 survey, when seven plants were seen in the Park: one north of Kaloko Pond and six in the forest to the north, south, and east of 'Aimakapā Pond (Fig. 6). Only one of these plants was actually on a transect (Transect 1); this plant was estimated to have 1-5% cover in one transect segment. Most of the ivy gourd plants were found during a search of vegetation surrounding 'Aimakapā Pond, where the vines were growing in full to partial sunlight in areas recently cleared of kiawe. In 1992-93 plants were small and the cover of the individual vines was minimal. During a revisit to 'Aimakapā Pond in June 1994, an additional three ivy gourd vines were found on the pond's southern perimeter, where kiawe trees had been cut. Small ivy gourd plants were uprooted at time of discovery during this survey, and the localities of other large vines were reported to Park staff. A recent invader in the Park, ivy gourd is a serious pest and should be immediately eradicated from Kaloko-Honokōhau NHP, while removal is still possible.

Prickly pear cactus (*Opuntia ficus-indica*) - Native to Mexico, the prickly pear cactus or pānini was probably brought to Hawai'i before 1809 by Don Francisco Paul de Marin, an early foreign resident of O'ahu, who introduced numerous fruit trees and other cultivated plants (Wagner et al. 1990, Nagata 1985). The cactus escaped cultivation and

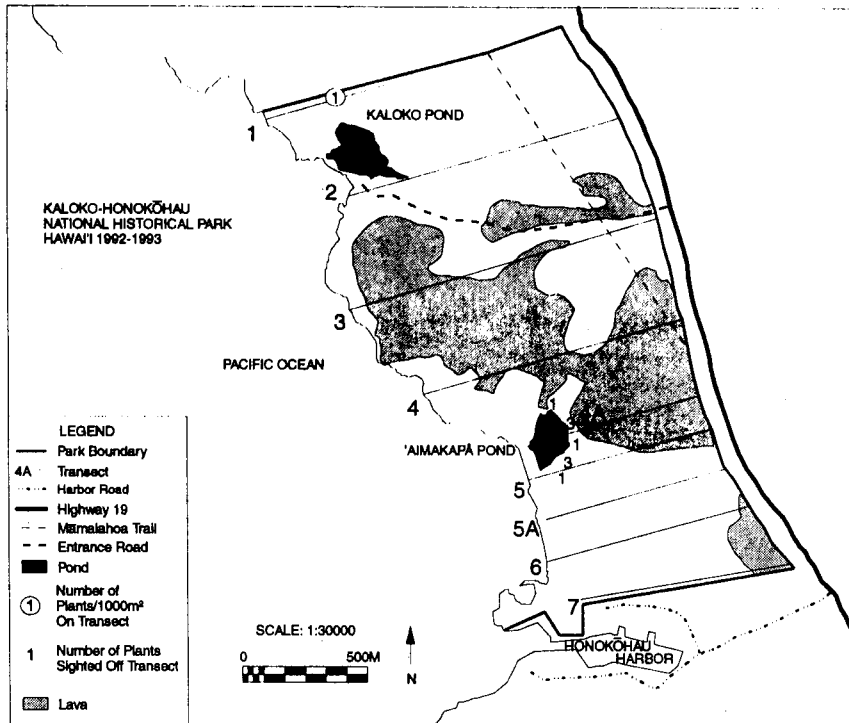


Figure 6. Number of ivy gourd (*Coccoloba grandis*) plants found on or near transects in Kaloko-Honokōhau National Historical Park.

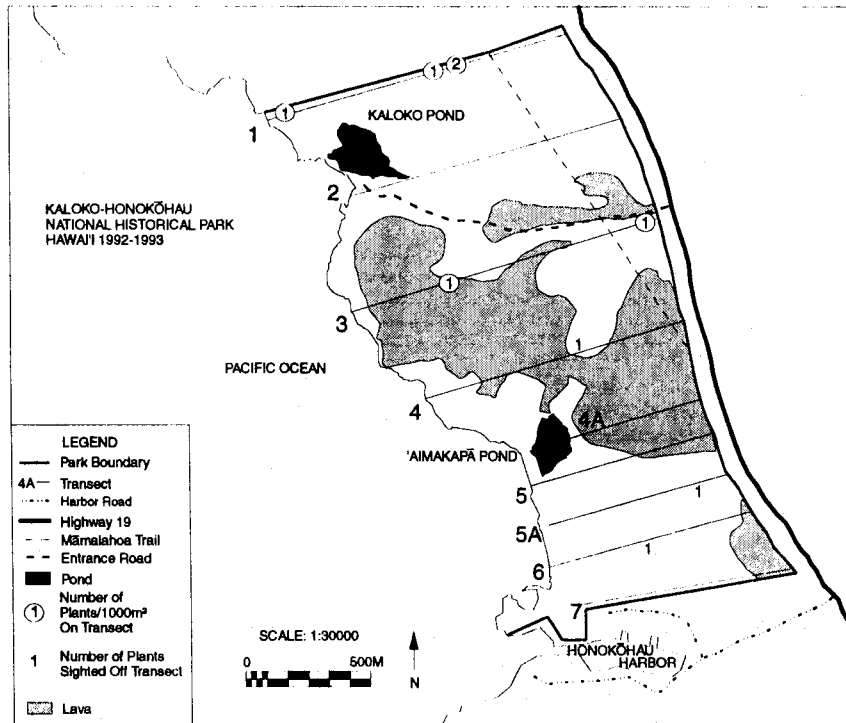


Figure 7. Number of prickly pear cactus (*Opuntia ficus-indica*) plants found on or near transects in Kaloko-Honokōhau National Historical Park.

is now naturalized in dry areas on five of the main Hawaiian Islands. Large and shrubby, prickly pear cactus is composed of many flat, succulent, green pads, that may be spiny or spineless.

Prickly pear cactus flowers are large and showy with yellow to orange petals. Cactus fruits are fleshy and edible; the color of ripe fruit varies with the strain, but is usually yellow or reddish-purple. Prickly pear cactus of Kaloko-Honokōhau have spiny pads, but the color of the fruits is unknown.

Prickly pear cactus was found in low numbers on or near five transects and the unpaved road to Kaloko Pond (Fig. 7). Frequency of occurrence along transects was extremely low (Fig. 3). Ten individuals were seen among alien shrubs and grasses on pāhoehoe substrates. Because prickly pear cactus grew as distinct individuals, numbers of plants rather than cover were mapped. Estimated cover of cactus did not exceed 1% in any transect segment. In the 1987 survey, Canfield (1990) found only one individual cactus planted south of Honokōhau Harbor. Cactus plants seen in 1992-93 were large and probably many years old; the greater number of plants observed probably reflects differences in survey techniques rather than an increasing cactus population.

Ēkoa (*Leucaena leucocephala*) - A large shrub or small tree in the pea Family, ēkoa or koa haole was an early historical introduction to the Hawaiian Islands, where it was first collected in 1837 (Wagner et al. 1990). Native to the Neotropics, ēkoa has been used as cattle fodder and was planted by foresters and agriculturists for erosion control and soil enrichment (it is a nitrogen-fixer). The shrub is now distributed on all the main Hawaiian Islands, and is particularly abundant in dry to moist lowland regions. Ēkoa has dark-green, feathery foliage composed of bipinnately compound leaves. Flowers are tiny, arranged in white, globose clusters; fruits are flattened pods or legumes, green when young and brown when mature.

Ēkoa was the most abundant woody plant species in Kaloko-Honokōhau NHP. The shrub was found on every transect in 1992-93, but was more common in the northern and southern extremes of the Park (Fig. 8). Cover values along Transects 1 and 2 were typically 25-50%. Transects south of 'Aimakapā Pond averaged 5-25% cover of ēkoa, but cover >25% was noted in the upslope central region of Honokōhau. Lava flows of the central portion of the Park had very little cover of ēkoa; the shrub was restricted mainly to flow edges. The shrub was also a component of the coastal forest near Honokōhau Harbor and was present in the understory of kiawe (*Prosopis pallida*) forest near Kaloko and 'Aimakapā Ponds. Canfield (1990) reported that ēkoa was "generally uncommon but widespread." This disparity may indicate that ēkoa has intensified in the past few years. The frequency of occurrence of ēkoa was very high on five of the transects in 1992-93, exceeding 68% on transects 1, 2, 5A, 6, and 7 (Fig. 3). Transects 3-5 had an ēkoa frequency of 24% or less.

Fountain grass (*Pennisetum setaceum*) - A large bunchgrass native to northern Africa, fountain grass was introduced to Hawai'i in the early 1900s for use as an

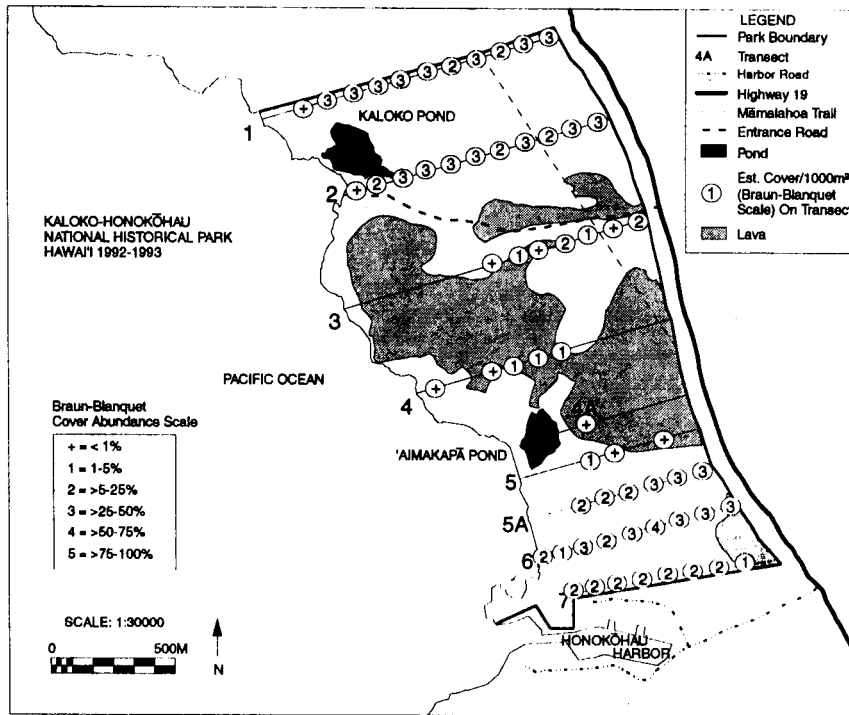


Figure 8. Estimated cover of ākoa (*Leucaena leucocephala*) on transects in Kaloko-Honokōhau National Historical Park.

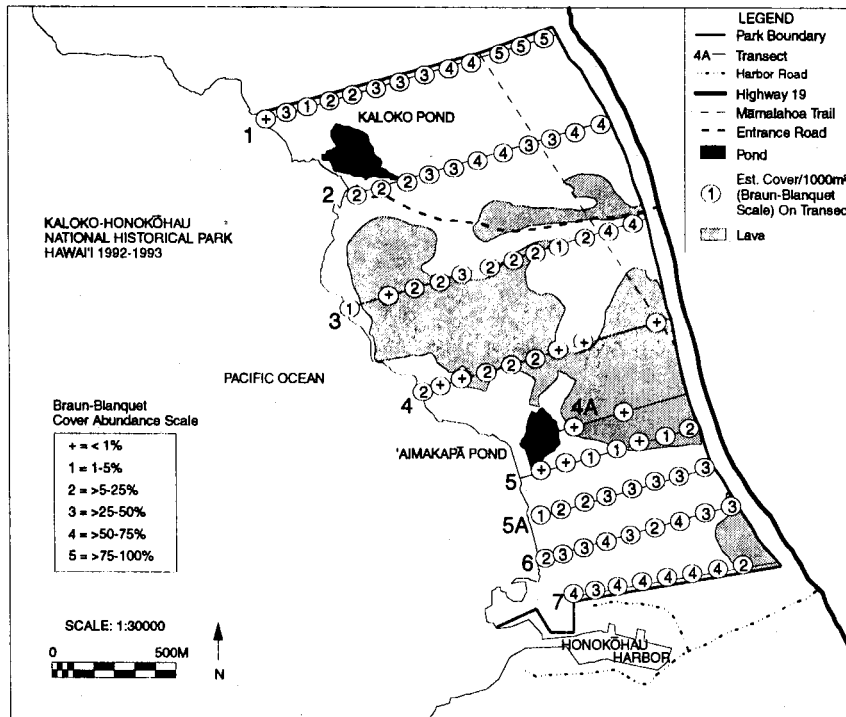


Figure 9. Estimated cover of fountain grass (*Pennisetum setaceum*) on transects in Kaloko-Honokōhau National Historical Park.

ornamental. It quickly spread and is now established on the islands of Hawai'i, Lāna'i, O'ahu, and Kaua'i (Wagner et al. 1990). Additionally, there are small populations on Maui that the State Department of Agriculture is attempting to control (Loope et al. 1992). A large, clump-forming grass with narrow, rolled leaves, fountain grass bears tall spikes of feathery, pink flowers. An invader of dry habitats and lava flows from sea level to 7,000 ft elevation, fire-adapted fountain grass has formed a layer of fine fuels and altered the natural fire regimes of many dry forests and shrublands on the island of Hawai'i (Cuddihy and Stone 1990).

Fountain grass was the most abundant grass in Kaloko-Honokōhau NHP. In the 1992-93 survey, the species was found on every transect in every vegetation type except marshland. Estimated cover on transects ranged from >75% on upper Transect 1 in the northeastern corner of the Park to <1 % on nearly barren lava flows (Fig. 9). The grass was most abundant in alien shrublands on pāhoehoe substrates in the northern and southern extremes of the Park. Fountain grass had less cover (ranging from <1% to 5-25%) in the kiawe forests near Kaloko and 'Aimakapā Ponds and the coastal forest near 'Ai'ōpio and Honokōhau Harbor. Coastal strand communities and 'a'ā lava flows had a very sparse cover of fountain grass. The species was essentially absent from the wetland communities near 'Aimakapā Pond. Bulldozed lava flows near the highway supported scattered fountain grass; the grass readily invades disturbed areas. The frequency of occurrence of fountain grass overall in the Park was 74%. Fountain grass frequency was >85% on Transects 1, 2, 5A, 6, and 7, and was only 12% on Transect 4A that crossed the 'a'ā flow in the center of the Park (Fig. 3). Canfield (1990) also considered fountain grass to be the dominant herb in all inland habitats of Kaloko-Honokōhau.

'Opiuma (Pithecellobium dulce) - 'Opiuma or Manila tamarind is native to tropical America, and was introduced to Hawai'i around 1870, probably for use as an ornamental tree. It is now established in dry areas at low elevation on all the main islands except Lāna'i and Kaho'olawe (Wagner et al. 1990). A member of the pea family, 'opiuma is a medium-sized tree with compound leaves; small, round clusters of white to yellow flowers; and reddish, twisted pods, which open to reveal shiny, black seeds embedded in white flesh.

'Opiuma was sparingly distributed on four transects in the northern (Transects 1 and 2) and southern (Transects 5A and 7) extremes of the Park (Fig. 10). Estimated cover did not exceed 1-5% in any transect segment. The frequency of occurrence of 'opiuma was low overall (3%) and was highest on Transects 1 and 2 (11% and 8%) (Fig. 3). Canfield (1990) rated this species as rare in the Park.

Sourbush (Pluchea symphytifolia) - An accidental introduction to Hawai'i first noticed in 1931, sourbush is native to tropical America (Hosaka and Thistle 1954). Sourbush spread rapidly after its introduction, and within 30 years had invaded approximately 50,000 acres (Clausen 1978). The shrub is now established in lowland and



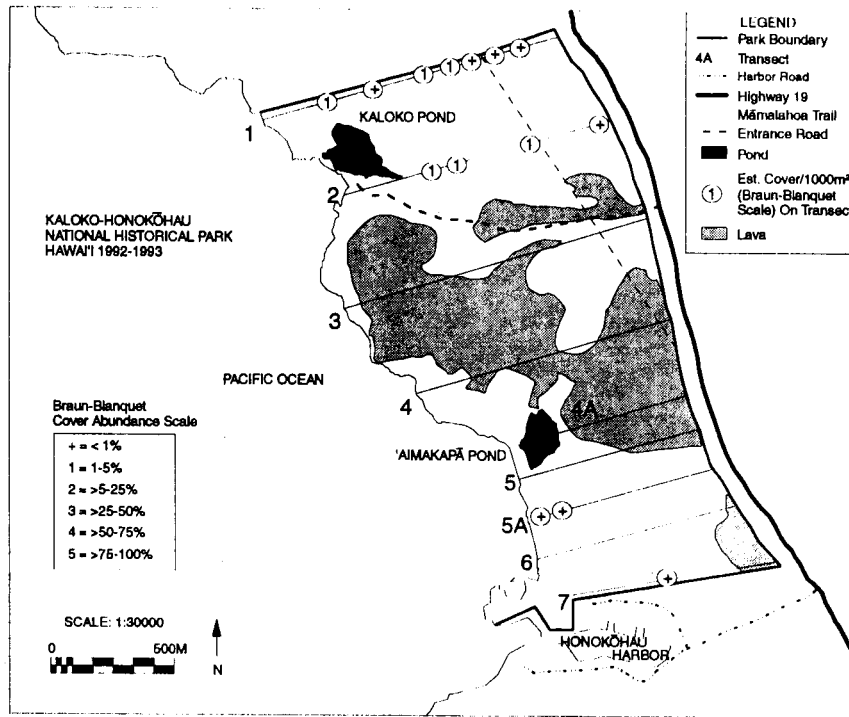


Figure 10. Estimated cover of 'opiuma (*Pithecellobium dulce*) on transects in Kaloko-Honokōhau National Historical Park.

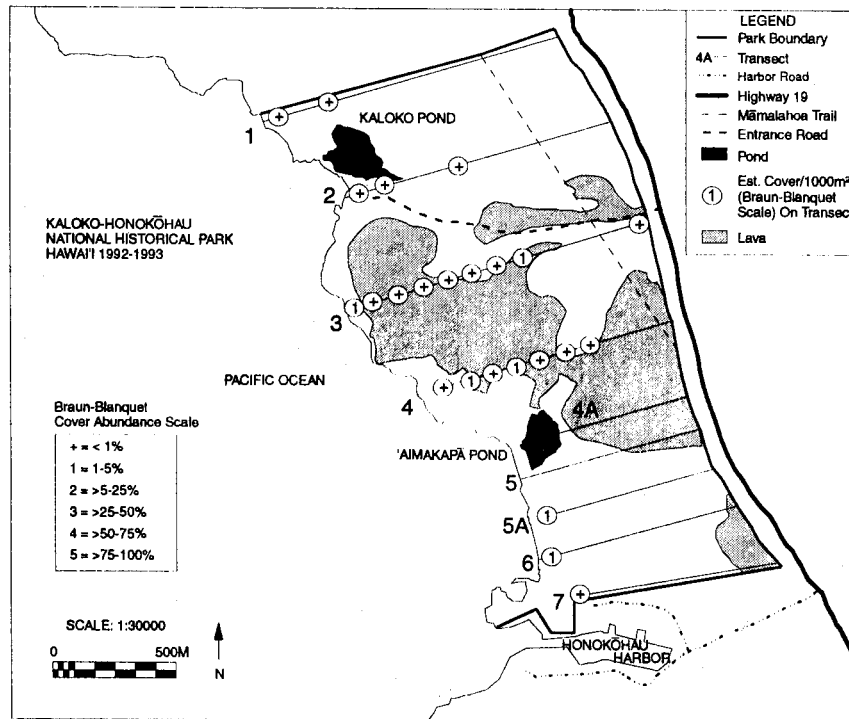


Figure 11. Estimated cover of sourbush (*Pluchea symphytifolia*) on transects in Kaloko-Honokōhau National Historical Park.

coastal regions of all the main Hawaiian Islands. Fast growing and capable of forming dense thickets (Smith 1985), sourbush is particularly threatening to anchialine pools, where its abundant leaf litter leads to increased eutrophication and early senescence of pools (Chai et al. 1989). A tall shrub with large hairy leaves, sourbush produces clusters of small, pale pink or lavender flower heads; flowers develop into tiny, white-plumed dry fruits that are widely dispersed by wind.

Sourbush was not widespread in Kaloko-Honokōhau NHP, but was found primarily on coastlines and 'a'ā flows. This shrub had <5% estimated cover where it occurred on transects (Fig. 11). The frequency of occurrence on transects was low, averaging 6% of segments (Fig. 3). Highest frequencies were encountered on Transects 3 and 4 (16% and 15%) that crossed large 'a'ā flows. Very few anchialine pools were encountered on transects, and it is in these sites that sourbush is likely to be most abundant and disruptive to natural resources. For example, sourbush and other shrubs are large and vigorous adjacent to Kahinahina'ula (Queen's Bath), where their leaves add litter to the pool. Canfield (1990) reported that sourbush was occasional and widespread; her appraisal was probably based on observations at the coast, where sourbush is most common.

Kiawe (*Prosopis pallida*) - Kiawe or mesquite was an early introduction to Hawai'i, arriving in 1828, when one tree was planted on the grounds of the Catholic mission in Honolulu (Wagner et al. 1990). Native to South America, kiawe is now naturalized in several tropical countries. It is abundant at dry, low elevation sites on all the main Hawaiian Islands, where it sometimes forms the dominant vegetation. Although useful for cattle feed, the tree shades out native vegetation and is capable of tapping into and drying out an area's ground water table (Smith 1985). A tall, thorny, deciduous tree, kiawe has pinnately compound leaves, small spikes of yellow-green flowers, and yellowish inflated pods.

Kiawe was the most abundant and widely distributed tree in Kaloko-Honokōhau NHP. Trees were found on all transects except Transect 4, but were concentrated on the pāhoehoe substrates in the northern and southern reaches of the Park. Estimated cover of kiawe was highest near Kaloko Pond and the coastal area between 'Aimakapā and 'Ai'ōpio (Fig. 12). In the coastal and pond perimeter forests, kiawe cover reached >75% but was typically 25-50% where mixed with other trees or shrubs. In the alien shrublands upslope from the coast, kiawe cover was much lower, (<1-5%). Kiawe was not a component of 'a'ā lava flow vegetation, except on flow edges. Frequency of occurrence of kiawe on transects ranged from 0 to 48% (the latter on Transect 5A), but was 27% for the Park overall (Fig. 3). Canfield (1990) also found kiawe to be common and widespread and the dominant tree of inland forests. She also reported kiawe as the dominant plant in savanna vegetation northeast of Kaloko Pond; in the current survey kiawe was found to have <5% cover in this area (Fig. 12).

