Endangered, Threatened, and Invasive Species Survey on a 34-acre parcel, Barbers Point, O'ahu

Hawaii Biological Survey

Final Report **June 2010**

ENDANGERED, THREATENED, AND INVASIVE SPECIES SURVEY ON A 34-ACRE PARCEL, BARBERS POINT, O'AHU

FINAL REPORT

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June 2010

Contribution No. 2010-012 to the Hawaii Biological Survey

Published by
BISHOP MUSEUM
The State Museum of Natural and Cultural History
1525 Bernice Street
Honolulu, Hawai'i 96817–2704, USA

ISSN 1085-455X

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EXECUTIVE SUMMARY

Staff from the Bishop Museum, Department of Natural Sciences, conducted a biological reconnaissance of 34 acres owned by the State of Hawai'i, Department of Hawaiian Home Lands, for Kiewit Pacific Company, on 16–17 June 2010. The parcel is located just east of the former Barbers Point Naval Air Station runway in the Kalaeloa District, O'ahu. This hot, dry leeward location is part of the 'Ewa Plain, a flat, calcareous substrate that supports drought-tolerant vegetation. The primary purposes of the survey were to report on locations and numbers of any federally listed endangered or threatened plant or animal species, in addition to any species deemed to be invasive, and to offer mitigative solutions for any encountered.

A walkthrough survey method was used, with three biologists from the Hawaii Biological Survey systematically combing the parcel and georeferencing all significant rare or invasive plant or animal species. Trimble and Garmin GPS units were used for georeferencing, and coordinate location points were recorded using the WGS 84 datum. A total of 34 plant species were recorded during the survey, including only 6 native species. The low percentage of natives (14%) is attributable to the highly disturbed nature of the site (former naval housing). The parcel is dominated by a canopy of *kiawe (Prosopis pallida),* with *koa haole (Leucaena leucocephala)* as a common mid-story plant, and buffel grass *(Cenchrus ciliaris)* and Guinea grass *(Panicum maximum)* as the main groundcover plants. None of the native plants occupied significant portions of the habitat, and none were federally protected endangered or threatened species, although one *(wiliwili, Erythrina sandwicensis)* is currently rated by the U.S. Fish and Wildlife Service as a Species of Concern, an informal designation applied to species appearing to face imminent endangerment, but for which persuasive data on biological vulnerability and threats are not currently available to support legal protection. No species on the Hawai'i State Department of Agriculture's noxious weed list were noted in the parcel, nor were any species on the incipient invasive target list of the O'ahu Invasive Species Committee's O'ahu Early Detection unit. No endangered or incipient invasive mammals were noted.

While there is currently no legal protection for the species, we recommend that a grove of four *wiliwili* trees be retained, perhaps as an element of a native xeriscape garden on the parcel incorporating other native plants known historically from the area. The existing limestone sinkhole topography could also be incorporated into the landscape. The *wiliwili* trees are large and probably would not survive transplanting. If saving the plants is not possible, cuttings should be taken and propagated at a local botanical garden, and any seed produced should be collected and either deposited with the Lyon Arboretum seed bank depository, or given to a botanical garden for germination.

INTRODUCTION

Staff from the Bishop Museum, Department of Natural Sciences, conducted a biological reconnaissance of 34 acres owned by the State of Hawai'i, Department of Hawaiian Home Lands, for Kiewit Pacific Company, on 16–17 June 2010. The parcel is located just east of the former Barbers Point Naval Air Station runway in the Kalaeloa District, O'ahu. The primary purposes of the survey were to report on locations and numbers of any federally listed endangered or threatened plant or animal species, in addition to any species deemed to be invasive, and to offer mitigative solutions for any encountered.

The parcel is located on the flat, dry coralline 'Ewa Plain in the southwestern corner of O'ahu, about 1 mile inland of the ocean on its south side. The area was once a part of the now decommissioned Barbers Point Naval Air Station complex, and at one time included military housing. A few now-abandoned roads subdivide the parcel. Elevation at the site is about 30 feet. Average annual rainfall is around 20 inches in this dry, leeward location.