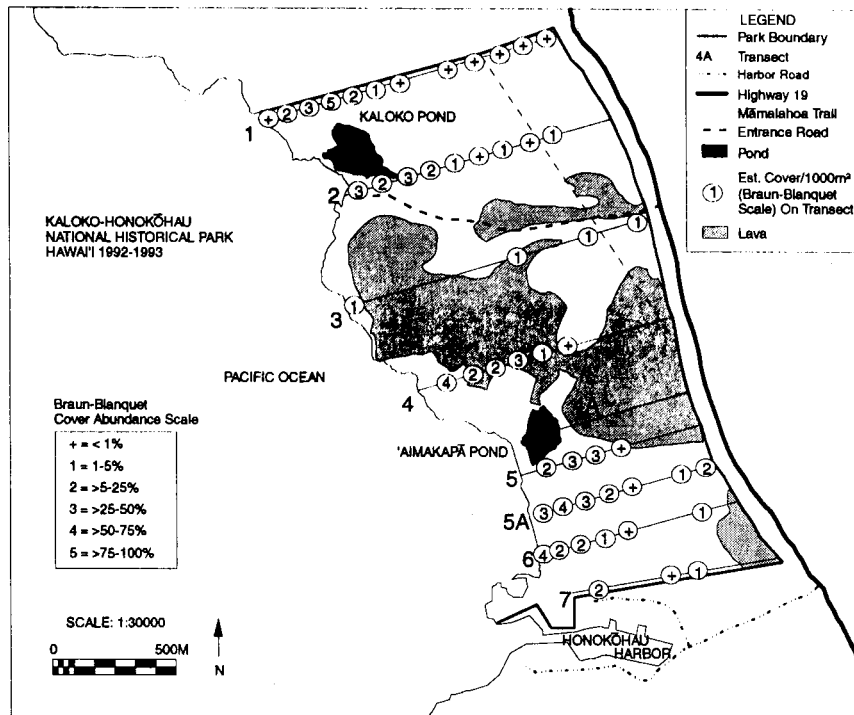


Figure 12. Estimated cover of kiawe (*Prosopis pallida*) on transects in Kaloko-Honokōhau National Historical Park.

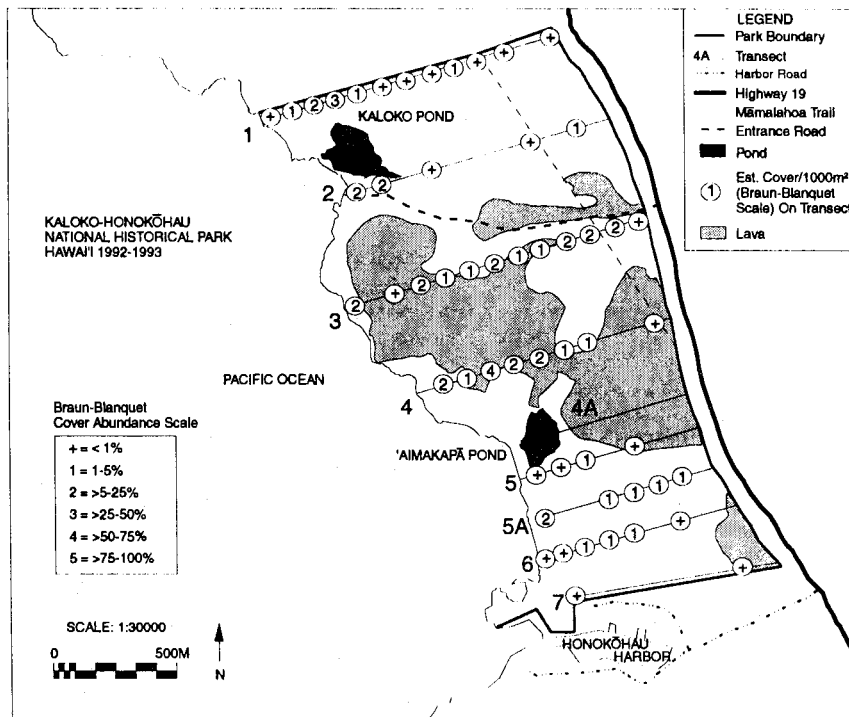


Figure 13. Estimated cover of Christmas berry (*Schinus terebinthifolius*) on transects in Kaloko-Honokōhau National Historical Park.

Christmas berry (*Schinus terebinthifolius*) - A shrub native to Brazil, Christmas berry was first collected on Hawai'i in 1911 (Wagner et al. 1990). It is now naturalized in lowland regions on all the main islands except Ni'ihau and Kaho'olawe. A member of the mango family, Christmas berry has shiny, dark green, strong-smelling foliage. Christmas berry flowers are small and white, borne in terminal clusters with male and female flowers on separate plants. Female flowers develop into round, red berry-like fruits. A tall shrub capable of forming dense thickets, Christmas berry may shade out other plants and chemically prevent them from re-establishing (Smith 1985).

Christmas berry was widespread in Kaloko-Honokōhau NHP, but generally had little vegetative cover in any plant community. The shrub was found on all but one transect (4), but its percentage cover was typically either <1% or 1-5% (Fig. 13). Christmas berry had its greatest cover north of Kaloko Pond and on the edge of the 'a'ā lava flow north of 'Aimakapā Pond; in the latter area the shrub exceeded >50% cover. The shrub was a component of most vegetation types in the Park, including sparsely vegetated lava flows. Only open marsh or wetlands were devoid of Christmas berry. Frequency of occurrence of Christmas berry was variable among the nine transects, ranging from 0 to 55% of transect segments (Fig. 3). The overall frequency of Christmas berry in the park was 24%. Canfield (1990) also rated Christmas berry as common and widespread, but she reported the species as a dominant of inland scrub. In the present survey, Christmasberry was found to be a relatively minor component (rarely exceeding 5% estimated cover) of most inland shrublands.

Guinea grass (*Panicum maximum*) - Native to Africa, Guinea grass was introduced to Hawai'i as cattle forage and had become naturalized before 1871 (Wagner et al. 1990). It is now common on all the main Hawaiian Islands. Capable of forming dense stands taller than 2 m, Guinea grass is drought-tolerant and produces allelopathic substances that may interfere with the reproduction of nearby plants (Smith 1985). In Kaloko-Honokōhau NHP, Guinea grass was found primarily south of 'Aimakapā Pond and in the coastal forest and shrublands east of 'Ai'ōpio (Fig. 14). In these localities, the grass had an average estimated cover of 5-25% or 1-5%. In a few transect segments, Guinea grass cover was 50-75%, but these dense patches were very localized. Guinea grass also occurred in low amounts at several scattered sites near Kaloko Pond, on the edge of the central 'a'ā flow, and on the coast. Frequency of Guinea grass occurrence along transects was relatively low (Fig. 3). Canfield (1990) did not observe this grass in Kaloko-Honokōhau in 1987.

Other Alien Plant Species - Several other alien plant species of Kaloko-Honokōhau NHP were formerly listed as noxious weeds or may be potential problems in the future. Silver or silk oak (*Grevillea robusta*), a tree from Australia, was introduced to Hawai'i for reforestation and ornamental purposes, and has now escaped and become established on most of the islands (Wagner et al. 1990, Little and Skolmen 1989). Only one individual tree was seen in Kaloko-Honokōhau NHP; this was midway between Kaloko

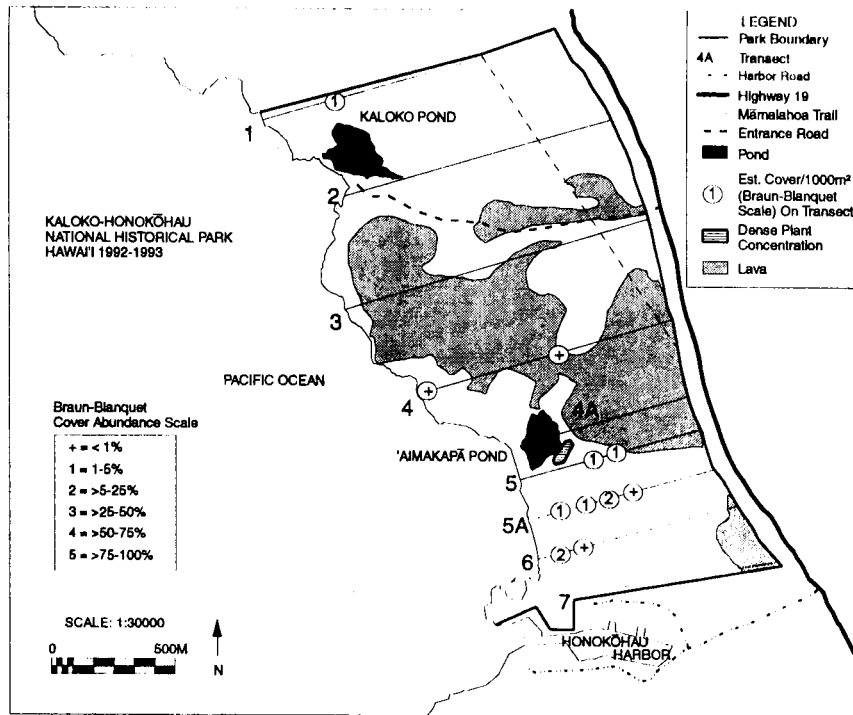


Figure 14. Estimated cover of Guinea grass (*Panicum maximum*) on transects and dense concentrations sighted off transect in Kaloko-Honokōhau National Historical Park.

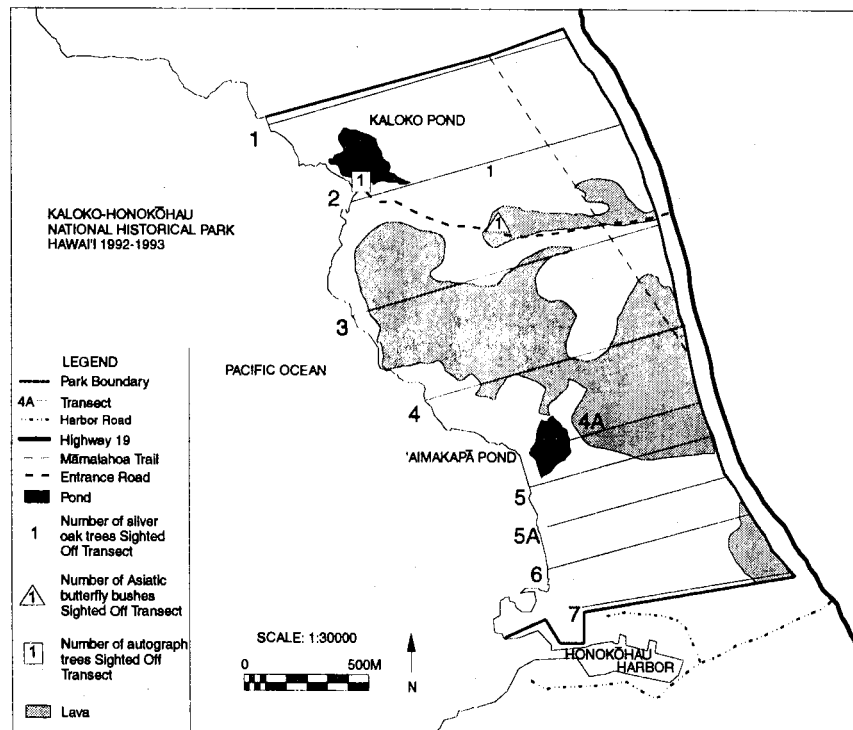


Figure 15. Number of silver oak (*Grevillea robusta*), Asiatic butterfly bush (*Buddleia asiatica*), and autograph trees (*Clusia rosea*) on or near transects in Kaloko-Honokōhau National Historical Park.

Pond and the Māmalahoa trail, just north of the unpaved road to Kaloko (Fig. 15). When sighted, the silver oak bore no flowers or fruits; the species may not yet be well established in Kaloko-Honokōhau, although it is more common at higher elevations on the slopes of Hualālai.

Asiatic butterfly bush or dogtail (Buddleia asiatica), native to Asia and the Mariana Islands, is naturalized in moist to wet lowland regions of four of the main Hawaiian Islands (Wagner et al. 1990). One butterfly bush was found on the side of the unpaved road to Kaloko Pond (Fig. 15). It would be prudent to remove this shrub before it spreads and becomes well established in the Park. Another woody alien seen in the Park as only one individual was the autograph tree (Clusia rosea). Native to the West Indies and Florida, this ornamental plant has escaped cultivation and spread at low elevations on Kaua'i, O'ahu, and Hawai'i (Wagner et al. 1990). The autograph tree was seen during the 1992-93 survey at the parking area terminating the jeep road to Kaloko Pond (Fig. 15). This plant may be the same individual noted by Canfield (1990) south of Kaloko Pond in 1987. After this survey, the autograph tree was removed from Kaloko by Park personnel.

Hairy honohono or dayflower (Commelina benghalensis) was considered to be noxious by Canfield (1990). This creeping herb with pale blue flowers is native to Asia and Africa and has become naturalized on four of the Hawaiian Islands (Wagner et al. 1990). In the 1992-93 survey, hairy honohono was found only in the southwestern corner of the Park near 'Ai'ōpio and the Honokōhau Harbor boundary, where the plant made up <1% of the ground cover in vegetation plots of the coastal kiawe forest (Transects 5A and 6). Canfield (1990) reported hairy honohono from northeast of Kaloko Pond; the herb was not seen in this area during the 1992-93 survey.

Indigo (Indigofera suffruticosa) is a shrub native to the New World tropics, but is widely naturalized throughout the tropics (Wagner 1990). First reported in Hawai'i in 1779, indigo may be either a Polynesian or an early historical introduction (St. John 1978). Indigo was infrequently seen in Kaloko-Honokōhau, east of Kaloko Pond and in the southern third of the Park, where its cover was never estimated as greater than 1% in vegetation plots.

Lantana (Lantana camara), a thorny shrub with malodorous, rough leaves and showy pink to orange flowers, is native to the West Indies, but is widely naturalized in the tropics and subtropics (Wagner et al. 1990). Very common in dry lowland regions on all the main islands, lantana is considered to be a serious weed in Hawai'i, where it forms dense stands, produces allelopathic substances, and displaces native shrubs and herbs (Smith 1985). Also a pest of pastures and rangelands (Hosaka and Thistle 1954), lantana was an early target of biocontrol efforts and has had more than 20 biocontrol agents introduced to combat its spread (Clausen 1978). Lantana was relatively common and widespread in Kaloko-Honokōhau, particularly in the northern half of the Park on Transects 1 and 2. The percentage cover of this shrub was low, estimated at <1% in most

of the plots in which it occurred. Canfield (1990) considered lantana to be uncommon but widespread in 1987.

American or red mangrove (Rhizophora mangle) was formerly a serious pest of wetlands in Kaloko-Honokōhau NHP, particularly near Kaloko Pond. Since 1988 active management has greatly reduced the cover of this thicket-forming, saltwater-tolerant tree. During this survey, live mangrove seedlings were noted only on Transect 2 on the southeastern edge of Kaloko Pond and near the seashore northeast of 'Aimakapā. Before control efforts were initiated, Canfield (1990) reported mangrove as the dominant tree on the border of ponds and occasional on the coastline.

Puncture vine (Tribulus terrestris), recently deleted from the State's noxious weed list (Hawaii Dept. of Agriculture 1991), was reported by Canfield (1990) from "sparsely vegetated coastal habitats" and from a jeep road south of Kaloko Point. In the present survey, the coastline and adjacent jeep roads were searched, but puncture vine was not observed. Instead, several individuals of the indigenous nohu (T. cistoides) were seen on the coastal road at Kaloko Point, as well as at one site on the Māmalahoa Trail. This related species is very similar to puncture vine, but it is a perennial with larger leaves and flowers. In 1995, one puncture vine was found and removed from the unpaved road to Kaloko Pond, near its junction with the Māmalahoa Trail. Puncture vine may have been intentionally removed from the Park, as it is a spiny weed. Canfield also noted puncture vine on beaches south of the entrance to Honokōhau Harbor, outside the current boundaries of the Park.

### Native Plants and Polynesian Introductions

Thirty-two native plant species were found in Kaloko-Honokōhau NHP during the 1992-93 survey; most of these (27) are indigenous species, native to Hawai'i and other lands. Five plant species within the Park are endemic or unique to the Hawaiian Islands. In addition to native taxa, there were four plant species in Kaloko-Honokōhau NHP introduced by Polynesians and now naturalized; these have probably been present in the Hawaiian Islands for many centuries.

Candidate Endangered Plant Species - Three of the five endemic species within Kaloko-Honokohau are currently candidates for listing as endangered or threatened species. Ko'oko'olau (Bidens micrantha subsp. ctenophylla) is a category 1 candidate (U. S. Fish and Wildlife Service 1994); this category designation means that the U. S. Fish and Wildlife Service currently has enough information on this species to warrant its listing. The species may be proposed as endangered in the near future (pers. comm. Loyal Mehrhoff 1994). Bidens micrantha is a variable species with three recognized subspecies; these are geographically isolated from one another. Two subspecies are found on Maui and Lāna'i, and B. micrantha subsp. ctenophylla occurs only on the island of Hawai'i, where it is restricted to the leeward slopes of Hualālai (Wagner et al. 1990). A

tall, spindly shrub with undivided toothed leaves and yellow heads of small flowers, this ko'oko'olau is native to dry forests and shrubland habitats. Very little undisturbed habitat remains on the urbanized lower slopes of Hualālai. In addition to the plants found in Kaloko-Honokōhau NHP, this ko'oko'olau is found upslope of the Kaloko Industrial Area and on lands of Palani Ranch.

During the 1992-93 botanical survey of Kaloko-Honokōhau seven live ko'oko'olau shrubs were found on or near transects (Fig. 16). Three of these were growing on the edge of the 'a'ā flow east of 'Aimakapā Pond. Several ko'oko'olau that had recently died were also seen in this area. The remaining four live plants were found on pāhoehoe substrates in vegetation dominated by fountain grass and alien shrubs. Flowers were noted in December, and fruits (small, dry, barbed achenes) were present in April. Subsequent to the survey, several ko'oko'olau were resighted on transects and appeared to be dead.

Maiapilo or pua pilo (Capparis sandwichiana) was recently added to the list of candidates for endangered or threatened species status, as a category 2 species (U. S. Fish and Wildlife Service 1994). Category 2 species, now called species of special concern, are those that require more data before listing can be accomplished. Formerly, two varieties of maiapilo were recognized (St. John 1965), and one of these (var. sandwichiana, found on windward O'ahu) was previously a candidate endangered taxon (U. S. Fish and Wildlife Service 1985). The two varieties were not recognized as distinct by Wagner et al. (1990), and the plant was temporarily removed from consideration as endangered. Some Hawaiian botanists are not convinced of the rarity of maiapilo and do not consider it in danger of extinction (C. H. Lamoureux, pers. comm. 1995). Other botanists consider the Hawaiian Capparis, as well as other species of the south Pacific, to be part of a wide-ranging species called C. spinosa var. mariana (Whistler 1992).

The Hawaiian maiapilo is found in coastal areas on all the main Hawaiian Islands, as well as on Midway, Pearl and Hermes, and Laysan (Wagner et al. 1990). A low-growing, sprawling shrub, maiapilo has fleshy, dull green leaves and large, showy flowers. Flowers have white petals and many long, white stamens; they bloom at night and fade to dull pink. Flowers are strong-smelling, fragrant when fresh, but with a foul putrid odor in an enclosed place (St. John 1965). Fruits are ellipsoid berries, orange when ripe.

Three hundred twenty five maiapilo plants were found in Kaloko-Honokohau during the 1992-93 survey. This included 137 plants growing within the 10-m-wide belt transects, 57 plants seen near the transects, 21 plants on the Māmalahoa Trail, 44 along the jeep road to Kaloko Pond, 11 along the coast, four on the Kaloko Pond perimeter, and 51 surrounding 'Aimakapā Pond (Fig. 17). Transects and trails were just a sample of the Park's vegetation to evaluate distribution and abundance; many more maiapilo plants



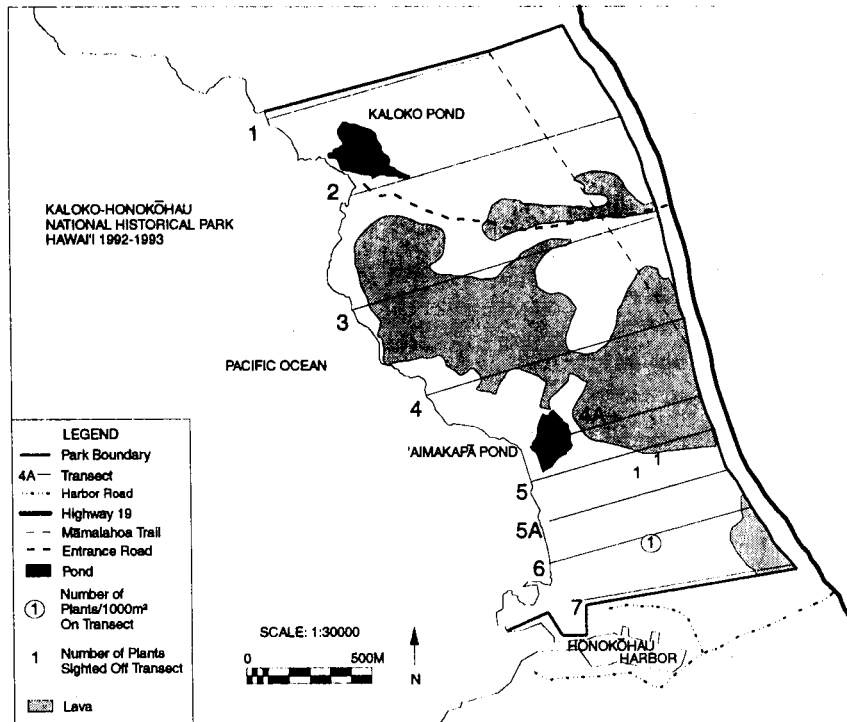


Figure 16. Number of ko'oko'olau (*Bidens micrantha* subsp. *ctenophylla*) plants found on or near transects in Kaloko-Honokōhau National Historical Park.