The substrate in the general vicinity and on sizable portions of the 'Ewa Plain is classified in Foote et al. (1972) as Coral Outcrop, formed long ago during a higher stand of the sea and later exposed when the oceans receded. The flat, calcareous, yet highly permeable substrate is pockmarked with numerous sinkholes formed by dissolution of the porous limestone by water. A thin layer of soil gathers in cracks, crevices, and depressions on the coral substrate. The vegetation is sparse and typically includes *kiawe (Prosopis pallida), koa haole (Leucaena leucocephala),* and fingergrass (*Chloris* spp.), and such lands are used for military installations, quarries, and urban development, or for wildlife habitat or recreation (Foote et al. 1972).

Char and Balakrishnan (1979) conducted an extensive botanical survey of all undeveloped, non-agricultural lands in the 'Ewa Plains, an area bounded by the ocean on the south and west, Pearl Harbor's West Loch on the east, and the H-1 freeway to the north. Their vegetation descriptions provide an excellent historical record of the vegetation present in the area 30+ years ago, and also supplied the present survey a baseline for the vegetation types to expect and rare species for which to target. The authors describe several inland vegetation types and their species composition, including several variants of *kiawe (Prosopis pallida)* forest and the rare plants they harbor, that match the description of the surveyed parcel.

Thus, we were aware of the historical presence of two federally listed Endangered species in *kiawe* forest on coral substrate in the 'Ewa Plain: *'akoko (Chamaesyce skottsbergii* var. *skottsbergii)* and *Achyranthes splendens* var. *rotundata;* as well as three rare but legally unprotected species: *wiliwili (Erythrina sandwicensis), ma'o* or Hawaiian cotton *(Gossypium tomentosum),* and *maiapilo (Capparis sandwichiana).* The report mentions the presence of a population of ca. 500 plants of the endangered *'akoko* on the parcel directly south of and bordering San Jacinto/South Hanson Road, and recommends the parcel as a potential natural area sanctuary (Char & Balakrishnan 1979). While walking along San Jacinto Road today, one can indeed see roadside signs designating the adjacent parcel as endangered species habitat.

SURVEY METHODS

A walkthrough survey method was used, with three biologists systematically combing the parcel, taking notes, and georeferencing all significant rare or invasive plant or animal species. The existing roadways provided reliable reference points for location within the parcel, and existing flagging helped to demarcate parcel boundaries away from the roads. Trimble and Garmin GPS units were used for georeferencing, and coordinate location points were recorded using the WGS 84 datum. Plant and animal identifications were largely made in the field; those that could not be positively identified were collected for later identification at Bishop Museum. Two days of fieldwork were conducted on 16–17 June 2010.

The species recorded reflects the season and environmental conditions at the time of the survey. During the summer of 2010, the state of Hawai'i was already in the throes of a prolonged drought, and it was reflected in the parched condition of the vegetation at the site. No doubt a survey during a wetter part of the year would yield additional species, especially of herbaceous annuals.

Photos in this report were taken by C. Imada, unless otherwise credited. The cover photo was taken by S. James.

SURVEY FINDINGS

Flora


Kiawe forest habitat

As revealed by Google Earth images, the parcel is dominated by *kiawe (Prosopis pallida)* forest, with varying degrees of canopy cover, from closed to open. *Kiawe* is a sinewy-trunked spiny tree in the bean family, native to South and Central America, and said to have been first grown in Hawai'i in 1828 (Wagner et al. 1999). Historically, *kiawe* has had some economic value in Hawai'i: the pods collected for cattle fodder, the wood for charcoal, the flowers for honey, and the trees for reforesting dry, waste areas. Cattle have since widely spread the seeds, and *kiawe* is ubiquitous in dry lowlands throughout the Islands.