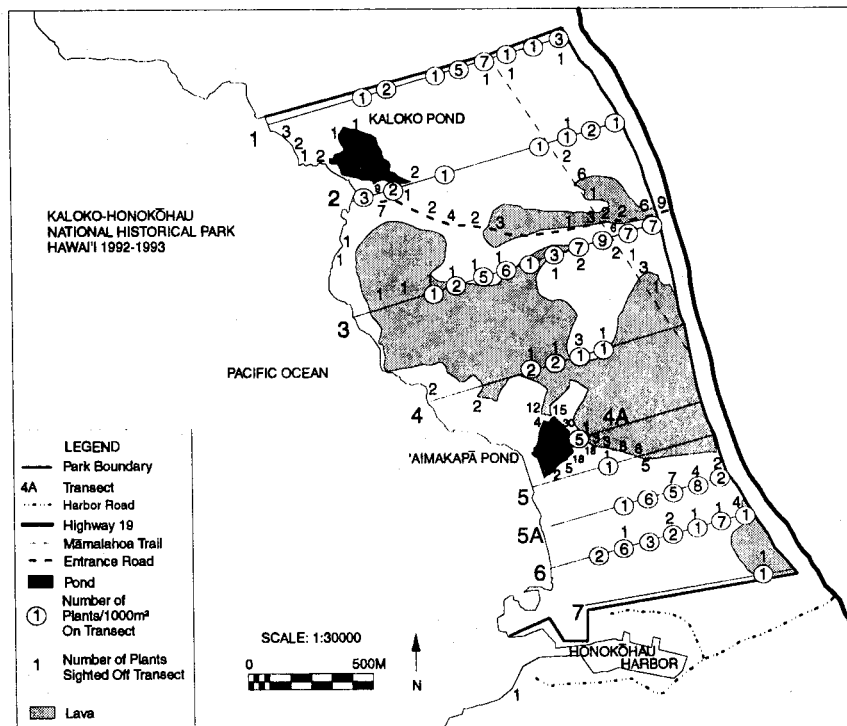


Figure 17. Number of maiapilo (*Capparis sandwichiana*) plants on or near transects, surveyed trails, and pond perimeters in Kaloko-Honokōhau National Historical Park.

occur away from surveyed areas. Considering just the on-transect maiapilo, the species had an overall density of 1.6/1000m<sup>2</sup> within the Park. Highest maiapilo density was observed on Transect 3 midway between Kaloko and 'Aimakapā Ponds (3.8/1000m<sup>2</sup>) and Transect 5A between 'Aimakapā and Honokohau Harbor (2.9/1000m<sup>2</sup>) (Table 1). Maiapilo was distributed throughout the Park in every vegetation type except marsh/wetland. This was one of the few plants found on otherwise bare lava flows. The shrub was particularly abundant on the eastern periphery of 'Aimakapā Pond, where it may benefit from the ongoing kiawe removal in that area. Maiapilo had a relatively high frequency of occurrence in the systematically placed vegetation plots, occurring in 27% of all 10- x 20-m plots. This was the third highest frequency of occurrence among native plants at Kaloko-Honokohau, exceeded only by 'ilima and 'uhaloa. However, young maiapilo plants were very rare and were only observed near Kaloko Pond. This species deserves additional monitoring to determine its reproductive status in the Park. Canfield (1990) reported that maiapilo was "uncommon but widespread." She also observed that the shrub was locally common on the mauka side of 'Aimakapā Pond.

Fimbristylis hawaiiensis, a tiny sedge with no Hawaiian or common name, is a category 2 candidate endangered species. Endemic to the island of Hawai'i, until recently this sedge had been collected only in Ka'ū District as a pioneer on pāhoehoe lava at low elevation (Wagner et al. 1990). Within the last few years, collections have been made in the Puna and Kona Districts, including areas near Kaloko-Honokōhau (Joan Yoshioka, pers. comm. 1994). A tiny herb with narrow, rolled leaves and small brown heads of flowers and dry fruits, this rare sedge is easily overlooked when mixed with grasses and alien shrubs. Because of its inconspicuousness, the degree of rarity of this sedge on the island is uncertain. Only 10 individuals of F. hawaiiensis were seen during the 1992-93 survey and 1994 revisits in Kaloko-Honokōhau NHP. One individual sedge was on Transect 2 east of Kaloko Pond and west of the Māmalahoa Trail and nine were found off transect south of Kahinahina'ula pool (Queen's Bath) (Fig. 18). The tiny plant was growing on pāhoehoe substrate in vegetation composed of fountain grass, ēkoa, and klu. In 1995, additional plants of this species were found near Kahinahina'ula; these will be monitored and discussed in a later report. The species was not observed by Canfield (1990).

Rare Native Trees and Shrubs - Four indigenous woody species were relatively rare within Kaloko-Honokōhau NHP. Alahe'e (Canthium odoratum, now called by many Psydrax odorata) is native to the Hawaiian Islands as well as Micronesia and a number of island groups in the South Pacific. In Hawai'i, alahe'e occurs in dry to moist lowland regions on all the main islands except Ni'ihau and Kaho'olawe (Wagner et al. 1990). A small tree or shrub, alahe'e has white bark; shiny, dark-green leaves; and fragrant, white flowers. Fruits are small and berry-like, black when ripe and irregular in shape with grooved sides. During the 1992-93 survey, 25 alahe'e were observed in Kaloko-Honokōhau NHP. This number included eight plants on transects, 11 adjacent to transects, two on the Māmalahoa Trail, and four along the road to Kaloko Pond (Fig. 19). The density of alahe'e on transect was very low, 0.1/1000m<sup>2</sup> for the entire Park. The

Table 1. Density (mean no./1,000 m<sup>2</sup>) of selected native plant species along transects in Kaloko-Honokōhau National Historical Park, 1992-93.

Native Plant Species	Transect No.								
	1	2	3	4	4A	5	5A	6	7
Alahe'e ( <u>Canthium odoratum</u> )	0.2	0	0.2	0	0	0	0	0.2	0.1
Maiapilo ( <u>Capparis sandwichiana</u> )	1.7	1.0	3.8	0.6	1.0	0.1	2.9	2.4	0.1
Pili ( <u>Heteropogon contortus</u> )	19.9	14.2	0	0	0	0	0	0	0
Koali'awa ( <u>Ipomoea indica</u> )	0.3	0.5	2.5	1.2	1.0	0	0.7	0.1	0
Hau ( <u>Hibiscus tiliaceus</u> )	0	0	0	89.0	0	1.7	0	0	0
Naio ( <u>Myoporum sandwicense</u> )	0.8	0.3	0	0	0	0.1	0	0	0
'Ilie'e ( <u>Plumbago zeylanica</u> )	1.0	0	0.2	0	0	0.1	1.1	0.1	0
'Ilima ( <u>Sida fallax</u> )	18.6	22.1	34.0	3.9	0	1.5	38.4	56.9	38.7
'Uhaloa ( <u>Waltheria indica</u> )	77.7	108.9	53.9	6.0	2.0	0.7	70.5	285.0	203.7

Only on-transect individuals were included in calculations; plants sighted off transect, on trails, or ponds perimeters were not considered.

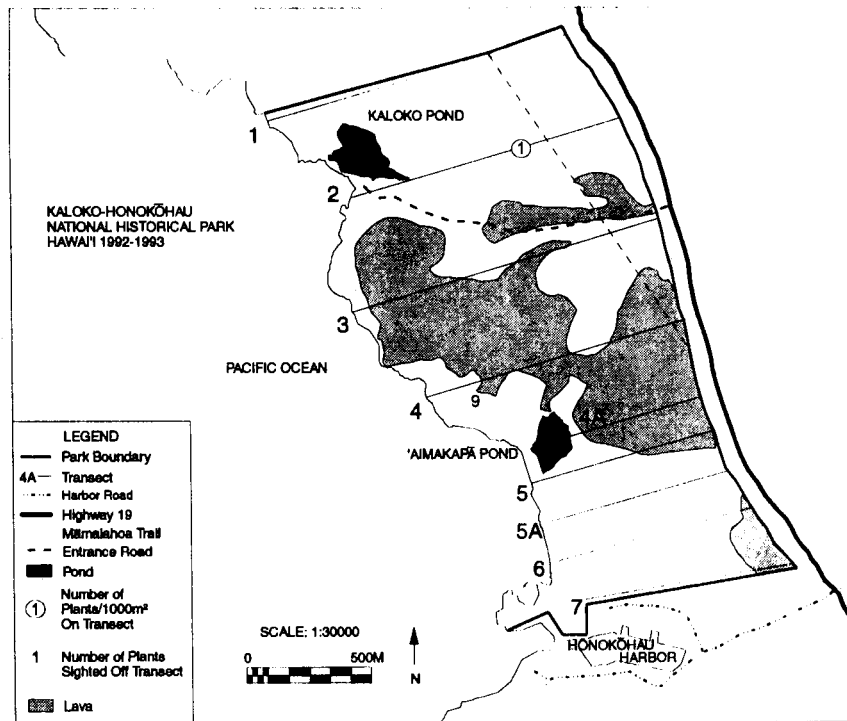


Figure 18. Number of plants of the endemic sedge *Fimbristylis hawaiiensis* on or near transects, surveyed trails and pond perimeters in Kaloko-Honokōhau National Historical Park.

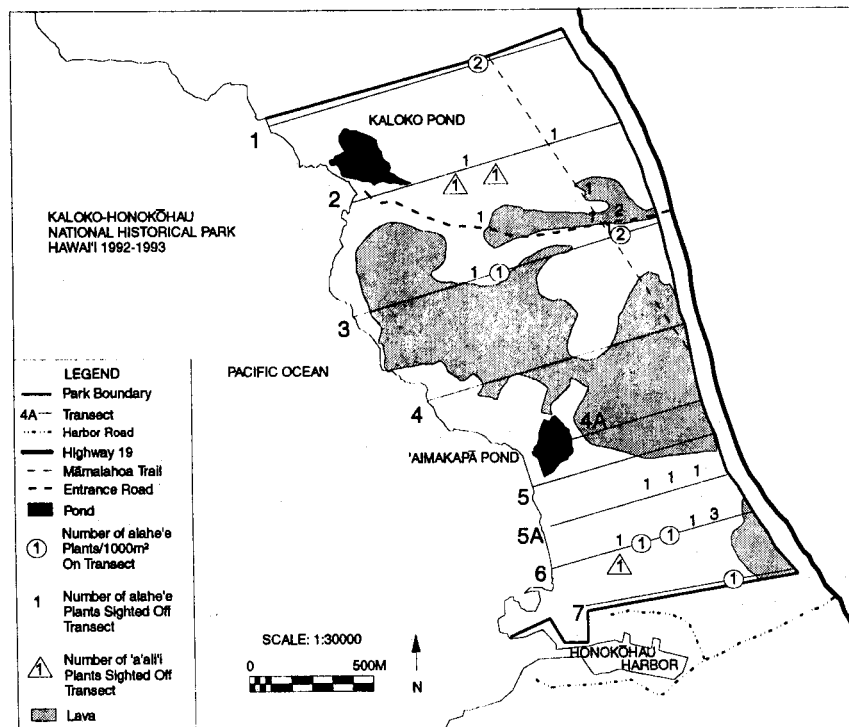


Figure 19. Number of alae'e (*Canthium odoratum*) and 'a'ali'i (*Dodonaea viscosa*) plants on or near transects, surveyed trails, and pond perimeters in Kaloko-Honokōhau National Historical Park.

species was found on only four transects, where its density did not exceed  $0.2/1000\text{m}^2$  (Table 1). Alahe'e trees or shrubs were most numerous near the Kaloko jeep road and in the southern third of the Park, where they grew mixed with alien shrubs and fountain grass on pāhoehoe substrate. Alahe'e was not detected in the systematic plots at 100-m intervals along transects, underscoring its rarity in the Park. Canfield (1990) rated alahe'e as uncommon in 1987; she found the shrub on the southeast side of Kaloko ahupua'a and southeast of 'Aimakapā Pond. These localities correspond to the sites of highest alahe'e density in 1992-93.

'A'ali'i (*Dodonaea viscosa*) is native to the Hawaiian islands and many other tropical regions, such as Australia, New Zealand, and tropical/subtropical America. In Hawai'i, the shrub is found on all the main islands except Kaho'olawe (Wagner et al. 1990). A shrub or small tree, 'a'ali'i is a common component of lowland shrublands, but is also found upslope to the subalpine zone on the high islands of Hawai'i and Maui. Only three individual 'a'ali'i shrubs were found in Kaloko-Honokōhau NHP during 1992-93; two were near Transect 2 east of Kaloko Pond, and one was seen just off Transect 6 near the Honokōhau Harbor boundary (Fig. 19). None of the sighted 'a'ali'i were on the 10-m-wide belt transects or within vegetation cover plots, so density of the species could not be calculated. 'A'ali'i was growing on pāhoehoe substrates in vegetation dominated by alien shrubs and fountaingrass. Canfield (1990) did not observe 'a'ali'i in the Park in 1987, but noted that it was likely to have been present in the past. Additional 'a'ali'i were found northeast of Kaloko Pond near the Park's northern boundary in 1995; these will be monitored and discussed in a later report. Other unmapped 'a'ali'i may be present in the southern half of the Park near archaeological features (pers. comm. Laura Schuster 1993).

Naio (*Myoporum sandwicense*) is a tree or shrub indigenous to all the main Hawaiian Islands and the Cook Islands of the South Pacific. Related species are found in the Austral Islands, the Marianas (Whistler 1992), Australia, and New Zealand (Mabberley 1990). In Hawai'i, naio grows from the coast to the subalpine zone, where its appearance is variable. The common coastal form, found in Kaloko-Honokōhau, has rough, furrowed bark; smooth, shiny leaves; and tubular, white to pink flowers. Usually a tree, naio is sometimes a low shrub, particularly when exposed to strong winds or salt spray. Ninety-seven naio trees were found in Kaloko-Honokōhau NHP: 14 on transects, five off transects, eight on the Māmalahoa Trail, 11 on the Kaloko road or parking area, 22 along the coast, and 37 on the perimeter of Kaloko Pond (Fig. 20). These trees were not evenly distributed through the Park, but were concentrated around Kaloko Pond. Naio trees were found in several vegetation types, including kiawe forest, ēkoa/fountain grass scrub, and coastal strand. Naio density on transects was very low,  $0.2/1000\text{m}^2$  for the Park overall. Highest on-transect densities of naio were found on Transects 1 and 2 near Kaloko Pond (Table 1). Frequency of occurrence of naio in plots was also very low (3 %). Canfield (1990) rated naio as uncommon but widespread in the northern half of the Park in 1987.

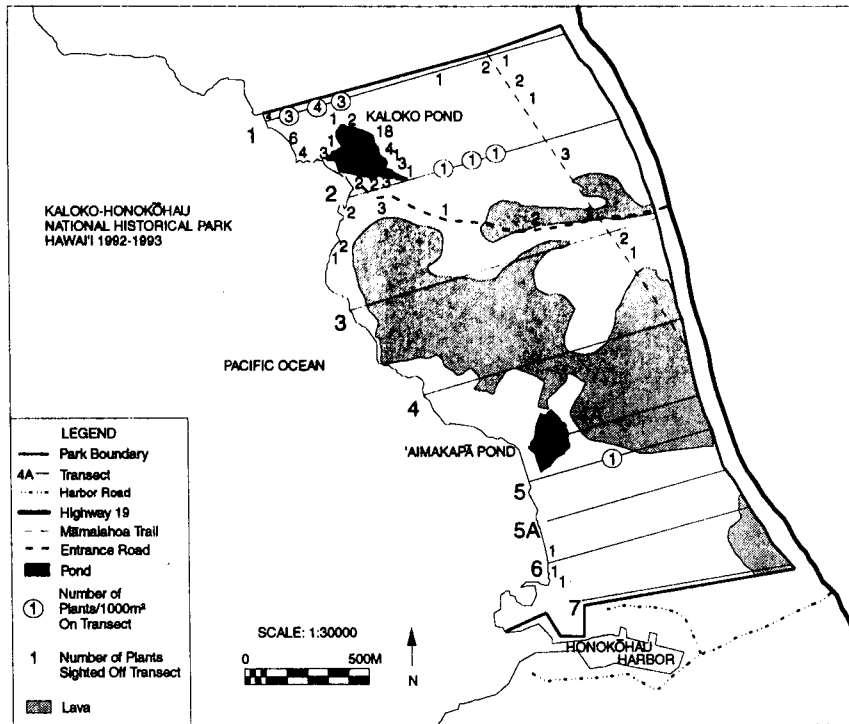


Figure 20. Number of naio (*Myoporum sandwicense*) plants on or near transects, surveyed trails and pond perimeters in Kaloko-Honokōhau National Historical Park.

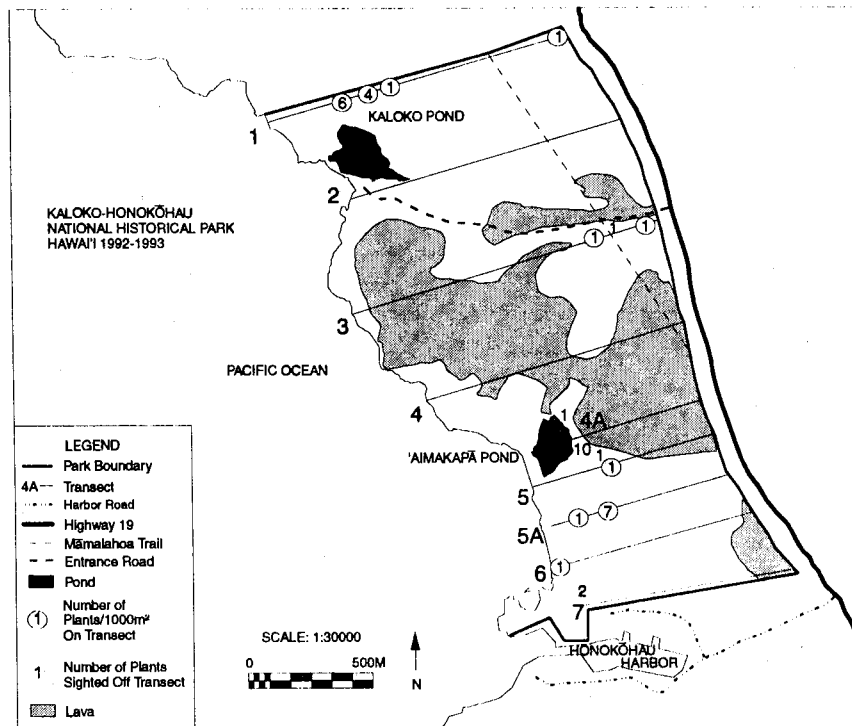


Figure 21. Number of ilie'e (*Plumbago zeylanica*) plants on or near transects, surveyed trails, and pond perimeters in Kaloko-Honokōhau National Historical Park.

'Ilie'e (Plumbago zeylanica) is a sprawling shrub with small ovate leaves and white, tubular flowers with many glandular hairs on calyx and inflorescence. The species is native to the Hawaiian Islands and the old world tropics. In Hawai'i, 'ilie'e grows in the dry lowlands of all the main islands (Wagner et al. 1990). The 1992-93 survey located 37 'ilie'e plants in Kaloko-Honokōhau NHP: 24 on transects, 12 near 'Aimakapā Pond, and three on trails (Fig. 21). Although several 'ilie'e plants were found in open alien shrubland with fountain grass, most occurred in kiawe forest near Kaloko and 'Aimakapā Ponds and in the coastal forest inland from 'Ai'ōpio. Overall density of 'ilie'e in the Park was 0.3/1000m<sup>2</sup>, with highest densities on Transects 1 and 5A (1.0 and 1.1/1000m<sup>2</sup>) (Table 1). Frequency of 'ilie'e shrubs was very low; they occurred in only 4% of systematic vegetation plots throughout the Park. Canfield (1990) did not observe this indigenous species in the Park in 1987.

Rare Native Herbaceous Plants - Four species of native grasses, sedges, and herbs occurred rarely in Kaloko-Honokōhau. While they were rare in the Park, these native plants cannot be considered rare on Hawai'i Island. Pua kala or Hawaiian prickly poppy (Argemone glauca) is endemic to all the main Hawaiian Islands, where the herb occurs in dry coastal and subalpine vegetation (Wagner et al. 1990). Pua kala is a conspicuous plant with bluish-green prickly leaves and large white flowers. Only one pua kala was found alive in Kaloko-Honokohau NHP in 1993; this large individual was growing beside the unpaved road south of Kaloko Pond, about 100-200 m southeast of the parking area (Fig. 22). Vegetation in this area was scattered alien shrubs and fountain grass. Earlier during the survey, another pua kala was sighted on the 'a'ā flow east of 'Aimakapā; this had disappeared by the end of 1993 and was not mapped. Canfield (1990) also considered pua kala a rare plant in 1987.

Pili (Heteropogon contortus) is probably indigenous to the Hawaiian Islands and is also found throughout the tropics (Wagner et al. 1990). Because of pili's usefulness as thatching material, some botanists believe Polynesian colonizers of Hawai'i brought the plant with them. At the time of European contact, pili was one of the dominant plants of dry lowlands on Hawai'i Island (Menzies 1920). Today pili still occurs in dry lowland regions on all the main islands, but the grass is no longer common. During the 1992-93 survey of Kaloko-Honokōhau, pili was found in the northeast corner of the Park on Transects 1 and 2 (Fig. 22). Approximately 400 plants were seen in 10 patches along these two transects. Although near the highway and Māmalahoa Trail, pili grass was not visible from roads or trails. The density of pili parkwide was 4.8/1000 m<sup>2</sup>; pili densities on Transects 1 and 2 were 19.9 and 14.2/1000m<sup>2</sup> (Table 1). Pili plants were growing in soil pockets and pāhoehoe cracks where vegetation was dominated by fountain grass and ēkoa shrubs. Canfield (1990) did not observe pili within the Park in 1987 but noted that the species might be present in the less thoroughly surveyed vegetation upslope of the coast.

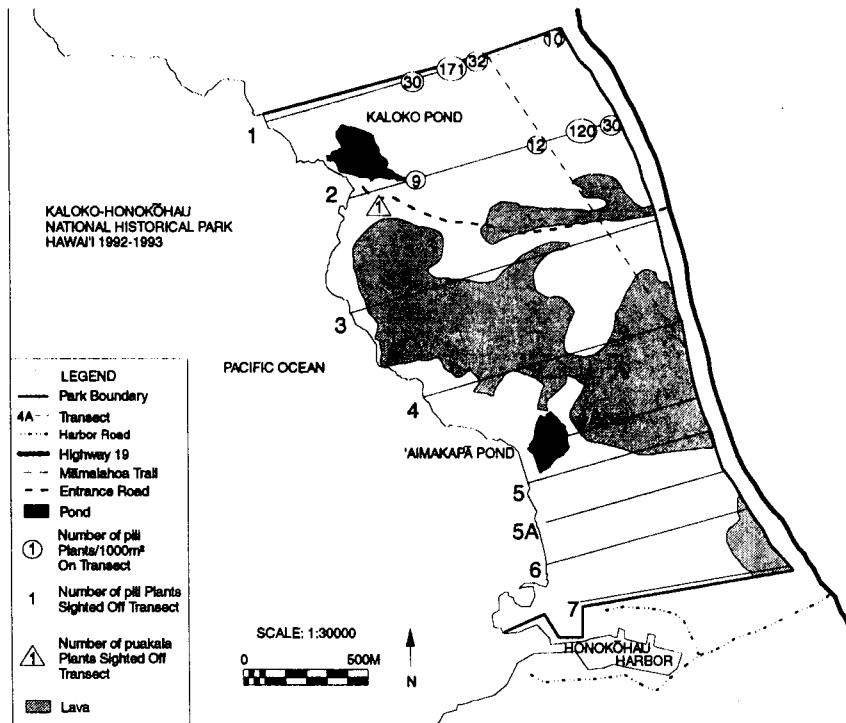


Figure 22. Number of pili (*Heteropogon contortus*) and pua kala or Hawaiian prickly poppy (*Argemone glauca*) plants on or near transects, surveyed trails and pond perimeters in Kaloko-Honokōhau National Historical Park.

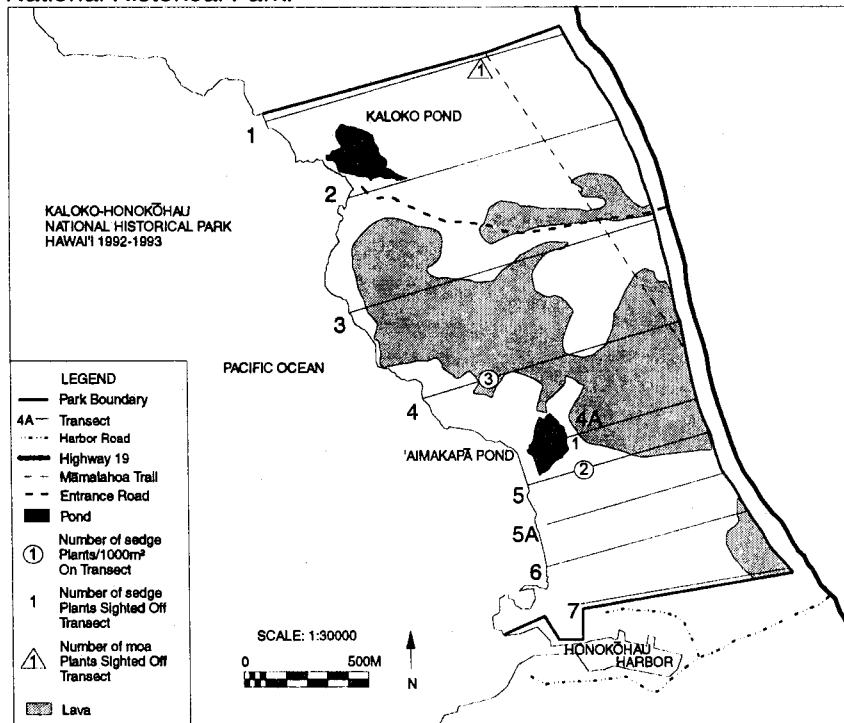


Figure 23. Number of moa or whisk fern (*Psilotum nudum*) and native sedge (*Pycnus polystachyos*) plants on or near transects, surveyed trails, and pond perimeters in Kaloko-Honokōhau National Historical Park.



Moa or whisk fern (Psilotum nudum) is a primitive vascular plant allied to ferns. Indigenous to the Hawaiian Islands, this small, terrestrial herb is widely distributed in tropical areas of the world (Degener 1975). A leafless herb <25 cm tall, moa is composed of fine green branches, upon which yellow spore-containing capsules are borne. Only one moa plant was found during the 1992-93 survey. This individual was on Transect 1 near the Māmalahoa Trail, growing in the shade of alien shrubs (Fig. 23). Canfield (1990) found moa plants only near the coast in an area not currently within Park boundaries.

Pycreus polystachyos, a sedge with no common name, is indigenous to the Hawaiian Islands and is also found in tropical and subtropical regions worldwide (Wagner et al. 1990). Although often a common species in dry and moist communities from the coast to middle elevations, this sedge was uncommon within Kaloko-Honokōhau NHP in 1992-93. Only six individuals were seen on or near transects; these were north of and immediately south of 'Aimakapā Pond on Transects 4 and 5 (Fig. 23). Calculated density of Pycreus was extremely low: 0.1/1000m<sup>2</sup> overall for the Park. Canfield (1990) did not observe this species within the Park in 1987.

Pōpolo or glossy nightshade (Solanum americanum) is a short-lived, weedy herb questionably native to the Hawaiian Islands (Wagner et al. 1990). Only one individual was seen during the 1992-93 survey; this plant was at the junction of the unpaved entrance road and parking area south of Kaloko Pond (Fig. 24). Canfield (1990) did not observe this species at Kaloko in 1987; it may be a recent accidental introduction to the Park.

Common Native Plants - Three indigenous species were found to be relatively common throughout Kaloko-Honokōhau NHP. These natives included one vine and two shrubs.

Koali 'awa or koali 'awahia (Ipomoea indica) is a pantropical species native to all the main Hawaiian Islands, as well as the Northwestern Hawaiian Islands (Wagner et al. 1990). Primarily a lowland species, koali 'awa is a vine with heart-shaped, softly hairy leaves and blue, funnel-shaped flowers that change to pink during the day. One hundred twelve koali 'awa vines were found in Kaloko-Honokōhau: 65 on transects, 10 near transects, 21 along the Māmalahoa Trail, 10 along the road to Kaloko Pond, and six near 'Aimakapā Pond (Fig. 24). Many more individuals of this species undoubtedly occur within the Park away from transects and trails. Koali 'awa vines were most often seen in open sunny areas with vegetation of fountain grass and alien shrubs. The density of koali 'awa along transects was 0.8/1000m<sup>2</sup> for the Park overall, with highest densities on Transects 3 and 4 (Table 1). Canfield (1990) rated koali 'awa (then known as I. congesta) as uncommon in the Park in 1987.

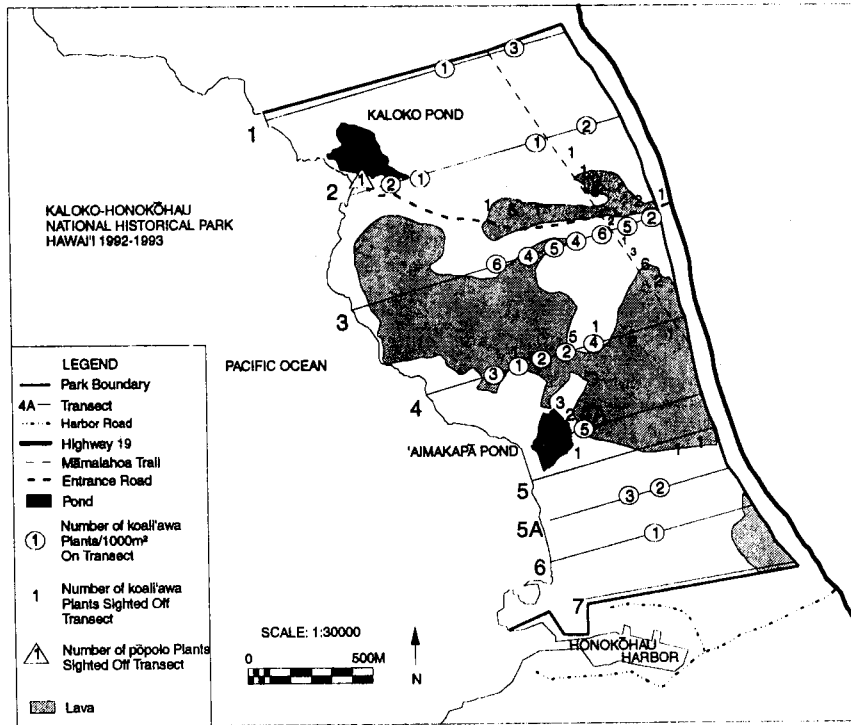


Figure 24. Number of pōpōlo (*Solanum americanum*) and koali'awa (*Ipomoea indica*) plants on or near transects, surveyed trails and pond perimeters in Kaloko-Honokōhau National Historical Park.

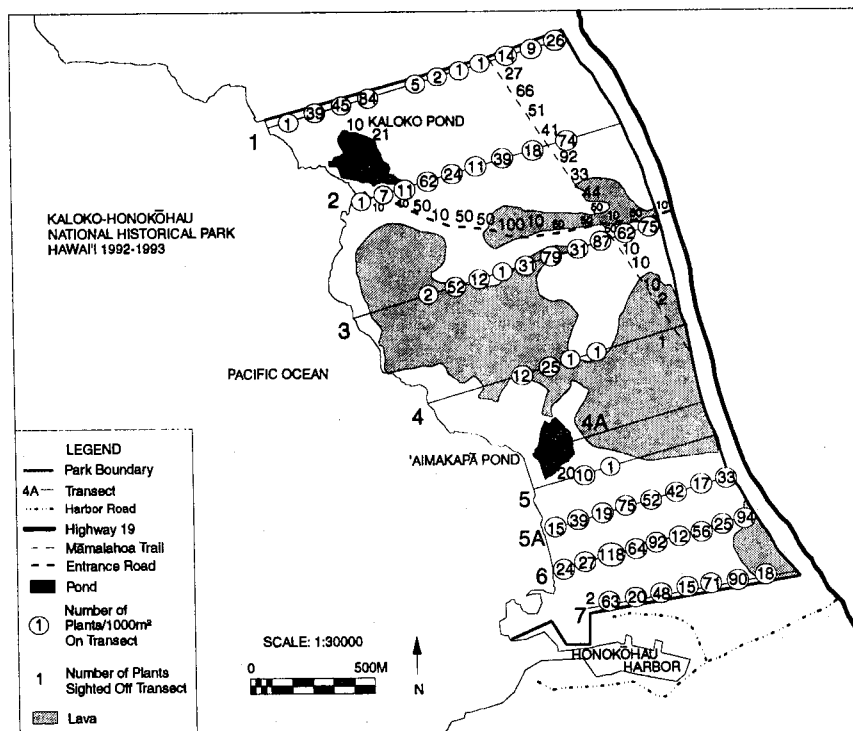


Figure 25. Number of 'ilima (*Sida fallax*) plants on transects, surveyed trails, and pond perimeters in Kaloko-Honokōhau National Historical Park (individuals sighted near transects not counted).

'Ilima (*Sida fallax*) is a shrub distributed from China to eastern Polynesia (Whistler 1992). It is found at low elevations in coastal and dry forest vegetation on all the main Hawaiian Islands (Wagner et al. 1990). More than 3,000 'ilima shrubs were counted along transects and trails in Kaloko-Honokōhau NHP; these were distributed throughout the vegetated portions of the Park and were absent only from nearly barren 'a'ā flows and wetlands near the two large ponds (Fig. 25). This number is artificially low, because 'ilima plants were too numerous to count along the coast and in sites other than transects, trails, and the road to Kaloko. The calculated density of 'ilima on transects was 24.9/1000m<sup>2</sup>. 'Ilima densities ranged from a low of 0 on Transect 4A to 56.9/1000m<sup>2</sup> on Transect 6 (Table 1). Canfield (1990) considered 'ilima to be uncommon but widespread in the Park in 1987.

'Uhaloa or hi'aloa (*Waltheria indica*), a low or prostrate shrub, is generally considered native to the Hawaiian Islands, as it is pantropical in distribution and was noted in Hawai'i as early as 1779 (Wagner et al. 1990, St. John 1978). Some botanists have considered the species (formerly called *W. americana*) a Polynesian introduction (Degener 1946). 'Uhaloa has small, scalloped, hairy leaves and tiny yellow flowers. More than 8,000 'uhaloa shrubs (8,421) were counted along transects and the Māmalahoa Trail; this was the most abundant native woody plant in the Park. Few 'uhaloa (161) were found along the coast or pond perimeters. The species was too numerous to count along the access road to Kaloko Pond or near (but off) transects. 'Uhaloa plants were distributed throughout the Park in every vegetation type except marshy wetland (Fig. 26). Thousands of additional 'uhaloa are undoubtedly present within the Park away from transects and trails. The on-transect density of 'uhaloa was 92.5/1000m<sup>2</sup> for the Park overall, ranging from a high of 285/1000m<sup>2</sup> on Transect 6 to a low of 0.7/1000m<sup>2</sup> on Transect 5 (Table 1). Canfield (1990) considered 'uhaloa to be uncommon but widespread in the Park in 1987.

Native Coastal Plants - Twelve native plant species were found primarily in coastal communities of Kaloko-Honokōhau NHP; these included a sedge, a grass, several herbs, vines, shrubs, and trees. Some of these were rare or uncommon in the Park, while others were very common.

Alena (*Boerhavia repens*) is a prostrate herb found from Africa to Polynesia. In Hawai'i it occurs on all the main islands and the Northwestern Hawaiian Islands (Wagner 1990). Only 14 alena plants were found in Kaloko-Honokōhau during the 1992-93 survey; most of these were on sparsely vegetated beach near Kaloko Pond, but a few were seen on pāhoehoe substrate on the upper half of Transects 3 and 4 (Fig. 27). Calculated density of alena was very low, 0.05/1000m<sup>2</sup>. Canfield (1990) reported alena (which she called by its former name *B. diffusa*) as uncommon in coastal communities and kiawe savanna of Kaloko ahupua'a.

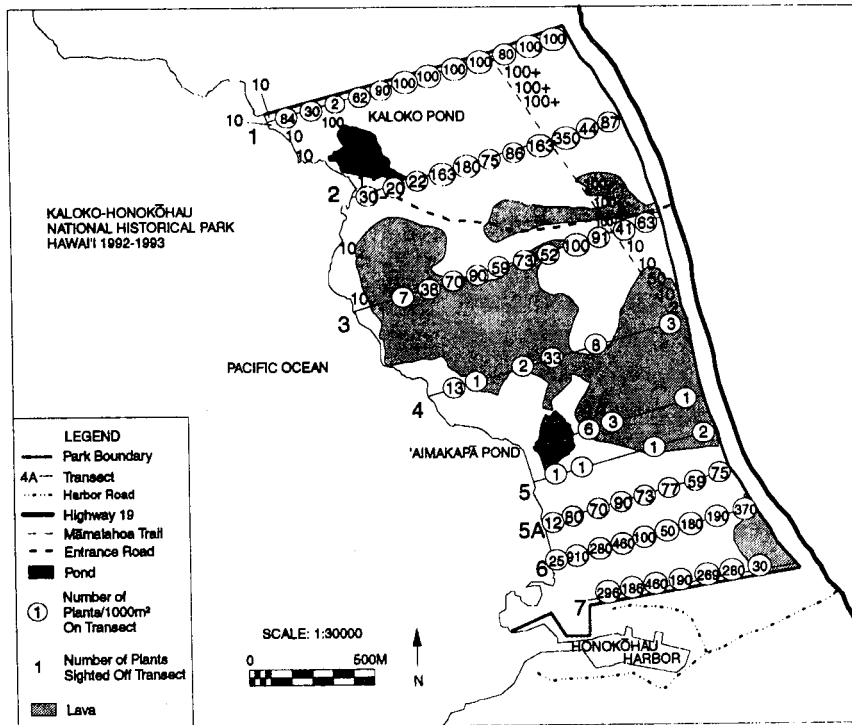


Figure 26. Number of 'uhaloa (*Waltheria indica*) plants on transects, surveyed trails and pond perimeters in Kaloko-Honokōhau National Historical Park (individuals sighted near transects not counted).

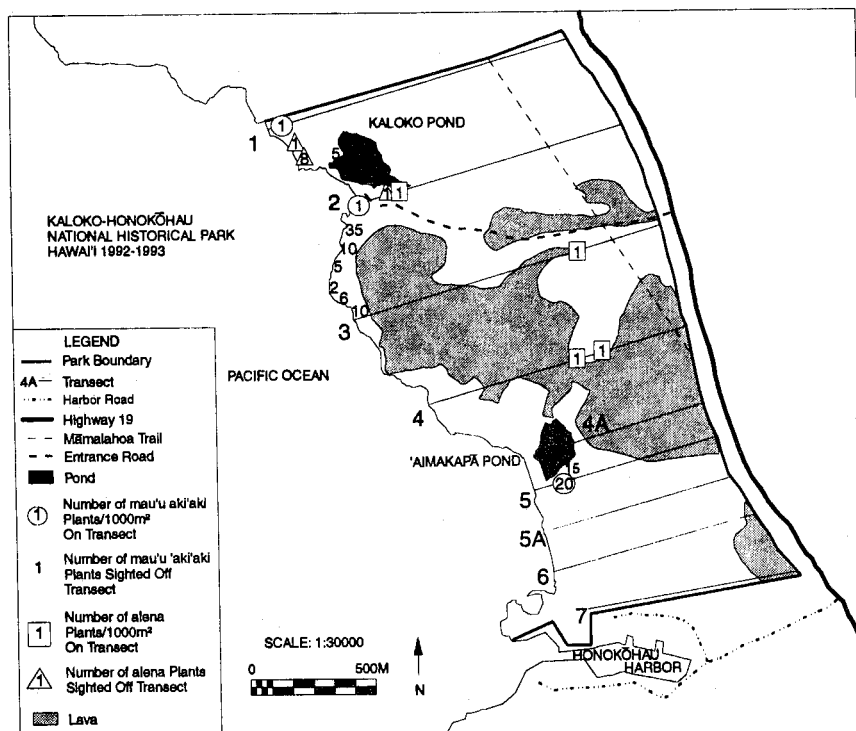


Figure 27. Number of alena (*Boerhavia repens*) and mau'u 'aki'aki (*Fimbristylis cymosa*) plants on or near transects, surveyed trails, and pond perimeters in Kaloko-Honokōhau National Historical Park.

Mau'u 'aki'aki (Fimbristylis cymosa), a small, densely tufted coastal sedge, is widely distributed in the Pacific and tropical America (Wagner et al. 1990). In Kaloko-Honokōhau NHP, mau'u 'aki'aki was found on the coast near Kaloko Pond and at one site south of 'Aimakapā Pond (Fig. 27). One hundred ten plants were counted during the 1992-93 survey, but this number does not reflect the true population size of the sedge in the Park. The coast near 'Ai'ōpio was not surveyed, as the coastline near the permittees' dwellings was inaccessible to botanists. On-transect density of the sedge was 0.3/1000m<sup>2</sup>, a very low number reflecting the plants concentration on the coast rather than on transects. Canfield (1990) did not list this species in her 1987 checklist of Park plants.

Kīpūkai or nena (Heliotropium curassavicum), a prostrate herb native to North and South America, the West Indies, Australia, and Hawai'i, occurs on the coast of all the main Hawaiian Islands (Wagner et al. 1990). The leaves of this succulent plant are typically dull bluish-green and its small, white flowers are borne on curved inflorescences. Only 51 nena plants were found in Kaloko-Honokōhau: 50 in sandy substrate beside the parking area on the south edge of Kaloko Pond and one near 'Ai'ōpio (Fig. 28). More individuals of this species may occur along the unsurveyed coastline near permittees' dwellings. Canfield (1990) found nena in the same area near Kaloko Pond in 1987; she rated the species as rare in the Park.

Hau (Hibiscus tiliaceus) is a common tree of coasts and lowland streams in Hawai'i; the tree is widely distributed in tropical and subtropical regions worldwide (Wagner et al. 1990). In Polynesia and Micronesia, hau is sometimes the dominant plant of coastal thickets and streambanks (Whistler 1992). More than 1,400 hau trees were seen on transects and along the coast of Kaloko-Honokōhau NHP; these were concentrated in the coastal area north of 'Aimakapā Pond (Fig. 28). This number was a very low estimate of the hau population; because of their shrubby growth form and habit of forming dense thickets, hau trees were very difficult to count. Additionally, many seedlings and young saplings were present in dense hau thickets. The density of hau on transects was 10.8/1000m<sup>2</sup> for the Park overall; highest hau density was on Transect 4 with 89 trees/1000m<sup>2</sup> (Table 1). Canfield (1990) did not observe hau within the Park in 1987.

Pōhuehue or beach morning glory (Ipomoea pes-caprae) is a pantropical species found on coastlines and at low-elevation sites on all the main Hawaiian Islands (Wagner et al. 1990). In Kaloko-Honokōhau NHP, the vine was restricted to beach communities, coastal forests, and pond edges. Fifty-two pōhuehue plants were found within the Park; these were concentrated on the coast near Kaloko Pond and south of 'Aimakapā Pond (Fig. 29). Single plants were seen on the southeastern edge of Kaloko Pond and on the northern perimeter of 'Aimakapā Pond. Very few pōhuehue (five) were observed on

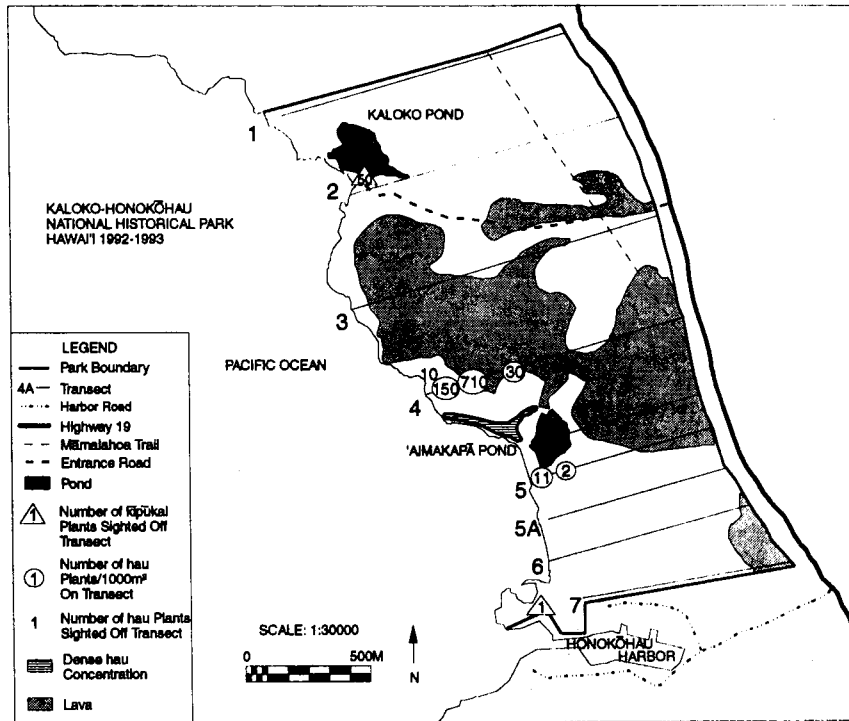


Figure 28. Number of plants or dense concentrations of kīpūkai (*Heliotropium curassavicum*) and hau (*Hibiscus tiliaceus*) on or near transects, surveyed trails, and pond perimeters in Kaloko-Honokōhau National Historical Park.