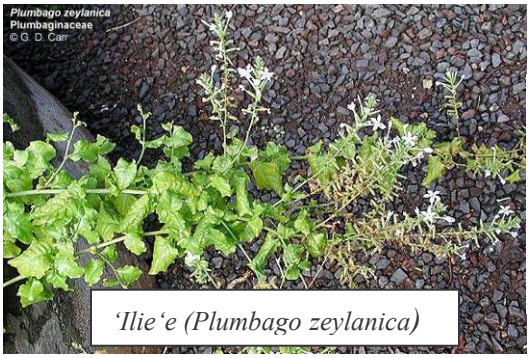
In the closed forests, *kiawe* can range up to 30 feet tall, and the feathery canopy allows enough light to penetrate so that the understory is vegetated, generally with a sparse shrub layer of scattered *koa haole (Leucaena leucocephala)* and a ground layer dominated by buffel grass *(Cenchrus ciliaris)* or a diminutive (1.5–2 feet tall) form of Guinea grass *(Panicum maximum),* with occasional patches of Chinese violet *(Asystasia gangetica).* In open-canopied kiawe forests, *koa haole* and Manila tamarind *(Pithecellobium dulce)* becomes more prevalent, and other small shrubs and herbs (e.g., the common natives *'ilima (Sida fallax),* the designated *lei* flower of the island of O'ahu*;* hoary abutilon *(Abutilon incanum);* and *'uhaloa (Waltheria indica),* whose bitter root is used in a remedy for sore throat) become more common.

Some portions of the parcel (such as approaching the gate on San Jacinto Road) lack *kiawe* canopy, and in these areas *koa haole* is generally the dominant large shrub/small tree cover, again with thick buffel grass or Guinea grass groundcover and a greater variety of herbaceous cover. Like *kiawe, koa haole* was introduced to Hawaii as cattle fodder, and was also broadcast from planes to revegetate barren leeward dry slopes; it is widespread throughout the Islands (Neal 1965).

Koa haole shrubland

In the easternmost part of the parcel, where there is a large concentration of limestone sinkholes, our survey discovered four *wiliwili (Erythrina sandwicensis),* an endemic dry forest tree that in pre-Polynesian times was probably one of the main canopy trees in an open savanna habitat of scattered trees and shrubs on the inland portion of the hot, dry 'Ewa Plain (Char and Balakrishnan 1979). This finding will be dealt with in the Discussion and Recommendations section below.

Two other interesting common native plant species noted during the survey were the *'ilie'e (Plumbago zeylanica),*a sprawling shrub with white, 5-lobed flowers and densely glandular, sticky calyx tube, whose sap was used to blacken tattoos in Hawai'i (single plant seen on the eastern border adjacent to the berm); and *kauna'oa pehu (Cassytha filiformis),* a parasitic vine with ropy, cascading yellow to green stems, readily seen on *kiawe* trees at the San Jacinto Road gate. Stems of *kauna'oa pehu* are used in *lei* that represent the island of Lana'i.



'Ilie'e (Plumbago zeylanica)

Photo by G. Carr

Kauna'oa pehu (Cassytha filiformis)

Several cultivated plants serve as evidence of former habitation in the parcel. These include several monkeypod *(Samanea saman),* Chinese banyan *(Ficus microcarpa),* African tulip *(Spathodea campanulata),* and Geiger trees *(Cordia sebestena).* Some of the cultivated plants have invasive tendencies or poisonous properties, which will be discussed in Discussion and Recommendations.

Fauna

A variety of arthropods were noted in the parcel. Appendix II includes a discussion of those that should be avoided during survey and construction work in the parcel. No endangered arthropods were noted.

Several common urban and game birds (doves, cardinals, bulbuls, mynahs, francolins) were noted during the survey (see Appendix III). No endangered birds were noted.

There was evidence of feral mammals in the parcel: cats, mongoose, and mice or rats (most evident from the

stripping of *koa haole* bark for moisture). No endangered mammals were noted.

DISCUSSION AND RECOMMENDATIONS

A total of 34 plant species were recorded during the survey, including 1 endemic, 5 indigenous, and 37 non-native (naturalized or remnants of former cultivation). The low percentage of natives (14%) is attributable to the highly disturbed nature of the site (former naval housing), and none of them occupy significant portions of the habitat. None of the six native plants is a federally protected endangered or threatened species, although one *(wiliwili, Erythrina sandwicensis)* is currently considered to be a species at risk of imminent endangerment (M. Bruegmann, USFWS, pers. comm.).