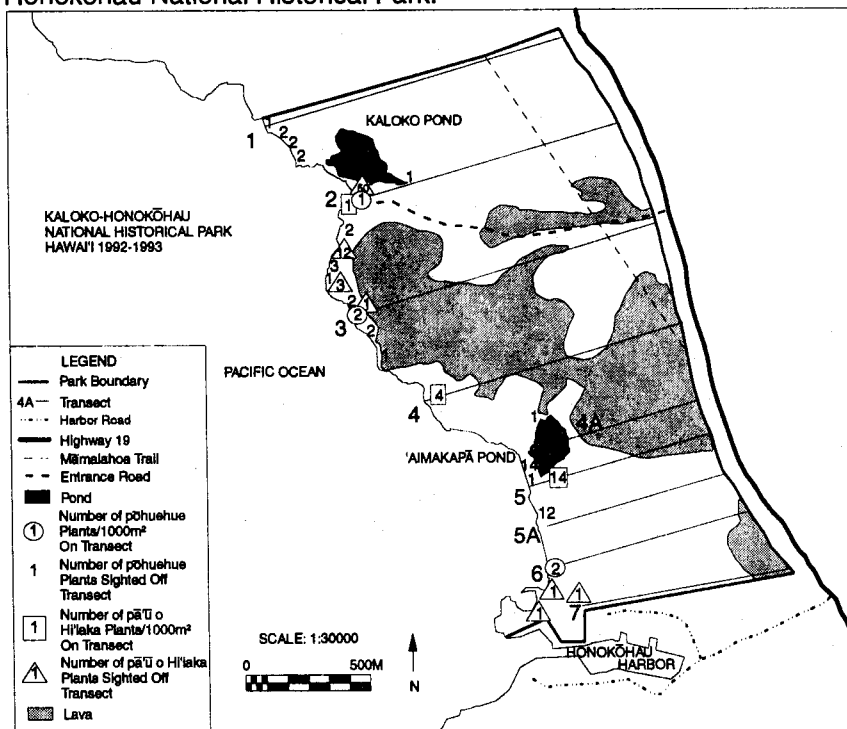


Figure 29. Number of pōhuehue (*Ipomoea pes-caprae*) and pā'ū o Hi'iaka (*Jacquemontia ovalifolia* subsp. *sandwicensis*) plants on or near transects, surveyed trails, and pond perimeters in Kaloko-Honokōhau National Historical Park.

transects, so the calculated density of the vine in the Park was only 0.1/1000m<sup>2</sup>. Canfield (1990) considered pōhuehue to be uncommon but widespread in strand communities in 1987.

Pā'ū o Hi'iaka (*Jacquemontia ovalifolia* subsp. *sandwicensis*) is an endemic subspecies of a plant also found in Africa, the West Indies, and Mexico (Wagner et al. 1990). In Polynesia, the plant is restricted to the Hawaiian Islands (Whistler 1992). A delicate vine with smooth or hairy, oval leaves and pale blue flowers, pā'ū o Hi'iaka is a plant of sandy beaches, rocky shores, and dry inland sites (Whistler 1992); the vine is sometimes seen in disturbed areas, such as roadsides. Eighty-eight individual plants were seen in Kaloko-Honokōhau; these were primarily on sandy beaches at two sites south of Kaloko Pond and near 'Aimakapā Pond (Fig. 29). The species may also grow on unsurveyed sandy beaches near permittees' dwellings. On-transect density of pā'ū o Hi'iaka was very low (0.2/1000m<sup>2</sup>), because most plants were encountered off transect during the coastal survey. Canfield (1990) listed pā'ū o Hi'iaka as widespread but uncommon in sandy coastal communities.

'Ōhelo kai (*Lycium sandwicense*) is a sprawling, succulent shrub indigenous to the Hawaiian Islands and also found on the shores of other Polynesian high islands (Whistler 1992) and the Juan Fernandez Islands near South America (Wagner et al. 1990). One hundred ninety five 'ōhelo kai shrubs or clusters of shrubs were found in Kaloko-Honokōhau NHP; these were along the coast, on the perimeter of Kaloko and 'Aimakapā Ponds, or in small anchialine pools (Fig. 30). The on-transect density of 'ōhelo kai was only 0.4/1000m<sup>2</sup>, as most of the plants were seen off-transect along the coast or east of 'Aimakapā. 'Ōhelo kai is adapted to grow near salt spray and brackish water; the shrubs may be in monospecific patches or mixed with other vegetation near the pond edges. Any future attempts to control or remove pickleweed should be done carefully to avoid damage to similar-appearing 'ōhelo kai, particularly near 'Aimakapā Pond. Canfield (1990) found that 'ōhelo kai was locally common in the northern half of the Park in 1987; she did not observe the shrub near 'Aimakapā Pond.

Naupaka kahakai (*Scaevola sericea*) is a common shrub of Hawaiian coastlines and is also found on shores throughout the Pacific and Indian Oceans (Wagner et al. 1990). Naupaka is one of the most abundant littoral shrubs of Polynesia and Micronesia and often forms dense thickets (Whistler 1992). The former scientific name of naupaka, *Scaevola taccada*, is considered the correct name by many botanists and may return to wide use and acceptance in the future (C. H. Lamoureux, pers. comm. 1995). Naupaka kahakai has succulent, hairy leaves; white, irregular flowers; and white, berry-like, buoyant fruits. In Kaloko-Honokōhau NHP, naupaka was restricted to the coast and the edge of 'Aimakapā Pond (Fig. 31). More than 500 naupaka plants (576) were counted in the Park during the 1992-93 survey. Because few were on transects, the calculated density of naupaka was only 0.8/1000m<sup>2</sup>. Canfield (1990) reported that naupaka was

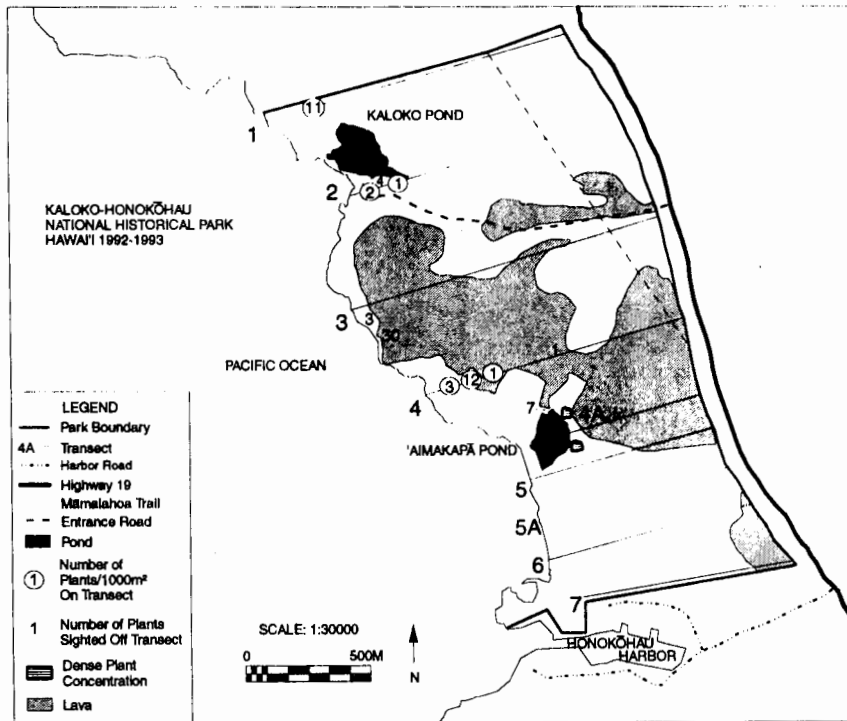


Figure 30. Number of plants or dense concentrations of 'ōhelo kai (*Lycium sandwicense*) on or near transects, surveyed trails, and pond perimeters in Kaloko-Honokōhau National Historical Park.

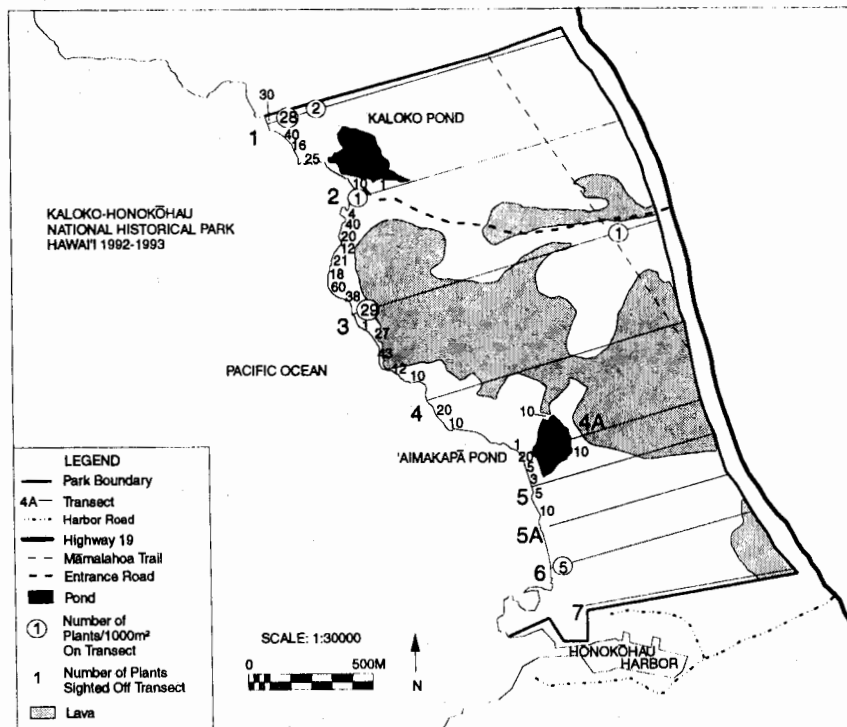


Figure 31. Number of naupaka kahakai (*Scaevola sericea*) plants on or near transects, surveyed trails, and pond perimeters in Kaloko-Honokōhau National Historical Park.



"extremely common and widespread" in coastal communities in 1987. While naupaka remains a common coastal plant, it is not abundant or widespread throughout the Park and is rated in the current Park checklist as locally common.

‘Ākulikuli (Sesuvium portulacastrum) is a prostrate succulent herb with narrow, rounded leaves, red stems, and small, tubular, pink flowers. Indigenous to Hawai‘i, this is a pantropical species found on many Pacific islands (Wagner et al. 1990, Whistler 1992). ‘Ākulikuli was found along the coast, around Kaloko Pond, and at several small anchialine pools in Kaloko-Honokōhau (Fig. 32). Because of its creeping habit, individual ‘ākulikuli were difficult to distinguish. More than 500 (554) ‘ākulikuli plants or patches of plants were counted during the 1992-93 survey, and the on-transect density was 4.6 plants/1000m<sup>2</sup>. Canfield (1990) observed that ‘ākulikuli was the dominant in low strand vegetation and was widespread along the coast.

‘Aki‘aki or beach dropseed (Sporobolus virginicus) is native to all the main Hawaiian Islands, as well as some of the Northwestern Islands; the grass is found in tropical and subtropical coastal habitats worldwide (Wagner et al. 1990). In Kaloko-Honokōhau, the grass was found along the coast at ‘Aimakapā Pond and midway between the two large fishponds. Only the coastal distribution of ‘aki‘aki is presented on the map (Fig. 33); the grass grows in dense mats, and it is impossible to distinguish individual plants. It is also likely that ‘aki‘aki grows mixed with seashore paspalum (Paspalum vaginatum) in wetlands surrounding ‘Aimakapā and behind ‘Ai‘ōpio. Canfield (1990) reported that ‘aki‘aki was common and locally abundant near ‘Aimakapā in 1987.

Milo (Thespesia populnea) is now considered to be indigenous to Hawai‘i, although in the past it was often treated as a Polynesian introduction (Wagner et al. 1990). The tree is distributed from tropical Africa to Hawai‘i, and in the Pacific it grows on high islands of Polynesia and Micronesia (Whistler 1992). The shiny, heart-shaped leaves and large yellow flowers of milo add to the tree’s attractiveness, and it is sometimes planted as an ornamental in Hawai‘i. Milo is very common in Kaloko-Honokōhau, where it is concentrated at coastal sites and is particularly abundant on the perimeter of ‘Aimakapā Pond (Fig. 34). More than 2,000 milo trees were counted along transects, on the coast, and near the two large fishponds, but this number is a very low estimate. Milo trees grow in dense thickets and produce thousands of seedlings each year, making the species very difficult to count. The hatched pattern near ‘Aimakapā on Fig. 34 indicates dense stands of milo, where individual trees could not be distinguished. Canfield (1990) described milo as the dominant tree in forested strand of Kaloko-Honokōhau.

Nohu (Tribulus cistoides) is a pantropical coastal species widespread in Polynesia and Micronesia (Whistler 1992). In Kaloko-Honokōhau, this was a rare species found at only two sites (Fig. 34). A group of eight nohu was seen on a sandy road at Kaloko Point, and one plant was found on the Māmalahoa Trail. A prostrate perennial herb with hairy, compound leaves, bright yellow flowers, and prickly fruits, the nohu is very similar

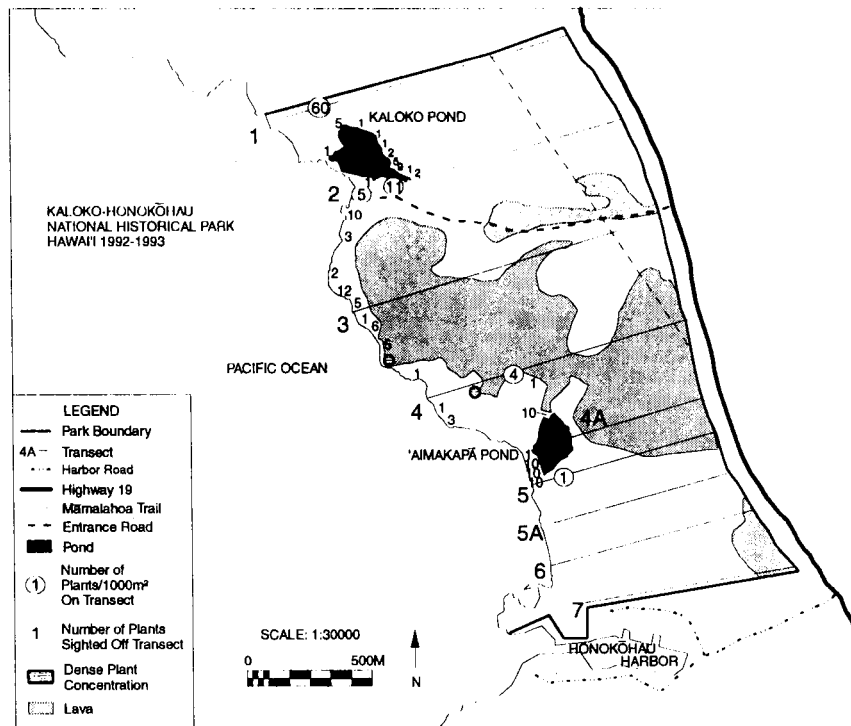


Figure 32. Number of plants or dense concentrations of 'ākulikuli (*Sesuvium portulacastrum*) on or near transects, surveyed trails, and pond perimeters in Kaloko-Honokōhau National Historical Park.

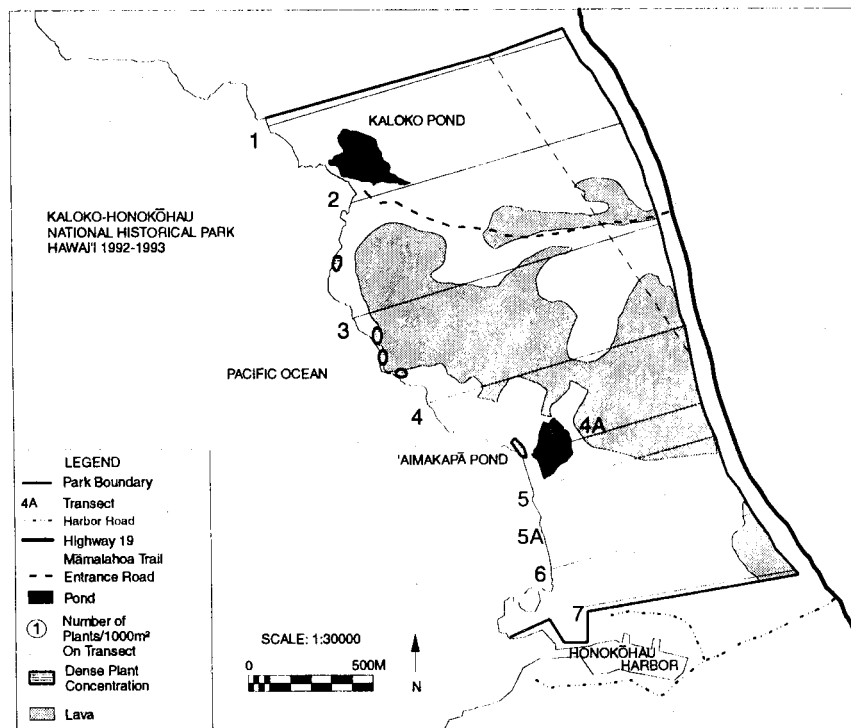


Figure 33. Number of plants or dense concentrations of 'aki'aki (*Sporobolus virginicus*) on or near transects, surveyed trails, and pond perimeters in Kaloko-Honokōhau National Historical Park.

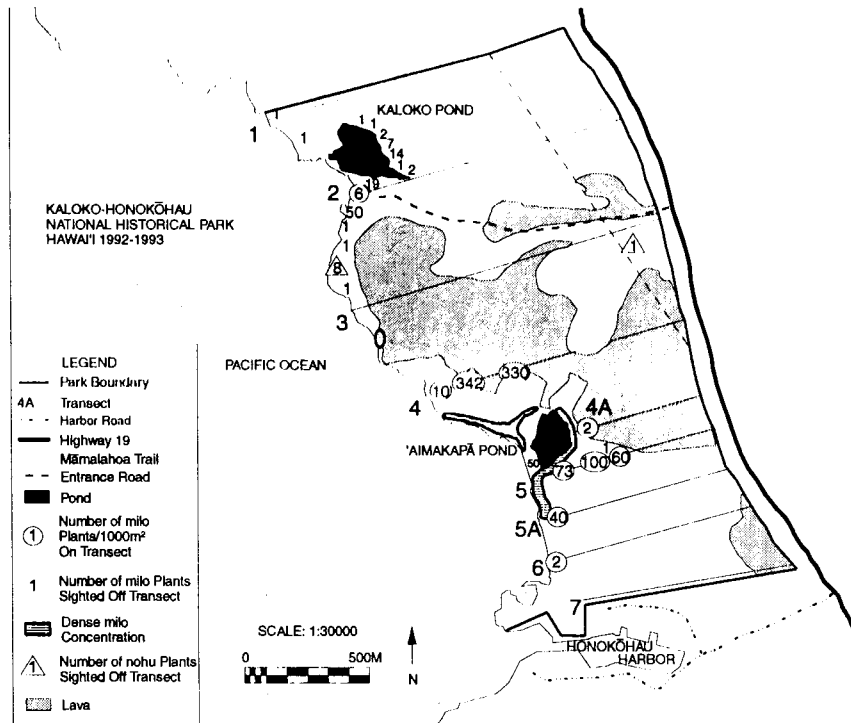


Figure 34. Number of plants or dense concentrations of milo (*Thespesia populnea*) and nohu (*Tribulus cistoides*) on or near transects, surveyed trails, and pond perimeters in Kaloko-Honokōhau National Historical Park.

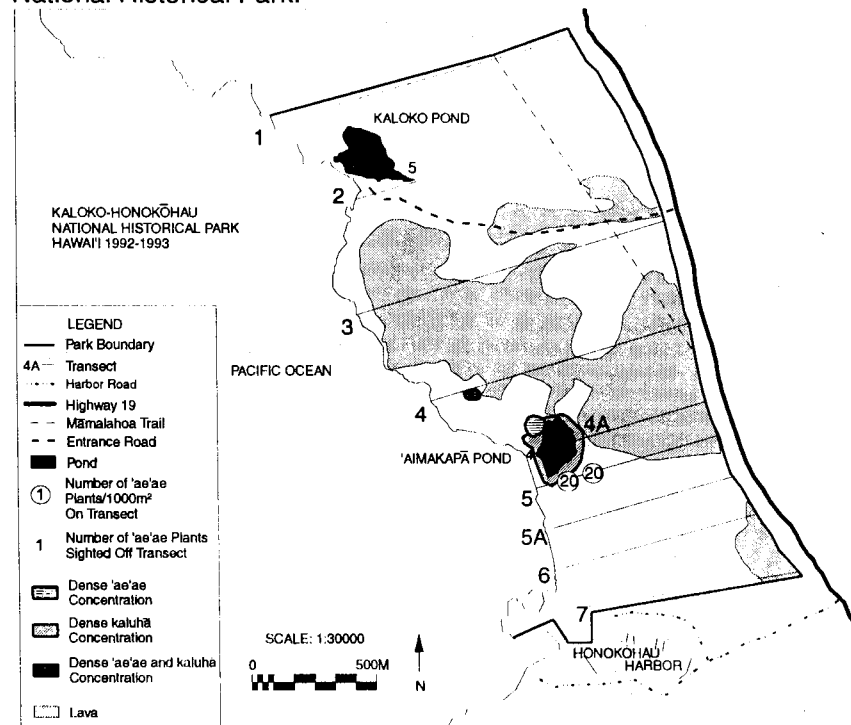


Figure 35. Number of plants or dense concentrations of 'ae'ae or water hyssop (*Bacopa monnieri*) and kaluhā (*Bolboschoenus maritimus* subsp. *paludosus*) on or near transects, surveyed trails, and pond perimeters in Kaloko-Honokōhau National Historical Park.

to an annual alien plant, puncture vine. Canfield (1990) did not observe nohu in the Park, but she reported puncture vine from the Huehue Ranch road south of Kaloko Point. Jeep roads near Kaloko Point were searched unsuccessfully for puncture vine in 1993 and 1994, but the weed was found on the upper part of the unpaved road to Kaloko Pond in 1995. Care should be taken not to remove the native nohu while controlling the noxious puncture vine.

Native Wetland Plants - Two herb and three sedge species were restricted to wetland communities in Kaloko-Honokōhau. 'Aimakapā Pond, in particular, supports an extensive wetland dominated primarily by native species. Native wetland plants are important as components of a vegetation type much depleted in Hawai'i and may also be critical to the survival of some native invertebrates and endangered waterbirds.