Invasive plants

Invasive species can be broadly defined as introduced species that are able to significantly disrupt community structure or proper functioning of an ecosystem. The state of Hawai'i abounds in such examples of introduced plants and animals that have flourished in our equable climate, freed from attack by their natural enemies in their homeland (e.g., European pig, goats, *koa haole, kiawe*). There are many invasive plants and animals that are already so widespread throughout the State that essentially nothing economically viable can be done to control them, except perhaps for biological control. For purposes of this survey, we chose to focus on locating and identifying those non-native plants that appear on one of two lists: the State noxious weed list, and a list of known weedy species not yet established on O'ahu. These lists, for the most part, ignore already widespread weeds in the Hawaiian Islands, instead focusing on those that are still controllable or not yet present.

The Hawai'i State Department of Agriculture maintains a list of noxious weeds designated for eradication or control (Hawai'i Administrative Rules, Title 4 Subtitle 6 Chapter 68). A weed species must meet several criteria involving plant reproduction, growth characteristics, detrimental effects, necessary control measures, and distribution and spread before it can be considered for addition to this list. The list was last updated on 18 June 1992. No species on the State noxious weed list were noted in the parcel.

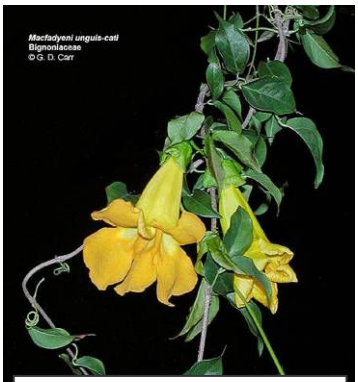
Statewide, there are five island-based Invasive Species Committees, operating under the auspices of the Department of Land and Natural Resources, Division of Forestry & Wildlife. Each of these committees is a partnership of government agencies, non-government organizations, and private businesses working together to protect their island from the most threatening invasive plant, animal, and insect pests The O'ahu Early Detection (OED) unit of the O'ahu Invasive Species Committee (OISC) is responsible for scanning Oahu roadsides, neighborhoods, nurseries, and commercial plant sellers for plant species that are considered to be incipient invasives. OED has developed a "hitlist" of plants that are uncommon or not yet known to be found on O'ahu, but historically have bad reputations for invasiveness elsewhere. When OED finds such plants in their daily survey rounds, they report these to OISC, which serves as the enforcement arm for

Photo by G. Carr

African tulip
(Spathodea campanulata)

disposition of the plant. OED's hitlist can be found at http://www.hear.org/oisc/oahuearlydetectionproject/pdfs/oedsurveyspeciesguide20080421.pdf. No species on OED's incipient invasive list were noted in the parcel.

There are a couple of cultivated species in the parcel that are documented as escaping and becoming problem weed species in Hawai'i, but more so in wetter habitats. African tulip is a tropical African tree popularly cultivated as a flowering street tree in Hawai'i. The small, wind-dispersed seeds have readily escaped the garden, however, and the species is spreading into moist upland forests. No seedlings were noted around the two flowering trees growing in the parcel (see Appendix IV for GPS locality, Appendix V for map location). Cat's-claw climber *(Macfadyena unguis-cati)* is a tenacious vine with 3-forked, clawlike tendrils that allow it to climb up and drape over any surface to which it clings. This aggressive vine with bell-shaped yellow flowers was only noted in one spot growing on a kiawe trunk. Once established, it can be difficult to eradicate (Staples & Herbst 2005; see Appendix IV for GPS locality, Appendix V for map location).



Cat's-claw climber *(Macfadyena unguis-cati)*

Photo by G. Carr

Endangered Species

As mentioned, while no Federally listed endangered species were found, a grove of four *wiliwili (Erythrina sandwicensis)* were located in the western section of the parcel (see Appendix IV for GPS locality, Appendix V for map location). *Wiliwili* is currently regarded as a Species of Concern by the U.S. Fish and Wildlife Service (U.S. Fish & Wildlife Service 2010), an informal term referring to a species for which listing as endangered or threatened is may be appropriate, but for which persuasive data on biological vulnerability and threats are not currently available to support legal protection (M. Bruegmann, USFWS, pers. comm.).

Wiliwili is a dry forest tree up to 40 feet tall found on leeward slopes of all the main Hawaiian Islands from sea level to 2000 feet elevation. The tree can often be picked out by its somewhat swollen trunk with an orangeish cast, sparsely armed with stiff prickles. The leaves are divided into three broad, oval leaflets, but these are wholly or partly shed during the summer months, when flowering occurs. Flower color ranges from orange to white, yellow, or greenish, and the pods contain 1–3 red to orange seeds. The lightweight wood was used for surfboards, canoe outriggers, and fish floats, and the red to orange seeds are used in *lei* (Staples & Herbst 2005). The *wiliwili* trees in the parcel were almost completely leafless during June 2010, with no signs of flowering.

Wiliwili flowers

Photo by G. Carr

As recently as the late 1990s, there was not much concern about the rarity of *wiliwili* populations in the State (Wagner et al. 1999a). However, in the early 2000s an introduced beetle, *Specularius impressithorax* (Pic), was observed infesting *wiliwili* seeds (Samuelson & Medeiros 2006). The larvae mature in the seed and emerge, leaving behind conspicuous round exit holes and inviable seeds, reducing potential regeneration within *wiliwili* groves.

Then in 2005, a new pest, the Erythrina gall wasp (*Quadrastichus erythrinae* Kim) started attacking all species of *Erythrina*, both native and cultivated. The wasp lays its eggs inside the leaf tissue, and the larvae then create gall-like chambers in which they mature. The grossly deformed leaves are unable to photosynthesize, and for most trees the condition proved fatal. Thousands of trees statewide died, and there were real fears that the endemic *wiliwili* was on the brink of extinction (Sustainablehawaii 2010).

Shelley James with *wiliwili* tree.

State entomologists were mobilized to track down natural predators of the gall wasp, and following two years of extensive research and testing, an African wasp (E*urytoma erythrinae* Gates & Delvare) was approved for release as a biological control in November 2008. The female wasp deposits its eggs into the galls, which hatch and feed on the Erythrina gall wasp larvae. This biocontrol effort thus far appears to be a successful one (Sustainablehawaii 2010). The few leaves noted on *wiliwili* in the parcel showed no signs of galling. The past decade's insect pest travails no doubt contributed to the Fish and Wildlife Service Species of Concern designation.

While there is no legal protection for the species, we recommend, if at all possible, that the *wiliwili* grove be retained, perhaps as an element of a native xeriscape garden on the parcel incorporating other native plants known historically from the area and that would be well-adapted to the site, such as *Achyranthes splendens* var. *rotundata,* Hawaiian cotton *(Gossypium tomentosum), maiapilo (Capparis sandwichiana), naio (Myoporum sandwicense), 'iliahi-a-lo'e (Santalum ellipticum), and aulu (Sapindus oahuensis).* The existing limestone sinkhole topography could also be incorporated. The four *wiliwili* trees are large and probably would not survive transplanting. If saving the plants is not possible, cuttings should be taken and propagated at a local botanical garden, and any seed produced should be collected and either deposited with the Lyon Arboretum seed bank depository, or given to a botanical garden for germination.

Poisonous Plants & Other Hazards

Pencil tree *(Euphorbia tirucalli)* can be found on the eastern edge of the parcel bordering the berm (see Appendix IV for GPS locality, Appendix V for map location). A member of the euphorbia family, this aptly named plant has many-branched, cylindrical green, non-spiny stems. Breaking the branches releases a milky sap that is highly toxic and corrosive, causing blistering upon contact with the skin (Staples & Herbst 2005).