'Ae'ae or water hyssop (Bacopa monnieri) is a small herb widespread in tropical and subtropical lands. In Hawai'i, the plant is found on all the main islands and Midway (Wagner et al. 1990). Usually prostrate, water hyssop has shiny, succulent leaves and showy, white, tubular flowers; it is sometimes used as an ornamental in Hawai'i. In Kaloko-Honokōhau, water hyssop was found primarily near 'Aimakapā Pond, although a few plants were noted near Kaloko Pond, and at least 100 were sighted in an anchialine pool northwest of 'Aimakapā (Fig. 35). The species was uncountable because of its growth habit, but the largest concentration of plants was in a marsh northwest of the open water of 'Aimakapā Pond. Canfield (1990) described water hyssop as abundant in marsh areas of Kaloko-Honokōhau.

Another wetland herb, widgeon grass (Ruppia maritima) was occasionally seen submerged in anchialine pools and wetlands near 'Aimakapā Pond in both 1987 and 1992-93 surveys. An aquatic plant, widgeon grass was impossible to count, and its preferred habitat (anchialine pools) was not specifically surveyed, so its distribution was not mapped during this project. This species was noted in a few pools in Kaloko-Honokōhau during a past survey (Chai 1991), and it should be evaluated during any future mapping or biological surveys of anchialine pools within the Park.

The indigenous sedges kaluhā (Bolboschoenus maritimus subsp. paludosus) and makaloa (Cyperus laevigatus) are both widespread in temperate and tropical regions worldwide (Wagner et al. 1990). In Kaloko-Honokōhau both species were restricted to wetlands near the two large fishponds and several small anchialine pools. A comprehensive survey of anchialine pools would further refine the actual distribution of native sedges in the Park. Kaluhā was concentrated on the perimeter of 'Aimakapā Pond (Fig. 35), where it rimmed the open water of the pond and was conspicuously taller than other wetland sedges, grasses, and herbs. Makaloa sedges were found along the eastern edge of Kaloko Pond and in a marsh on the northwestern side of 'Aimakapā Pond (Fig. 36). It was impossible to count individuals of either species. Makaloa and other native plants will likely increase in cover on the edge of Kaloko, where alien mangrove and

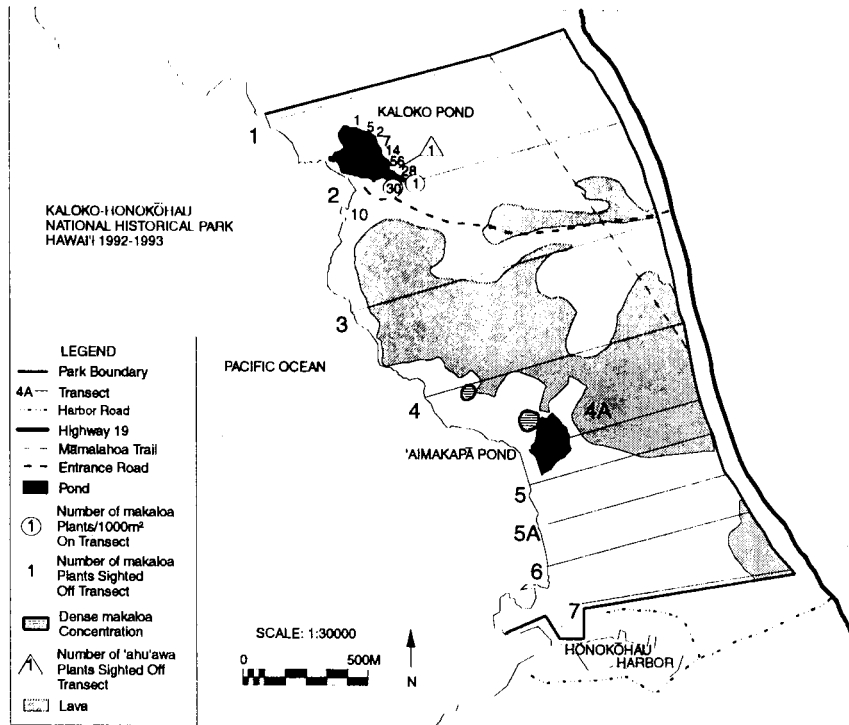


Figure 36. Number of plants or dense concentrations of makaloa (*Cyperus laevigatus*) and 'ahu'awa (*Mariscus javanicus*) on or near transects, surveyed trails, and pond perimeters in Kaloko-Honokōhau National Historical Park.

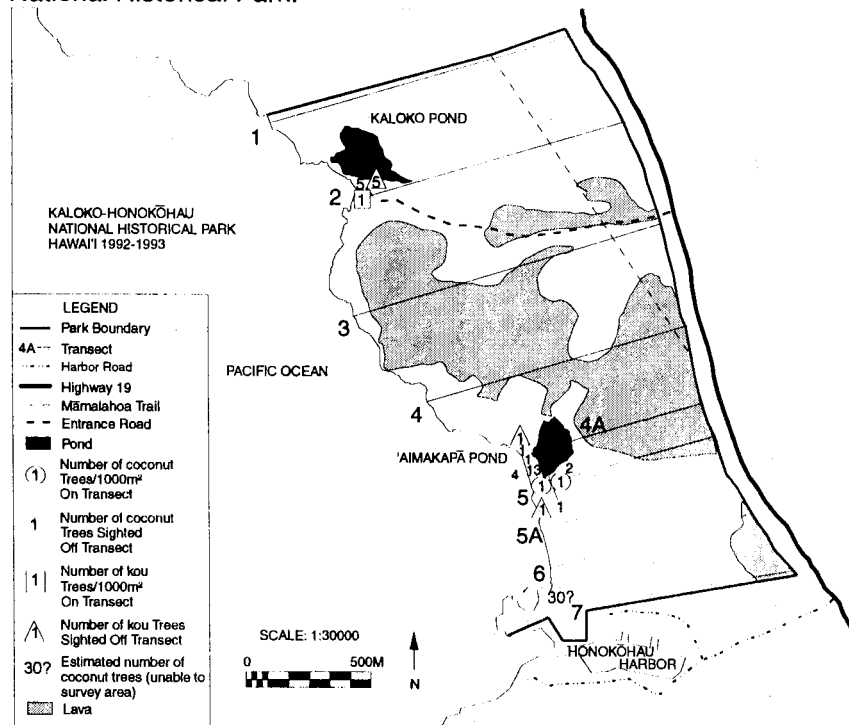


Figure 37. Number of niu or coconut (*Cocos nucifera*) and kou (*Cordia subcordata*) trees on or near transects, surveyed trails, and pond perimeters in Kaloko-Honokōhau National Historical Park.

kiawe have been cleared. As makaloa has limited habitat in the Park and is subject to competition with alien plants, it is possible that this culturally important sedge could be depleted by collecting for mat and basket weaving. Canfield (1990) described both sedge species as locally abundant or codominant in marsh vegetation.

A third indigenous sedge, 'ahu'awa or 'ehu'awa (Mariscus javanicus), is very rare in Kaloko-Honokōhau NHP, although it is more common elsewhere on the island. This sedge is native to tropical Africa and Asia, as well as Hawai'i, where it is common in wetlands on all the main islands except Kaho'olawe (Wagner et al. 1990). During the 1992-93 survey of the Park, 'ahu'awa was found only at one site on the eastern edge of Kaloko Pond (Fig. 36). Here the sedge had been previously obscured by kiawe thickets, recently cleared during the alien plant control project. Canfield (1990) did not observe 'ahu'awa in the Park in 1987.

Polynesian Introductions - Four tree or shrub species originally introduced by Polynesians and planted by Hawaiians were found in Kaloko-Honokōhau NHP. These plants may be considered important elements in the cultural landscape of the Park.

Niu or coconut was an extremely important plant to aboriginal Hawaiians; its origin is uncertain but may have been Malesia. Today, the palm grows on the coasts of all the main Hawaiian Islands, where it persists and is sparingly naturalized (Wagner et al. 1990). Seventy-five coconut trees were counted within surveyed portions of the Park; these were primarily at the parking area south of Kaloko Pond and on the beach near 'Aimakapā Pond (Fig. 37). At least additional 30 palms were on the beach at 'Ai'ōpio near the permittees' dwellings; an accurate mapping was not possible in this restricted area. Canfield (1990) reported coconut as occasional along the coastline and the dominant tree near former dwellings south of Kaloko Pond.

Kou (Cordia subcordata), native to tropical Asia, was an ancient introduction to islands of Polynesia and Micronesia (Whistler 1992). A medium-size tree with large, ovate leaves and showy clusters of orange flowers, kou was both ornamental and useful to ancient Hawaiians. Flowers were used for leis, and kou wood was used for bowls, paddles, drums, and other items. Only eight trees were located during the 1992-93 survey of Kaloko-Honokōhau NHP; these were on the coast and near the parking area south of Kaloko Pond and on the coast near 'Aimakapā Pond (Fig. 37). The 'Ai'ōpio area was not surveyed, but may be expected to have kou trees. Canfield (1990) considered kou to be uncommon in northern Kaloko but locally common just south of the Kaloko-Kohanaiki boundary. As kou trees were not found to be common at any Park site during the current survey, the species may have decreased in the Park since 1987 or trees may have been too defoliated to recognize. The species is often heavily infested by the kou leafworm (Ethmia nigroapicella), a non-native moth in the family Oecophoridae (Hawaiian Entomological Society 1990).

By far the most common of the Polynesian introductions in the Park is noni (*Morinda citrifolia*). This shrub or small tree with shiny, strongly-veined leaves and globose clusters of white flowers is native to southeastern Asia and Australia. Polynesians introduced noni to Hawai'i and cultivated it for its medicinal and dye properties (Wagner et al. 1990); noni fruits are still sought after for folk medicine. Three hundred seventy three noni trees or shrubs were counted during systematic sampling in the Park: 126 on transects, 93 near transects, 33 along the road to Kaloko, 82 around Kaloko Pond, and the remainder near the coast or the Māmalahoa Trail (Fig. 38). In addition, noni occurred on the unsurveyed northern and southern margins of 'Aimakapā Pond, but could not be mapped there. This species was distributed throughout the Park in both shrubland and forest, but was very sparse or absent on 'a'ā flows. Noni was densest near the two large fishponds and in the coastal forest near 'Ai'ōpio. The on-transect density of noni was 1.5 plants/1000 m<sup>2</sup>. Canfield (1990) considered noni to be widespread but uncommon; noni was considered common in the current survey.

'Auhuhu (*Tephrosia purpurea* var. *purpurea*) is a small shrub used by Hawaiians as fish poison. Roots and leaves were crushed and placed in fishponds or lagoons, where the 'auhuhu poison would stun fish and cause them to float to the surface, permitting easy collection. The poison does not affect humans (Whistler 1992). 'Auhuhu has compound leaves, white or purple flowers, and small, flattened pods that twist when ripe. This species is native to Africa, Asia, Australia, and the Tuamotus, but was introduced by Polynesians to Hawai'i, where it grows in coastal and lowland sites on all the main islands (Wagner et al. 1990). 'Auhuhu was relatively uncommon in Kaloko-Honokōhau NHP; only 24 shrubs were found on or near transects (Fig. 39). Six 'auhuhu were growing near the anchialine pool Kahinahina'ula (Queen's Bath); the remainder were on Transects 5 and 6. Here 'auhuhu plants were in a fountain grass community with ēkoa shrubs near rock walls and remains of Hawaiian structures. On-transect density of 'auhuhu was 0.2 shrubs/1000m<sup>2</sup>. Canfield (1990) also described 'auhuhu as uncommon; she noted the shrub near 'Aimakapā and on the jeep road to Kaloko Pond. 'Auhuhu was not seen in this latter area in 1992-93.

### Vegetation Types

Canfield (1990) recognized eight different vegetation types in Kaloko-Honokōhau NHP and further subdivided one of these, strand vegetation, into four subtypes. From aerial photograph interpretation and a ground survey, she produced a vegetation type map of the Park. In the current survey, nine systematically placed transects crossed the Park and traversed each of Canfield's mapped vegetation types. Some of the mapped vegetation boundaries were not clearly detectable on the ground, and variation in grass and shrub cover within adjacent systematically-placed vegetation plots indicated that three of Canfield's vegetation types could be combined (grassland, inland scrub, and savanna). The following vegetation descriptions are based on a total of 90 systematic plots, 10- x 20-m in size, distributed throughout the Park at 100-m intervals on transects (Fig. 2).

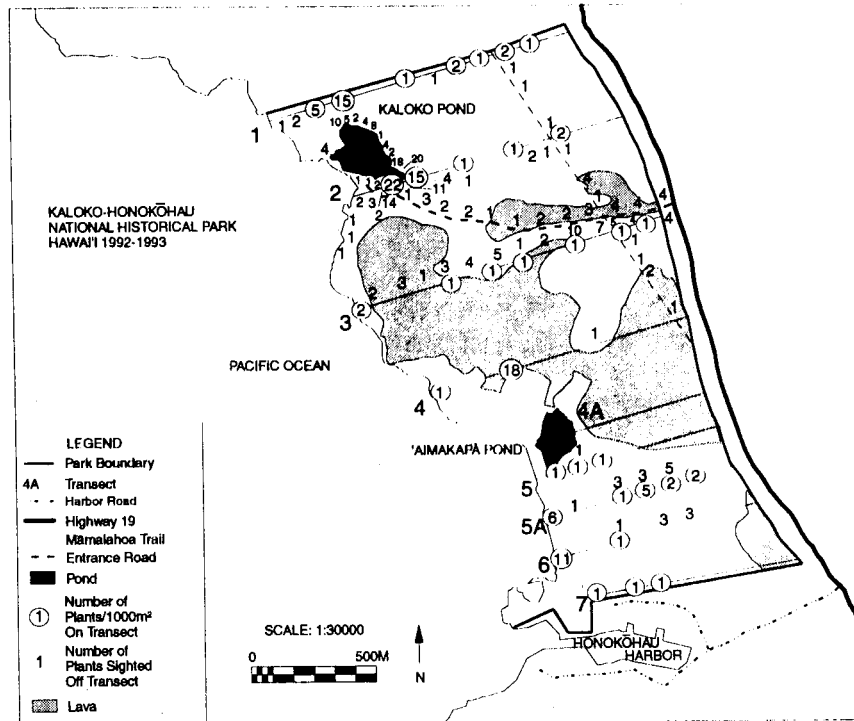


Figure 38. Number of noni (*Morinda citrifolia*) plants on or near transects, surveyed trails, and pond perimeters in Kaloko-Honokōhau National Historical Park (noni not mapped on 'Aimakapā Pond perimeter).

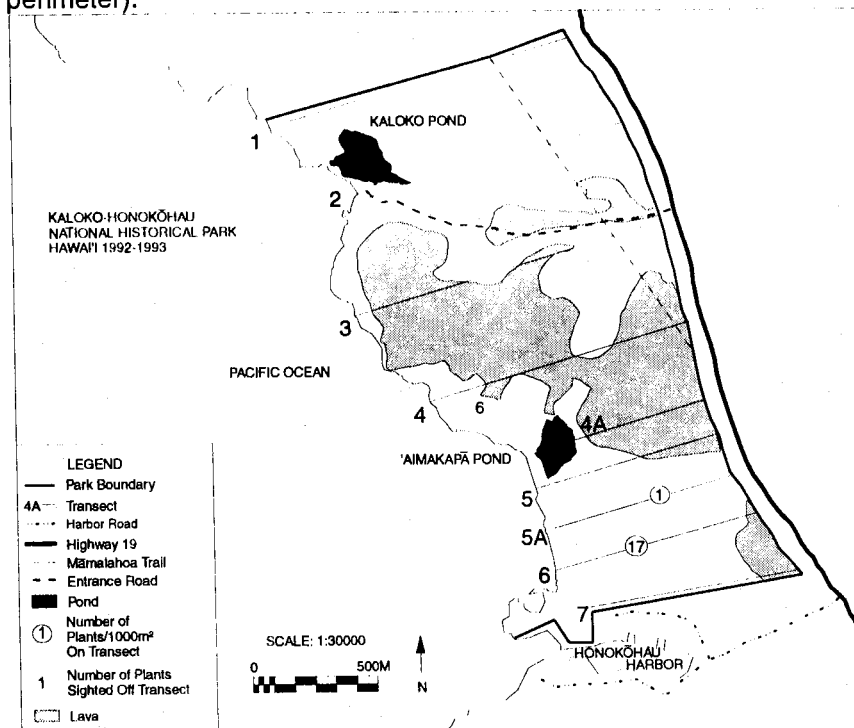


Figure 39. Number of 'auhuhu (*Tephrosia purpurea* var. *purpurea*) plants on or near transects, surveyed trails, and pond perimeters in Kaloko-Honokōhau National Historical Park.



Barren or Sparsely Vegetated Lava - Twenty-four plots (27%) were systematically placed in this vegetation type. These plots were on five transects; barren or sparsely vegetated 'a'ā lava was the predominant vegetation type on Transects 4, 4A, the lower half of 3, and the upper part of 5 and 7. Some of these plots supported no vascular plants at all, and the only "plant" life present was scattered fruticose lichens (Stereocaulon vulcani) on chunks of 'a'ā lava. Most plots in this vegetation type had very scattered individuals of fountain grass and 'uhaloa, and some had a low percentage cover of Christmas berry, ēkoa, sourbush, or Natal redtop. No alien species had more than 1% estimated cover in sparsely vegetated lava plots, except fountain grass with 5-25% cover in three plots, ēkoa with 1-5% cover in one plot, and Christmas berry with either 1-5% or 5-25% cover in three plots. Maiapilo had 1-5% cover in several sparsely vegetated plots. Estimated cover and species composition in sparsely vegetated lava plots in 1992-93 were similar to those described for barren lava by Canfield (1990). Canfield's estimates of cover in barren lava plots with vegetation were somewhat higher than in the current study; she described localized associations of fountain grass/hi'aloa ('uhaloa) with 5% cover and fountain grass/koa-haole (ēkoa) with 20% cover.

Strand Vegetation - Strand or coastal vegetation was not extensively surveyed during this project. Because of the systematic east to west placement of transects, only four plots happened to fall on strand vegetation. Vegetation of the four strand plots was primarily beach heliotrope (Tournefortia argentea) shrubland with either naupaka kahakai or 'ōhelo kai of secondary importance. Estimated cover of beach heliotrope varied from 25-50% to 50-75%. A few scattered fountain grass or alien shrubs (Christmas berry, kiawe, sourbush) also occurred in plots. Substrates were sand, and more than 50% of the ground area was bare of vegetation. Canfield (1990) focused more attention on coastal vegetation in her survey, and recognized four major structural categories or plant communities: low strand vegetation, strand scrub, shrubby strand, and strand forest. She further subdivided the four categories into 12 specific vegetation subtypes made up of 37 localized plant associations. The strand vegetation sampled in the current study corresponds to Canfield's tree heliotrope/naupaka association of shrubby strand vegetation. Several additional recognizable plant associations/community subtypes were also noted during the 1992-93 coastal survey, although they were not sampled with vegetation plots. These included 'ākulikuli/'ōhelo kai/pickleweed association on pāhoehoe at the ocean edge, naupaka scrub on sandy strand, coconut grove near Kaloko Pond, milo forest on sand, and kiawe forest on sand. The two latter strand forest types seemed to be indistinguishable from and continuous with inland forest near the two large fish ponds.

Anchialine Ponds - Anchialine ponds or pools were not sampled during the 1992-93 systematic survey of Park vegetation. These special pond communities scattered throughout the Park near the shore deserve a separate project to map pools and monitor their unique biological resources. Canfield (1990) recognized four plant community subtypes centered on anchialine pools within the Park; the dominant plants of these communities were 'ākulikuli kai, 'aki'aki, fountain grass, and Christmas berry.

Marsh - This plant community occurs near Kaloko and 'Aimakapā Ponds, but covers relatively little of the Park. Only four vegetation plots occurred in marsh vegetation, and each supported slightly different vegetation. One plot on the edge of Kaloko Pond contained forest dominated by kiawe with ēkoa and sourbush shrubs. The substrate was flooded pāhoehoe with a 5-25% cover of pickleweed. A second type of marsh vegetation was sampled near 'Aimakapā Pond on Transect 4, where there was a forest of hau and milo with Christmas berry shrubs and very little ground cover. Nearby on Transect 5, the marsh vegetation was either a milo forest with ground cover of seashore paspalum and pickleweed or an open marsh of paspalum with scattered milo, hau, and patches of pickleweed. Several other marsh subtypes or associations were observed near 'Aimakapā, but were not sampled with systematic vegetation plots. Canfield (1990) recognized four marsh community subtypes in Kaloko-Honokōhau; her knotgrass marsh and milo shrubs in knotgrass marshy meadow correspond to the two sampled vegetation plots on Transect 5. Canfield's water hyssop meadow north of 'Aimakapā Pond was observed but not sampled during this study; makaloa sedge appears to be co-dominant with water hyssop ('ae'ae) in this marsh. Canfield's fourth marsh subtype, mangrove forest, is no longer present, as the alien mangrove is being actively controlled within the Park.

Alien Grassland and Shrubland - Fifty percent (45) of systematically placed vegetation plots were in vegetation that could be described as either grassland with shrubs or shrubland with grasses (scrub). True savanna, defined as a grassland supporting scattered (5-20%) trees, was not observed within the Park except as a narrow band in the interface between forest and shrubland/grassland. Most sites dominated by grasses had a significant shrub component, although scattered tall trees were not common. Vegetation dominated by fountain grass (27 plots) was found along the upper reaches of Transects 1, 2, and 5A, and in the central portions of Transects 6 and 7. Elsewhere scattered patches of vegetation in lava flows were also dominated by grasses. The estimated cover of fountain grass in 27 grassland plots ranged from 25-50% to 75-100%. Ēkoa was often an important component of grassland vegetation, where the alien shrub typically had 5-25% cover. Other shrubs, such as klu, lantana, 'opiuma, and Christmas berry were present with <5% cover.

Vegetation dominated by alien shrubs occurred on Transects 1, 2, 3, 5A, and 6. Shrublands (18 plots) were distinguished from grassland vegetation only by a greater cover of alien shrubs, particularly ēkoa. Ēkoa typically had estimated cover of 25-50% or 50-75% in these plots. In several shrubland plots, Christmas berry or klu was the dominant shrub, mixed with ēkoa and other aliens. Almost all sampled shrubland plots had a significant percentage cover of fountain grass, usually 25%. Plant species composition was very similar in shrubland and grassland. Because of the intermixing of grassland and shrubland along the systematic transects and the juxtaposition of the two structural vegetation types within a few meters of each other, it might be more realistic to consider them the same vegetation called ēkoa/fountain grass shrubland (or scrub). This general vegetation type would encompass the grassland, inland scrub, and savanna of the vegetation map of Canfield (1990). Covering approximately half of

Kaloko-Honokohau, *ēkoa*/fountain grass shrubland was the main vegetation cover of the Park in 1992-93.