Pencil tree *(Euphorbia tirucalli)*

Photo by G. Carr

Be-still tree *(Thevetia peruviana)* is located near the

gate at San Jacinto Road just inside the kiawe forest. The shiny green leaves are leathery, linear, and up to 6 inches long; the funnel-shaped flowers are bright yellow. It is commonly cultivated, despite the fact that all parts of the plant are toxic, especially the milky latex.

Other unmarked manmade hazards (e.g., razor wire, open holes) have been give GPS localities in Appendix IV, and mapped in Appendix V.

Be-still tree *(Thevetia peruviana)*

Photo by G. Carr

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APPENDIX I: PLANT CHECKLIST

The following is a list of vascular plant species noted during a walk-through survey of 34 acres of DHHL land on 16–17 June 2010. A total of 43 taxa were noted during the survey, including 1 endemic, 5 indigenous (including "ind?"), and 37 non-native (including naturalized plants and remnants of cultivation).

In the following table, plants are divided into two main groups: dicots and monocots. Within these groups, plants are arranged alphabetically by family, genus, and species. Each entry includes scientific name with author citation, common name (if available), biogeographic status, Federal endangerment status, and frequency in the parcel. Taxonomy follows Wagner et al. (1999a) or Staples and Herbst (2005). An explanation of abbreviations used in the list follows.

STAT = Biogeographic Status (from Wagner et al. 1999a)

end	Endemic: native, occurring only in the Hawaiian Archipelago
ind	Indigenous: native, occurring naturally in the archipelago but also outside of Hawai'i
ind?	Questionably indigenous: probably indigenous, possibly naturalized
nat	Naturalized: introduced to the archipelago directly or indirectly by humans since Western contact and reproducing and spreading vegetatively or by seed
cult	Cultivated: an artifact of former cultivation at the site

FREQ = Frequency

vc	Very common
c	Common
o	Occasional
r	Rare
1	One-of-a-kind

FEDST = Federal Endangerment Status

SOC	Species of Concern: an informal term referring to species for which listing as endangered or threatened is possibly appropriate, but for which persuasive data on biological vulnerability and threat are not currently available to support legal protection (M. Bruegmann, USFWS, pers. comm.).

FAMILY	SCIENTIFIC NAME	COMMON NAME	STAT	FREQ	FEDST
DICOTS					
Acanthaceae	Asystasia gangetica (L.) T. Anderson	Chinese violet	nat	c	
Amaranthaceae	Achyranthes aspera L. var. aspera		nat	o	
Apocynaceae	Thevetia peruviana (Pers.) K. Schum.	be-still tree, yellow oleander	cult	1	
Asclepiadaceae	Stapelia gigantea N. E. Br.	Zulu giant, carrion flower	nat	o	
Asteraceae	Bidens cynapiifolia Kunth	Spanish needle, beggartick	nat	r	
Asteraceae	Pluchea carolinensis (Jacq.) G. Don	sourbush, marsh fleabane	nat	o	

FAMILY	SCIENTIFIC NAME	COMMON NAME	STAT	FREQ	FEDST
Asteraceae	Verbesina encelioides (Cav.) Benth. & Hook.	golden crown-beard	nat	r	
Bignoniaceae	Macfadyena unguis-cati (L.) A. H. Gentry	cat's-claw climber	cult	1	
Bignoniaceae	Spathodea campanulata P. Beauv.	African tulip tree	cult	r	
Boraginaceae	Heliotropium procumbens Mill. Var. depressum (Cham.) Fosberg		nat	r	
Boraginaceae	Cordia sebestena L.		cult	r	
Chenopodiaceae	Chenopodium murale L.	goosefoot, pigweed	nat	r	
Euphorbiaceae	Chamaesyce hypericifolia (L.) Millsp.	graceful spurge	nat	r	
Fabaceae	Desmanthus pernambucanus (L.) Thell.	slender mimosa	nat	o	
Fabaceae	Erythrina sandwicensis O. Deg.	*wiliwili*	end	r	SOC
Fabaceae	Leucaena leucocephala (Lam.) de Wit	*koa haole*	nat	vc	
Fabaceae	Macroptilium atropurpureum (DC.) Urb.		nat	r	
Fabaceae	Pithecellobium dulce (Roxb.) Benth.	Manila tamarind, *'opiuma*	nat	o	
Fabaceae	Prosopis pallida (Humb. & Bonpl. Ex Willd.) Kunth	mesquite, *kiawe*	nat	vc	
Fabaceae	Samanea saman (Jacq.) Merr.	monkeypod	cult	r	
Fabaceae	Tamarindus indica L.	tamarind	cult	1	
Lamiaceae	Leonotis nepetifolia (L.) R. Br.	lion's ear	nat	c	
Lauraceae	Cassytha filiformis L.	*kauna'oa pehu*	ind	o	
Malvaceae	Sida fallax Walp.	*'ilima*	ind	o	
Malvaceae	Malvastrum coromandelianum (L.) Garcke ssp. Coromandelianum	false mallow	nat	c	
Malvaceae	Hibiscus rosa-sinensis L.		cult	1	
Malvaceae	Abutilon incanum (Link) Sweet	*ma'o,* hoary abutilon	ind?	o	
Malvaceae	Sida ciliaris L.		nat	o	
Moraceae	Ficus microcarpa L. f.	Chinese banyan	cult	r	
Nyctaginaceae	Bougainvillea glabra Choisy		cult	r	
Nyctaginaceae	Boerhavia coccinea Mill.		nat	r	
Passifloraceae	Passiflora foetida L.	love-in-a-mist, running pop	nat	o	
Plumbaginaceae	Plumbago zeylanica L.	*'ilie'e*	ind	r	
Polygonaceae	Antigonon leptopus Hook. & Arn.	Mexican creeper, confederate vine	nat	r	
Portulacaceae	Portulaca pilosa L.	*'ākulikuli*	nat	o	
Solanaceae	Solanum seaforthianum Andrews		nat	r	
Sterculiaceae	Waltheria indica L.	*'uhaloa*	ind?	c	
Verbenaceae	Vitex trifolia L.		cult	r	
Verbenaceae	Stachytarpheta jamaicensis (L.) Vahl	Jamaica vervain	nat	r	
MONOCOTS					
Agavaceae	Agave sisalana Perrine	sisal, century plant	nat	r	
Agavaceae	Sansevieria trifasciata Prain		cult	r	
Arecaceae	Phoenix hybrid	date palm	cult	1	
Poaceae	Cenchrus ciliaris L.	buffelgrass	nat	vc	
Poaceae	Panicum maximum Jacq.	Guinea grass	nat	vc	

APPENDIX II: ARTHROPODS OF SOME SAFETY CONCERN FOUND AT THE SURVEY SITE

By David J. Preston

Elongate Twig Ant /Mexican Ant

Scientific name: *Pseudomyrmex gracilis* (Fabricius, 1804)

Distribution: Only known from O'ahu

This aggressive ant is widespread on O'ahu and prefers dry habitats. It is very common in *kiawe* forests with mixed understory plants. It is an arboreal species usually found singly running along branches and twigs of *kiawe* trees.

Notes: This ant is very abundant at the site. While working in Hawai'i and the Pacific this author has been stung by many bees, wasps, and ants. It is my opinion that this ant possesses one of the most painful stings of any species found in Hawai'i. As with any bee, ant, or wasp, precautions with regards to allergies should be considered.

Elongate Twig Ant
Photo by Forest & Kim Starr

Common Paper Wasp / *Nalo*

Scientific name: *Polistes exclamans* Viereck, 1906

Distribution: All the main islands

Paper wasps are common around homes, abandoned buildings, and fallow land. These wasps are social in that they build communal nests in the form of a papery structure with multiple cells. The wasps feed on and gather caterpillars and other arthropods to place in the cells where the female will lay a single egg, and seal the cell. The larva hatch out and feed on the caterpillars in the cell. After about two weeks a new adult wasp will emerge and contribute to the group.