A few plots had vegetation that could not be placed in any of Canfield's vegetation type categories. These were plots sparsely covered by native shrubs such as *maiapilo*, *milo*, or *'uhaloa* with scattered alien shrubs and grasses.

Inland (Kiawe) Forest - Closed to open forest of *kiawe* occurred on 11 plots, 12% of the systematically sampled plots. *Kiawe* forest was sampled on Transects 1 and 2 near Kaloko Pond, on Transects 4 and 5 near 'Aimakapā Pond, and at the coastal end of Transects 5A and 6. At most of these sites, *kiawe* formed a closed canopy (>50% cover) over scattered alien shrubs and grasses. *Kiawe* trees were typically 4-5 m tall, and alien understory shrubs such as Christmas berry, *ēkoa*, *sourbush*, and coral berry were 1-3 m tall. Fountain grass and Guinea grass were common in the *kiawe* forest; many other alien herbs were also scattered on the forest floor. There was usually a noticeable amount of bare rock or exposed soil beneath *kiawe* cover. This forest surrounded much of Kaloko and 'Aimakapā Ponds and occurred in a swath along the coast from 'Aimakapā to near the Park's boundary with Honokōhau Harbor. To the east, *kiawe* forests intergraded with *ēkoa*/fountain grass shrubland. Near wetlands, *kiawe* forest gave way to thickets of *milo* and *hau*. After *kiawe* removal near 'Aimakapā Pond, forests there may eventually be dominated by indigenous *milo* trees or may be converted to shrublands. Canfield (1990) recognized two subtypes of inland forest, dominated by either *kiawe* or *milo*.

### Monitoring and Research Recommendations

The 1992-93 botanical survey of Kaloko-Honokōhau NHP resulted in an updated checklist of vascular plants, distribution maps and abundance estimates of disruptive alien plants, distribution maps and density calculations for native plants, and a system for monitoring vegetation in most of the recognized vegetation types of the Park. It is recommended that further monitoring be carried out on the three candidate endangered plant species known to be in the Park, as well as on selected native woody plant species. More intensive monitoring of numbers and size classes of native plants would reveal their reproductive status and the condition of native plant populations in the Park (i.e. declining, increasing, stable). Information on the current distribution and status of native plants will be particularly useful if restoration of native or Polynesian plants is attempted. Plant restoration has been recognized as desirable to achieve landscapes appropriate to the interpretation of the important cultural resources contained within the Park (National Park Service 1991). However, native plant restoration should only be undertaken after vegetation management and outplanting plans are developed. Guidelines for revegetation and outplanting are available from the Park Service (National Park Service 1993) and Hawaiian arboreta and rare plant groups (Woolliams and Llop 1993).

Future re-monitoring of alien plant species along systematic transects would help the Park evaluate threats to native plants and would allow prioritization of alien plants for

future eradication or reduction. Those alien plants that are present in low amounts but are known to be invasive and disruptive elsewhere should be eradicated from the Park as soon as possible. Examples of such alien species are ivy gourd, molasses grass, and autograph tree. Areas being cleared of dominant alien plants, such as kiawe and mangrove, should be periodically monitored to check for new alien plant introductions. Monitoring would also help to determine what plants will, without further human intervention, replace those removed. Additionally, roads and trails of the Park should be regularly examined for new alien plant introductions that may pose a risk to native plants, plant communities, or archaeological resources.

The Park is fortunate to have a recent vegetation map and detailed descriptions of specific plant associations (Canfield 1990). As wetland and strand vegetation types are well represented in the Park and may be particularly dynamic, it would be useful to establish permanent monitoring plots in some of the important native plant associations identified by Canfield along the coast and near 'Aimakapā Pond. Rare systems, such as anchialine pools, also deserve further research and monitoring.

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APPENDIX 1  
KALOKO-HONOKŌHAU NATIONAL HISTORICAL PARK  
VASCULAR PLANT CHECKLIST

ANNOTATIONS AND SYMBOLS

Status:

Endemic = Native and unique to the Hawaiian Islands

Indigenous = Native to the Hawaiian Islands and other lands

Polynesian = Introduced by Polynesians prior to 1778

Alien = Introduced to Hawai'i after 1778, non-indigenous, exotic

Symbols:

! = Species in Park in 1987, not seen in 1992-93 (or 1995): 5 species (1 alien, 2 indigenous, 2 endemic)

+ = Species on 1987 checklist in areas not currently within Park boundaries: 7 species

\* = Additions since Canfield's 1987 checklist: 56 species (46 alien, 9 indigenous, 1 endemic)

Abundance Ratings:

A = Abundant

C = Common, numerous and widespread

O = Occasional, scattered in many localities in Park

U = Uncommon, infrequent, few plants scattered or localized

R = Rare, one or very few plants seen

lc = Localized

Collectors: Listed by initials and specimen # at end of checklist entries (sn indicates those without #). All voucher specimens deposited at Hawaii Volcanoes National Park Herbarium.

DKP = David K. Palumbo

LLA = Lyman L. Abbott

LWP = Linda W. Pratt

MLF = Michelle L. Fulton



KALOKO-HONOKŌHAU NATIONAL HISTORICAL PARK  
VASCULAR PLANT CHECKLIST

	<u>Status</u>	<u>Abundance</u>
<u>FERNS AND FERN ALLIES</u>		
DRYOPTERIDACEAE (NEPHROLEPIDOIDEAE) - WOODFERN FAMILY (SWORDFERN SUBFAMILY)		
<u>Nephrolepis exaltata</u> (L.) Schott Kupukupu Reported by Canfield (1990) from area just north of Noio Point; not seen in Park during 1992-93 survey.	+Indigenous	
<u>Nephrolepis multiflora</u> (Roxb.) F. M. Jarrett ex C. V. Morton Syn: <u>Nephrolepis hirsutula</u> Scaly swordfern Occasional on lava flows and near Kahinahina'ula (LWP 2619, 2890).	*Alien	O
POLYPODIACEAE - POLYPODY FAMILY		
<u>Phymatosorus grossus</u> (Langsd. & Fisch.) Brownlie Laua'e Creeping fern seen only on Transect 3 near coast.	*Alien	R
<u>Polypodium pellucidum</u> Kaulf. 'Ae Reported by Canfield (1990) from central Kaloko ahupua'a and north of Noio Point, not seen in Park during 1992-93 survey.	!Endemic	
PSILOTACEAE - WHISK FERN FAMILY		
<u>Psilotum nudum</u> (L.) P. Beauv. Moa, whisk fern Small herb seen only on Transect 1.	Indigenous	R

KALOKO-HONOKŌHAU NATIONAL HISTORICAL PARK  
VASCULAR PLANT CHECKLIST (Continued)

	<u>Status</u>	<u>Abundance</u>
<u>FLOWERING PLANTS -</u>		
<u>DICOTYLEDONS (MAGNOLIOPSIDA)</u>		
ACANTHACEAE - ACANTHUS FAMILY		
<u>Barleria cristata</u> L. Philippine violet Small shrub seen only in kiawe forest east of 'Aimakapā Pond (LWP & DKP 2856).	*Alien	R
AIZOACEAE - FIG-MARIGOLD FAMILY		
<u>Sesuvium portulacastrum</u> (L.) L. 'Ākulikuli, sea purslane Creeping succulent herb common on coast and margins of ponds (LWP 2476).	Indigenous	C
AMARANTHACEAE - AMARANTH FAMILY		
<u>Achyranthes aspera</u> L. No common name Herb or shrub uncommon on east side of 'Aimakapā Pond (LWP 2470, 2584).	*Alien	U
<u>Amaranthus lividus</u> L. subsp. <u>polygonoides</u> (Moq.) Probst Amaranth Herb uncommon on east side of 'Aimakapā Pond, also on Transect 1 near coast (LWP 2668).	Alien	U
<u>Amaranthus spinosus</u> L. Spiny amaranth Herb seen only on Transect 7.	*Alien	R
<u>Amaranthus viridis</u> L. Slender amaranth Herb uncommon on sandy substrate near access trail from Honokōhau Harbor and near 'Aimakapā Pond (LWP 2582, 2904).	*Alien	U

KALOKO-HONOKŌHAU NATIONAL HISTORICAL PARK  
VASCULAR PLANT CHECKLIST (Continued)

	<u>Status</u>	<u>Abundance</u>
<b>ANACARDIACEAE - MANGO FAMILY</b>		
<u>Schinus terebinthifolius</u> Raddi Christmas berry Shrub common throughout Park, except on sparsely vegetated 'a'ā lava (LWP 2914).	Alien	C
<b>APOCYNACEAE - DOGBANE FAMILY</b>		
<u>Catharanthus roseus</u> (L.) G. Don Madagascar periwinkle Scattered herb in shrublands of northern third of Park and near Honokōhau Harbor boundary.	Alien	O
<u>Plumeria rubra</u> L. Plumeria, frangipani Only one tree seen, planted at heiau near 'Ai'ōpio (probably by permittees).	*Alien	R
<b>ASTERACEAE (COMPOSITAE) - SUNFLOWER FAMILY</b>		
<u>Ageratum conyzoides</u> L. Ageratum Herb uncommon near Honokōhau Harbor boundary (MLF 502).	Alien	U
<u>Bidens cynapiifolia</u> Kunth West Indian beggar's tick Herb uncommon on Transect 6 near Honokōhau Harbor boundary.	*Alien	U
<u>Bidens micrantha</u> Gaud. subsp. <u>ctenophylla</u> (Sherff) Nagata & Ganders Ko'oko'olau Rare shrub found east of 'Aimakapā and on Transect 6. Listed as a Candidate Endangered Species (Category 1). This is most likely the same species called <u>Bidens hawaiiensis</u> by Canfield (1990); the two species are similar in appearance (LWP 2475, LLA sn).	Endemic	R

KALOKO-HONOKŌHAU NATIONAL HISTORICAL PARK  
VASCULAR PLANT CHECKLIST (Continued)

	<u>Status</u>	<u>Abundance</u>
ASTERACEAE		
- SUNFLOWER FAMILY (Continued)		
<u>Bidens pilosa</u> L. Spanish needle Large herbaceous plant uncommon on lava east of 'Aimakapā Pond.	*Alien	U
<u>Emilia fosbergii</u> Nicolson Pualele Few plants on Transect 2 and near unpaved road to Kaloko Pond (LWP 2888).	*Alien	R
<u>Emilia sonchifolia</u> (L.) DC Flora's paintbrush Only one plant seen east of 'Aimakapā Pond (LWP 2675).	*Alien	R
<u>Pluchea symphytifolia</u> (Mill.) Gillis (Syn: <u>Pluchea odorata</u> ) Sourbush, shrubby fleabane Large shrub occasional on lava and near coast, common near anchialine pools (LWP 2910).	Alien	O
<u>Reichardia picroides</u> (L.) Roth Picridium Reported by Canfield (1990) from area south of entrance to Honokōhau Harbor (outside Park); not seen in Park during 1992-93 survey.	+Alien	
<u>Tridax procumbens</u> L. Coat buttons Herb uncommon on main jeep road to Kaloko Pond, on the Māmalahoa Trail, and on Transect 2 (LWP 2792).	Alien	U
BATACEAE - SALTWORT FAMILY		
<u>Batis maritima</u> L. Pickleweed, 'ākulikuli kai Sprawling succulent shrub abundant at coastal sites and edges of ponds.	Alien	A, lc

KALOKO-HONOKŌHAU NATIONAL HISTORICAL PARK  
VASCULAR PLANT CHECKLIST (Continued)

	<u>Status</u>	<u>Abundance</u>
<b>BORAGINACEAE - BORAGE FAMILY</b>		
<u>Cordia subcordata</u> Lam. Kou Coastal tree uncommon near Kaloko Pond (LWP 2915).	Polynesian	U
<u>Heliotropium anomalum</u> Hook. & Arnott subsp. <u>argenteum</u> A. Gray Hinahina Reported by Canfield (1990) from milo forest at Kaloko-Honokōhau boundary; not seen during 1992-93 survey.	!Indigenous	
<u>Heliotropium curassavicum</u> L. Kīpūkai, nena, seaside heliotrope Low-growing, succulent herb seen near Kaloko Pond and near Honokōhau Harbor boundary.	Indigenous	U
<u>Tournefortia argentea</u> L. fil. (Syn: <u>Messerschmidia argentea</u> ) Tree heliotrope Tree abundant in coastal forest and on beaches.	Alien	A, lc
<b>BUDDLEIACEAE (LOGANIACEAE in part) - BUTTERFLY BUSH FAMILY</b>		
<u>Buddleia asiatica</u> Lour. Asiatic butterfly bush One shrub seen on jeep road to Kaloko Pond.	Alien	R
<b>CACTACEAE - CACTUS FAMILY</b>		
<u>Opuntia ficus-indica</u> (L.) Mill. (Syn: <u>Opuntia megacantha</u> ) Prickly pear cactus, pānini Few, very scattered individuals on main jeep road to Kaloko Pond, and on Transects 1, 3, 4, 5A, and 6.	Alien	U

KALOKO-HONOKŌHAU NATIONAL HISTORICAL PARK  
VASCULAR PLANT CHECKLIST (Continued)

	<u>Status</u>	<u>Abundance</u>
<b>CAPPARACEAE - CAPER FAMILY</b>		
<u>Capparis sandwichiana</u> DC Maiapilo, pua pilo Shrub found occasionally throughout Park, locally common east of 'Aimakapā Pond. This is a Candidate Endangered Species (Category 2).	Endemic	O
<u>Cleome gynandra</u> L. (Syn: <u>Gynandropsis gynandra</u> ) Wild spider flower Herb seen only at heiau near 'Ai'ōpio. This plant is much more common to the north in South Kohala District.	*Alien	R
<b>CHENOPODIACEAE - GOOSEFOOT FAMILY</b>		
<u>Chenopodium ambrosioides</u> L. Mexican tea Reported by Canfield (1990) from area just south of Honokōhau Harbor entrance (outside Park); not seen in Park during 1992-93 survey.	+Alien	
<u>Chenopodium murale</u> L. Nettle-leaved goosefoot, 'āheahea Herb uncommon at parking area at Kaloko Pond, near northern boundary of Park, on Transect 6, and occasional on beach near 'Ai'ōpio (LWP 2586, 2592, 2905).	Alien	O
<b>CLUSIACEAE (GUTTIFERAE) - MANGOSTEEN FAMILY</b>		
<u>Clusia rosea</u> Jacq. Autograph tree One young tree near rock wall at Kaloko Pond parking area. This tree was later removed by Park personnel.	Alien	R

KALOKO-HONOKŌHAU NATIONAL HISTORICAL PARK  
VASCULAR PLANT CHECKLIST (Continued)

	<u>Status</u>	<u>Abundance</u>
CONVOLVULACEAE - MORNING GLORY FAMILY		
<p><u>Ipomoea indica</u> (J. Burm.) Merr. (Syn: <u>Ipomoea congesta</u>) Koali 'awa, koali 'awahia Vine found in low numbers throughout Park, primarily in open shrublands.</p>	Indigenous	O
<p><u>Ipomoea pes-caprae</u> (L.) R. Br. subsp. <u>brasiliensis</u> (L.) Ooststr. (Syn: <u>Ipomoea brasiliensis</u>) Pōhuehue, beach morning glory Trailing vine occasionally seen on sandy coast and in forest inland from 'Ai'ōpio (LWP 2894).</p>	Indigenous	O
<p><u>Ipomoea violacea</u> L. No common name Few plants seen near Kaloko Pond after Hurricane Iniki (LWP 2854).</p>	*Alien	R
<p><u>Jacquemontia ovalifolia</u> (Choisy) H. Hallier subsp. <u>sandwicensis</u> (A. Gray) K. Robertson (Syn: <u>Jacquemontia sandwicensis</u>) Pā'ū o Hi'iaka Slender vine uncommon on sandy beaches of Kaloko, also on pāhoehoe south of 'Aimakapā Pond, and on Transect 5 (LWP 2891).</p>	Endemic	U
CRASSULACEAE - ORPINE FAMILY		
<p><u>Kalanchoe pinnata</u> (Lam.) Pers. (Syn: <u>Bryophyllum pinnatum</u>) Air plant Succulent herb rare in Park. Few plants seen near gate leading from highway to bulldozed site in lava; these plants had disappeared by 1995.</p>	*Alien	R

KALOKO-HONOKŌHAU NATIONAL HISTORICAL PARK  
VASCULAR PLANT CHECKLIST (Continued)

	<u>Status</u>	<u>Abundance</u>
CRASSULACEAE - ORPINE FAMILY (Continued)		
<u>Kalanchoe tubiflora</u> (Harv.)	!Alien	
Raym.-Hamet (Syn: <u>Bryophyllum tubiflorum</u> ) Chandelier plant Reported by Canfield (1990) from area just north of entrance to Honokōhau Harbor; not seen in Park during 1992-93 survey.		
CUCURBITACEAE - GOURD FAMILY		
<u>Coccinia grandis</u> (L.) Voigt	*Alien	R
Ivy gourd, scarlet-fruited gourd Invasive vine found rarely on Transects 1 and 5, and in areas cleared of kiawe east of 'Aimakapā Pond (LWP 2514, 2666, 2667). Plants uprooted during survey where possible.		
<u>Momordica charantia</u> L.	*Alien	R
Balsam pear, bitter melon One vine on Transect 5 (400 m).		
EUPHORBIACEAE - SPURGE FAMILY		
<u>Chamaesyce hirta</u> (L.) Millsp.	Alien	O
(Syn: <u>Euphorbia hirta</u> ) Hairy spurge Herb scattered along the Māmalahoa Trail and on Transects 1, 2, 3, and 6 (LWP 2626, 2881).		
<u>Chamaesyce hypericifolia</u> (L.) Millsp.	*Alien	R
(Syn: <u>Euphorbia glomerifera</u> ) Graceful spurge Roadside herb not seen on transects.		



KALOKO-HONOKŌHAU NATIONAL HISTORICAL PARK  
VASCULAR PLANT CHECKLIST (Continued)

	<u>Status</u>	<u>Abundance</u>
<b>EUPHORBIACEAE - SPURGE FAMILY (Continued)</b>		
<p><u>Chamaesyce prostrata</u> (Aiton) Small (Syn: <u>Euphorbia prostrata</u>) Prostrate spurge Herb growing near 'Aimakapā Pond, not seen on transects.</p>	Alien	R
<p><u>Euphorbia</u> sp. Unknown Ornamental succulent planted near heiau at 'Ai'ōpio (probably by permittees), only one seen. This area is generally off-limits to researchers and the public, but was visited once.</p>	*Alien	R
<p><u>Phyllanthus debilis</u> Klein ex Willd. Niruri Reported by Canfield (1990) from south of entrance to Honokōhau Harbor (outside Park); not seen in Park during 1992-93 survey.</p>	+Alien	
<b>FABACEAE (LEGUMINOSAE) - PEA FAMILY</b>		
<p><u>Acacia farnesiana</u> (L.) Willd. Klu Shrub common on pāhoehoe substrates throughout Park.</p>	Alien	C
<p><u>Chamaecrista nictitans</u> (L.) Moench subsp. <u>patellaria</u> (DC ex Collad.) H. Irwin &amp; Barneby var. <u>glabrata</u> (Vogel) H. Irwin &amp; Barneby (Syn: <u>Cassia leschenaultiana</u>) Partridge pea Small shrub uncommon on pāhoehoe substrates on Transects 2, 4, 6, and 7.</p>	Alien	U
<p><u>Delonix regia</u> (Bojer ex Hook.) Raf. Royal poinciana Few trees planted along highway just outside of Park boundary (LWP 2877).</p>	*Alien	R

KALOKO-HONOKŌHAU NATIONAL HISTORICAL PARK  
VASCULAR PLANT CHECKLIST (Continued)

	<u>Status</u>	<u>Abundance</u>
FABACEAE - PEA FAMILY (Continued)		
<p><u>Desmodium tortuosum</u> (Sw.) DC Florida beggarweed Shrub found in one locality on the Māmalahoa Trail and on Transect 3 (LWP 2527, 2627).</p>	*Alien	R
<p><u>Desmodium triflorum</u> (L.) DC Three-flowered beggarweed Small herb uncommon on Transects 1 and 2 near the Māmalahoa Trail.</p>	*Alien	U
<p><u>Erythrina variegata</u> L. Coral tree Few trees planted along the Highway just outside upper boundary of Park (LWP 2878).</p>	*Alien	U
<p><u>Indigofera suffruticosa</u> Mill. Indigo Shrub scattered on pāhoehoe substrates on Transects 2, 4, and 7, and near the Honokōhau Harbor boundary (LWP 2909).</p>	Alien	O
<p><u>Leucaena leucocephala</u> (Lam.) de Wit Ēkoa, koa haole Large shrub or small tree abundant on pāhoehoe substrates throughout Park (LWP 2911).</p>	Alien	A
<p><u>Pithecellobium dulce</u> (Roxb.) Benth. 'Opiuma, Manila tamarind Large shrub or small tree common on pāhoehoe substrates in the northern third of the Park, also found infrequently between 'Aimakapā Pond and the southern Park boundary.</p>	Alien	C

KALOKO-HONOKŌHAU NATIONAL HISTORICAL PARK  
VASCULAR PLANT CHECKLIST (Continued)

	<u>Status</u>	<u>Abundance</u>
FABACEAE - PEA FAMILY (Continued)		
<p><u>Prosopis pallida</u> (Humb. &amp; Bonpl. ex Willd.) Kunth Kiawe, mesquite Tree or shrub scattered throughout Park on pahoehoe substrates, particularly abundant near Kaloko and 'Aimakapā Ponds and in coastal forest east of 'Ai'ōpio. Kiawe removal is in progress near Kaloko and 'Aimakapā Ponds.</p>	Alien	A
<p><u>Senna occidentalis</u> (L.) Link Coffee senna Shrub seen only on Transect 1 near northern Park boundary (DKP 95-001).</p>	*Alien	R
<p><u>Tephrosia purpurea</u> (L.) Pers. var. <u>purpurea</u> 'Auhuhu Small shrub uncommon on pāhoehoe in southern half of Park on Transects 4, 5A, and 6 (LWP 2579).</p>	Polynesian	U
GOODENIACEAE - GOODENIA FAMILY		
<p><u>Scaevola sericea</u> Vahl (Syn: <u>Scaevola taccada</u>) Naupaka kahakai Shrub common along coast and on margin of 'Aimakapā Pond.</p>	Indigenous	C
LAMIACEAE (LABIATAE) - MINT FAMILY		
<p><u>Hyptis pectinata</u> (L.) Poit. Comb hyptis Few shrubby plants at one site along Māmalahoa Trail (LWP 2628).</p>	*Alien	R

KALOKO-HONOKŌHAU NATIONAL HISTORICAL PARK  
VASCULAR PLANT CHECKLIST (Continued)

	<u>Status</u>	<u>Abundance</u>
LAMIACEAE - MINT FAMILY (Continued)		
<u>Salvia occidentalis</u> Sw. West Indian sage Herb seen only near Honokāhau Harbor boundary (Transect 7) (MLF 503).	*Alien	R
MALVACEAE - MALLOW FAMILY		
<u>Abutilon grandifolium</u> (Willd.) Sweet Hairy abutilon Shrub uncommon on Transects 1, 2, and 6 (LLA sn).	*Alien	U
<u>Hibiscus tiliaceus</u> L. Hau Common shrubby tree growing with milo on edge of 'Aimakapā Pond and near coast (Transects 4 and 5) (LWP 2893).	*Indigenous	C, lc
<u>Malvastrum coromandelianum</u> (L.) Garcke subsp. <u>coromandelianum</u> False mallow Small shrub found on Transects 1 and 6 (LWP 2566, 2919, LLA sn).	*Alien	R
<u>Sida fallax</u> Walp. 'Ilima Shrub common and scattered in shrublands on pāhoehoe throughout Park (LWP 2916).	Indigenous	C
<u>Sida spinosa</u> L. Prickly sida Small shrub uncommon on pāhoehoe south and east of 'Aimakapā Pond (Transects 5A, 6, and 7 (LWP 2515, 2585, 2669, 2882).	*Alien	U
<u>Thespesia populnea</u> (L.) Sol. ex Correa Milo Tree abundant on coast and surrounding Kaloko and 'Aimakapā Ponds (LWP 2913).	Indigenous	A, lc

KALOKO-HONOKŌHAU NATIONAL HISTORICAL PARK  
VASCULAR PLANT CHECKLIST (Continued)

	<u>Status</u>	<u>Abundance</u>
MORACEAE - MULBERRY FAMILY		
<u>Ficus benamina</u> L. Weeping fig Reported by Canfield (1990) from area south of Honokōhau Harbor entrance (outside Park); not seen in Park during 1992-93 survey.	+Alien	
<u>Ficus microcarpa</u> L. fil. Chinese banyan One plant growing from crack in pāhoehoe north of Kaloko Pond; destroyed when found (LWP 2884).	*Alien	R
MYOPORACEAE - MYOPORUM FAMILY		
<u>Myoporum sandwicense</u> A. Gray Naio Uncommon in Park. Small tree or shrub found primarily in northern half of Park, most often near Kaloko Pond. Few plants seen in southern half of Park (Transect 5 and coast near 'Ai'ōpio).	Indigenous	U
NYCTAGINACEAE - FOUR-O'CLOCK FAMILY		
<u>Boerhavia coccinea</u> Mill. No common name Herb occasionally seen on coast near Kaloko Pond (LWP 2883, 2899).	*Alien	O
<u>Boerhavia repens</u> L. (Syn: <u>Boerhavia diffusa</u> , in part) Alena Sprawling herb uncommon on sandy beaches, near Kaloko Pond and on pāhoehoe in central part of Park (LWP 2517, 2565, 2591).	Indigenous	U

KALOKO-HONOKŌHAU NATIONAL HISTORICAL PARK  
VASCULAR PLANT CHECKLIST (Continued)

	<u>Status</u>	<u>Abundance</u>
<p>NYCTAGINACEAE - FOUR-O'CLOCK FAMILY (Continued)</p>		
<p><u>Bougainvillea glabra</u> Choisy Lesser bougainvillea Sprawling woody vine planted on rock berm along boundary with Honokōhau Harbor (LWP 2901); several color forms are present.</p>	*Alien	U
<p><u>Bougainvillea spectabilis</u> Willd. Bougainvillea Sprawling woody vine planted on rock berm along boundary with Honokōhau Harbor (LWP 2900).</p>	*Alien	U
<p>PAPAVERACEAE - POPPY FAMILY</p>		
<p><u>Argemone glauca</u> (Nutt. ex Prain) Pope var. <u>decipiens</u> Ownbey Pua kala, Hawaiian prickly poppy Herb seen near jeep road south of Kaloko Pond and on 'a'ā east of 'Aimakapā Pond.</p>	Endemic	R
<p>PASSIFLORACEAE - PASSION FLOWER FAMILY</p>		
<p><u>Passiflora foetida</u> L. Love-in-a-mist, scarlet-fruited passion flower Vine uncommon in shrubland south of Kaloko Pond (Transect 3) (LWP 2889).</p>	Alien	U
<p>PHYTOLACCACEAE - POKEWEED FAMILY</p>		
<p><u>Rivina humilis</u> L. Coral berry Shrub locally common near beneath kiawe trees near 'Aimakapā Pond (LWP 2471, LLA sn).</p>	*Alien	C, lc

KALOKO-HONOKŌHAU NATIONAL HISTORICAL PARK  
VASCULAR PLANT CHECKLIST (Continued)

	<u>Status</u>	<u>Abundance</u>
<b>PLUMBAGINACEAE - LEADWORT FAMILY</b>		
<u>Plumbago zeylanica</u> L. 'Ilie'e	*Indigenous	U
Low sprawling shrub uncommon in open shrubland near northern Park boundary (Transect 1) and near the Māmalahoa Trail (Transect 3). Also found beneath kiawe east and south of 'Aimakapā Pond (LWP 2513, 2593).		
<b>PORTULACACEAE - PURSLANE FAMILY</b>		
<u>Portulaca lutea</u> Sol. ex G. Forster 'Ihi	+Indigenous	
Reported by Canfield (1990) from area between Honokōhau Harbor and Noio Point; not found within Park during 1992-93 survey.		
<u>Portulaca oleracea</u> L. Pigweed, common purslane	Alien	O
Herb occasionally seen in shrublands and forests throughout Park (LWP 2621).		
<u>Portulaca pilosa</u> L. (Syn: <u>Portulaca cyanosperma</u> ) No common name	Alien	O
Herb scattered in shrublands and forests throughout Park; locally common on pāhoehoe substrates near coast (LWP 2895).		
<u>Talinum triangulare</u> (Jacq.) Willd. No common name	*Alien	U
Herb uncommon in shrublands between 'Aimakapā Pond and the Honokōhau boundary; also found just south of Kaloko Pond (LWP 2879, 2892).		

KALOKO-HONOKŌHAU NATIONAL HISTORICAL PARK  
VASCULAR PLANT CHECKLIST (Continued)

	<u>Status</u>	<u>Abundance</u>
<b>PROTEACEAE - PROTEA FAMILY</b>		
<u>Grevillea robusta</u> A. Cunn. ex R. Br. Silk oak, silver oak One tree in shrublands east of Kaloko Pond (Transect 2, 570 m) (LWP 2618).	*Alien	R
<b>RHIZOPHORACEAE - MANGROVE FAMILY</b>		
<u>Rhizophora mangle</u> L. American mangrove, red mangrove Few seedlings of this actively managed species remain at Kaloko and 'Aimakapā Ponds (LWP 2674); formerly abundant.	Alien	U
<b>RUBIACEAE - COFFEE FAMILY</b>		
<u>Canthium odoratum</u> (G. Forster) Seem. Alahe'e Shrub or small tree scattered in shrublands throughout Park. Now called <u>Psydrax odorata</u> by many botanists.	Indigenous	U
<u>Morinda citrifolia</u> L. Noni, Indian mulberry Shrub or small tree common in shrublands and forests throughout Park; particularly numerous near Kaloko Pond and in forest south of 'Aimakapā Pond (LWP 2912).	Polynesian	C
<b>SAPINDACEAE - SOAPBERRY FAMILY</b>		
<u>Dodonaea viscosa</u> Jacq. (Syn: <u>Dodonaea eriocarpa</u> ) 'A'ali'i Few individuals seen in shrublands east of Kaloko Pond and south of 'Aimakapā Pond near the Honokōhau Harbor boundary (LWP 2578).	*Indigenous	R



KALOKO-HONOKŌHAU NATIONAL HISTORICAL PARK  
VASCULAR PLANT CHECKLIST (Continued)

	<u>Status</u>	<u>Abundance</u>
<b>SCROPHULARIACEAE - FIGWORT FAMILY</b>		
<p><u>Bacopa monnieri</u> (L.) Wettst. ‘Ae‘ae, water hyssop Aquatic herb locally common at ‘Aimakapā Pond and relatively uncommon at Kaloko Pond (LWP 2474, 2624).</p>	Indigenous	C, lc
<b>SOLANACEAE - NIGHTSHADE FAMILY</b>		
<p><u>Lycium sandwicense</u> A. Gray ‘Ōhelo kai Succulent shrub seen near Kaloko and ‘Aimakapā Ponds and at several coastal sites (LWP 2473, 2512, 2562).</p>	Indigenous	O
<p><u>Lycopersicon esculentum</u> Mill. Tomato One plant seen near Kaloko Pond adjacent to jeep road and parking area.</p>	*Alien	R
<p><u>Solanum americanum</u> Mill. (Syn: <u>Solanum nigrum</u>) Pōpolo, glossy nightshade One plant seen near Kaloko Pond adjacent to jeep road and parking area (LWP 2623).</p>	*Indigenous	R
<b>STERCULIACEAE - CACAO FAMILY</b>		
<p><u>Waltheria indica</u> L. (Syn: <u>Waltheria americana</u>) ‘Uhaloa, hi‘aloha Low-growing shrub common in shrublands, forests, and on open lava flows throughout Park (LWP 2917).</p>	Indigenous	C

KALOKO-HONOKŌHAU NATIONAL HISTORICAL PARK  
VASCULAR PLANT CHECKLIST (Continued)

	<u>Status</u>	<u>Abundance</u>
VERBENACEAE - VERBENA FAMILY		
<u>Lantana camara</u> L. Lantana Shrub common in forests and shrublands, particularly in the northern part of the Park and near the coast.	Alien	C
<u>Stachytarpheta jamaicensis</u> (L.) Vahl Jamaica vervain Shrub seen at two sites south of 'Aimakapā (Transect 5A) (LWP 2580, 2671).	*Alien	R
ZYGOPHYLLACEAE - CREOSOTE BUSH FAMILY		
<u>Tribulus cistoides</u> L. Nohu Herb found along coastal road on Kaloko Point south of Kaloko Pond and on Māmalahoa Trail (LWP 2526, DKP 95-002).	*Indigenous	R
<u>Tribulus terrestris</u> L. Puncture vine Reported by Canfield (1990) from jeep road south of Kaloko Point, not seen in Park during 1992-93 survey. Found once on entrance road in 1995 (LWP 2887).	Alien	R
<u>FLOWERING PLANTS - MONOCOTYLEDONS (LILIOPSIDA)</u>		
AGAVACEAE - AGAVE FAMILY		
<u>Sansevieria trifasciata</u> Prain Bowstring hemp Planted (probably by permittees) at heiau near 'Ai'ōpio.	*Alien	R

KALOKO-HONOKŌHAU NATIONAL HISTORICAL PARK  
VASCULAR PLANT CHECKLIST (Continued)

	<u>Status</u>	<u>Abundance</u>
ARECACEAE (PALMAE) - PALM FAMILY		
<u>Cocos nucifera</u> L. Niu, coconut Locally common coastal tree near Kaloko and 'Aimakapā Ponds and on beach near 'Ai'ōpio Fishtrap.	Polynesian	C, lc
<u>Phoenix</u> sp. Date palm One young tree in sandy substrate near 'Aimakapā Pond.	Alien	R
COMMELINACEAE - SPIDERWORT FAMILY		
<u>Commelina benghalensis</u> L. Hairy honohono Uncommon herb in kiawe forest near coast south of 'Aimakapā Pond near Honokōhau boundary (Transects 5A and 6) (LWP 2583).	Alien	U
CYPERACEAE - SEDGE FAMILY		
<u>Bolboschoenus maritimus</u> (L.) Palla subsp. <u>paludosus</u> (A. Nels.) T. Koyama (Syn: <u>Scirpus maritimus</u> var. <u>paludosus</u> ) Kaluhā Large sedge common near edge of open water at 'Aimakapā Pond; also occurs in some anchialine pools (LWP 2472, 2563).	Indigenous	C
<u>Cyperus laevigatus</u> L. Makaloa Large sedge found in wetlands and anchialine pools. Uncommon on edge of Kaloko Pond; abundant in marsh north of 'Aimakapā Pond (LWP 2477).	Indigenous	C, lc

KALOKO-HONOKŌHAU NATIONAL HISTORICAL PARK  
VASCULAR PLANT CHECKLIST (Continued)

	<u>Status</u>	<u>Abundance</u>
CYPERACEAE - SEDGE FAMILY (Continued)		
<p><u>Fimbristylis cymosa</u> R. Br. Mau'u 'aki'aki Sedge uncommon on rocky coast in northern half of Park and on pāhoehoe south of 'Aimakapā Pond (LWP 2590, 2672).</p>	*Indigenous	U
<p><u>Fimbristylis dichotoma</u> (L.) Vahl Tall fringe rush Reported by Canfield (1990) as widespread; not seen in Park during 1992-93 survey.</p>	!Indigenous	
<p><u>Fimbristylis hawaiiensis</u> Hillebr. No common name Small sedge seen in one location east of Kaloko Pond (Transect 2) and near Kahinahina'ula (Queen's Bath) (LWP 2516, 2791). This is a Candidate Endangered Species (Category 2).</p>	*Endemic	R
<p><u>Mariscus javanicus</u> (Houtt.) Merr. &amp; Metcalfe (Syn: <u>Cyperus javanicus</u>) 'Ahu'awa, 'ehu'awa Large sedge seen in only one locality on eastern edge of Kaloko Pond (LWP 2673).</p>	*Indigenous	R
<p><u>Pycurus polystachyos</u> (Rottb.) P. Beauv. (Syn: <u>Cyperus polystachyos</u>) No common name Small sedge found only on Transect 5 south of 'Aimakapā Pond (LWP 2589).</p>	*Indigenous	R

KALOKO-HONOKŌHAU NATIONAL HISTORICAL PARK  
VASCULAR PLANT CHECKLIST (Continued)

	<u>Status</u>	<u>Abundance</u>
<b>LILIACEAE - LILY FAMILY</b>		
<u>Aloe vera</u> L. Aloe Succulent herb found along southern boundary with Honokōhau Harbor; probably planted there (LWP 2918).	Alien	U
<b>PANDANACEAE - SCREW PINE FAMILY</b>		
<u>Pandanus tectorius</u> S. Parkinson ex Z Hala, pūhala Not found within current Park boundaries, but one plant seen on beach south of Honokōhau Harbor in 1992-93. Canfield (1990) reported one hala from pond between Honokōhau Harbor and Noio Point.	+Indigenous	
<b>POACEAE (GRAMINEAE) - GRASS FAMILY</b>		
<u>Cenchrus ciliaris</u> L. Buffelgrass Mat-forming grass found near Park boundary with Honokōhau Harbor; few plants seen (LWP 2897).	*Alien	U
<u>Chloris barbata</u> (L.) Sw. Swollen fingergrass Few plants seen on pāhoehoe south of 'Aimakapā Pond (LWP 2907).	*Alien	U
<u>Chloris virgata</u> Sw. Feather fingergrass Small grass uncommon in kiawe forest south of 'Aimakapā Pond (LWP 2587).	*Alien	U
<u>Cynodon dactylon</u> (L.) Pers. Bermuda grass Creeping grass uncommon on beaches north of Kaloko Pond, north and south of 'Aimakapā Pond, and at 'Ai'ōpio; also rarely on pāhoehoe southeast of 'Aimakapā Pond (DKP sn).	Alien	U

KALOKO-HONOKŌHAU NATIONAL HISTORICAL PARK  
VASCULAR PLANT CHECKLIST (Continued)

	<u>Status</u>	<u>Abundance</u>
POACEAE (GRAMINEAE) - GRASS FAMILY (Continued)		
<u>Dactyloctenium aegyptium</u> (L.) Willd. Beach wiregrass Small grass uncommon on pāhoehoe near northern boundary of Park, near Queen Ka'ahumanu Highway in southeastern part of Park, and on beach north of Kaloko Pond (LWP 2880, LLA sn).	*Alien	U
<u>Eleusine indica</u> (L.) Gaertn. Wiregrass Uncommon grass near Honokōhau boundary and along trail from Harbor to beach.	*Alien	U
<u>Eragrostis tenella</u> (L.) P. Beauv. ex Roem. & Schult. Japanese lovegrass Small grass uncommon on coastal road, on pāhoehoe in center of Park and near Highway in southern part of Park (LWP 2564, 2908).	Alien	U
<u>Heteropogon contortus</u> (L.) P. Beauv. ex Roem. & Schult. Pili Grass growing in few small patches among alien shrubs and grasses in northeastern corner of Park (LWP 2886).	*Indigenous	R
<u>Melinis minutiflora</u> P. Beauv. Molasses grass Large mat-forming grass seen in only one location in shrubland near the Park's southern boundary with Honokōhau Harbor (LWP 2581).	*Alien	R
<u>Panicum maximum</u> Jacq. Guinea grass Large grass locally common in kiawe forest south of 'Aimakapā Pond and near the Honokōhau boundary (LWP 2906).	*Alien	C, lc

KALOKO-HONOKŌHAU NATIONAL HISTORICAL PARK  
VASCULAR PLANT CHECKLIST (Continued)

	<u>Status</u>	<u>Abundance</u>
POACEAE (GRAMINEAE) - GRASS FAMILY (Continued)		
<p><u>Panicum fauriei</u> Hitchc. var. <u>latius</u> (St. John) Davidse (Syn: <u>Panicum nubigenum</u>) No common name Annual grass reported by Canfield (1990) from barren 'a'ā near Kahinahina'ula (Queen's Bath); not seen in Park during 1992-93 survey.</p>	!Endemic	
<p><u>Paspalum vaginatum</u> Sw. or <u>Paspalum distichum</u> L. Seashore paspalum or knotgrass Abundant in marsh surrounding 'Aimakapā Pond; occasional along coast. Uncertainty about identity due to lack of fertile material (LWP 2588, 2670).</p>	Alien	A, lc
<p><u>Pennisetum setaceum</u> (Forssk.) Chiov. Fountain grass Abundant in shrublands on pāhoehoe throughout Park; scattered on less vegetated 'a'ā flows; occasional to common in forests surrounding ponds and along coast.</p>	Alien	A
<p><u>Rhynchelytrum repens</u> (Willd.) Hubb. (Syn: <u>Tricholaena rosea</u>) Natal redtop Common in low numbers throughout Park, except on sparsely vegetated 'a'ā flows.</p>	Alien	C
<p><u>Setaria verticillata</u> (L.) P. Beauv. Bristly foxtail Uncommon in open shrublands in southern part of Park (Transects 6 and 7) and along trail from Honokōhau Harbor. One plant seen near end of jeep road south of Kaloko Pond (LWP 2793, 2898).</p>	*Alien	U

KALOKO-HONOKŌHAU NATIONAL HISTORICAL PARK  
VASCULAR PLANT CHECKLIST (Continued)

	<u>Status</u>	<u>Abundance</u>
POACEAE (GRAMINEAE) - GRASS FAMILY		
(Continued)		
<u>Sporobolus virginicus</u> (L.) Kunth	Indigenous	C, lc
'Aki'aki, beach dropseed		
Common along beaches and rocky shores near 'Aimakapā Pond (LWP 2620, 2896).		
RUPPICACEAE - DITCHGRASS FAMILY		
<u>Ruppia maritima</u> L.	Indigenous	R
Widgeon grass		
Submerged herb rare in anchialine pools and on eastern edge of 'Aimakapā Pond.		



KALOKO-HONOKŌHAU NATIONAL HISTORICAL PARK  
VASCULAR PLANT CHECKLIST

SUMMARY

<u>Plant Group and Status</u>	<u>Number of Species**</u> <u>(% of total in group)</u>	
Ferns and Fern Allies	3	
Endemic	0	(0%)
Indigenous	1	(33%)
Alien	2	(67%)
Flowering Plants - Dicotyledons	86	
Endemic	4	(5%)
Indigenous	18	(21%)
Polynesian Introduction	3	(4%)
Alien	61	(71%)
Flowering Plants - Monocotyledons	27	
Endemic	1	(4%)
Indigenous	8	(30%)
Polynesian Introduction	1	(4%)
Alien	17	(63%)
<u>Total- Vascular Plants</u>	116	
Endemic	5	(4%)
Indigenous	27	(23%)
Polynesian Introduction	4	(3%)
Alien	80	(69%)

\*\* Does not include those species on Canfield (1990) checklist that were not seen in 1992-93 survey (! in preceding checklist) or did not occur within current Park boundaries (+ in preceding checklist).

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NOTES

Seven species on Canfield's 1987 (1990) checklist were in areas not currently within Park boundaries (+ in preceding checklist):

Nephrolepis exaltata (I), Dryopteridaceae

Reichardia picroides (A), Asteraceae

Chenopodium ambrosioides (A), Chenopodiaceae

Phyllanthus debilis (A), Euphorbiaceae

Ficus benjamina (A), Moraceae

Portulaca lutea (I), Portulacaceae

Pandanus tectorius (I), Pandanaceae

SOURCES OF NOMENCLATURE

Wagner, W. H. Jr and F. S. Wagner. 1995. Revised Tentative Checklist of Hawaiian Pteridophytes. Unpublished checklist, Feb. 22, 1995.

Wagner, W. L., D. R. Herbst, and S. H. Sohmer. 1990. Manual of the Flowering Plants of Hawai'i. Bishop Museum Special Publication 83. University of Hawaii Press and Bishop Museum Press, Honolulu.

Additional sources of Hawaiian and common names are:

Porter, J. R. 1972. Hawaiian Names for Vascular Plants. College of Tropical Agriculture, Hawaii Agricultural Experiment Station, University of Hawaii Departmental Paper 1. [Used for ferns and a few non-naturalized flowering plants].

St. John, H. 1973. List and Summary of the Flowering Plants in the Hawaiian Islands. Pacific Tropical Botanical Garden Memoir Number 1, Lawai, Kauai, Hawaii. [Used for non-naturalized and ornamental species and for species listed without common names in Wagner et al. 1990].

KALOKO-HONOKOHAU NATIONAL HISTORICAL PARK  
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HAWAIIAN AND COMMON NAMES

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O

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P

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R

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S (Continued)

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Spanish needle ( <u>Bidens pilosa</u> ) . . . . .	61
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Spiny amaranth ( <u>Amaranthus spinosus</u> ) . . . . .	59
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Widgeon grass ( <u>Ruppia maritima</u> ) . . . . .	81
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