Notes: This wasp is very common in the area, taking advantage of a large prey base afforded them by an abundance of *kiawe* trees that provide caterpillars commonly found feeding on the leaves. These wasps will defend their nests aggressively and can deliver a very painful sting. They, unlike honeybees, can sting multiple times. The sting has been described as a sharp pinch developing into a strong burning sensation. Nests will be found under branches, in tree hollows, and the bunkers at the site.

Common paper wasp
Photo by Forest & Kim Starr

Carpenter bee / *Nalo*

Scientific name: *Xylocopa sonorina* F. Smith, 1874

Distribution: Common on all main islands

Introduced to the Hawaiian Islands sometime in the late 1800s. This large and imposing bee bores into dead tree limbs and trunks as well as milled lumber. Despite its large size the bee is very shy and rarely stings humans except when physically harassed. It is not know whether people allergic to honeybees are also allergic to the carpenter bee.

Notes: This bee is very common at the site. It frequents the abundant *kiawe* blossoms as well as many other flowering plants. Because the bee can chew into hard wood, it should be able to give you a painful nip if you handle it. The female carpenter bee is black while the male is copper colored. Only the female can sting.

Male Carpenter bee
Photo by Forest and Kim Starr

Female Carpenter bee
Photo by Viriditas
http://commons.wikimedia.org/wiki/File:Xylocopa_wailea_maui_hawaii.jpg

Common Honeybee / *Nalo meli*

Scientific name: *Apis mellifera* Linnaeus, 1758

Distribution: All the main islands

This familiar insect was intentionally introduced to the Islands in 1857 for its honey and to help pollinate crops. Unfortunately, its aggressive pollination habits have had a negative impact on our native pollinators by limiting their resources. This has led to the reduction of populations of many native bees and, as a result, some of our native plants that depend on native bees for pollination have declined or have gone extinct.

Notes: Although common in certain areas especially around plants in flower, they are not generally aggressive. Several large hives were observed in the sinkhole area of the site. People known to be allergic should carry appropriate antihistamines and make supervisors aware of their allergy.

Common Honeybee
Photo by Forest and Kim Starr

Giant Centipede / *Kanapi*

Scientific name: *Scolopendra subspinipes* Leach, 1815

Distribution: Midway Atoll, O'ahu, Lana'i, Maui, Kaho'olawe, Hawai'i

This painful pest was introduced to Hawai'i before 1847, possibly even by Polynesian voyagers since it occurs commonly throughout the Pacific and tropics. Despite fantastic tales of its huge size from those who have killed them in their homes, these creatures rarely get over 6 inches in length. Their bite is extremely painful and some people and pets require hospitalization due to a severe reaction to it. It is a generalist predator, often active at night, when it forages for small prey such as insects, worms, slugs, and even geckos.

Notes: Common at the site, found under rocks, larger branches on the ground, in tree crevices, under discarded lumber, and tin cans strewn about the area and discarded in sinkholes.

The Giant centipede
Photo by G.M. Nishida, HBS

Lesser Brown Scorpion / *Kopiana*

Scientific name: *Isometrus maculatus* (De Geer, 1778)

Distribution: Kaua'i, O'ahu, Maui, Hawai'i

This is the only scorpion established in Hawai'i. Humans have spread it worldwide. Despite its appearance, this is not a deadly enemy. It has a painful sting, but it does not have a neurotoxin like some of its mainland cousins, so the sting is more like that of a bee. Still, it is wise to keep clear of it! This normally shy creature is active at night and preys on insects, spiders, millipedes, and even small rodents.

Notes: Uncommon at the site, found under rocks, larger branches, in tree crevices, under discarded lumber and tin cans strewn about the area, especially the sink holes.

The Lesser brown scorpion
Photo by Forest and Kim Starr

APPENDIX III: BIRD CHECKLIST

SCIENTIFIC NAME	COMMON NAME	STATUS
Streptopelia chinensis	Spotted Dove	Naturalized
Geopelia striata	Zebra Dove	Naturalized
Cardinalis cardinalis	Northern Cardinal	Naturalized
Paroaria coronata	Red-crested Cardinal	Naturalized
Pycnonotus cafer	Red-vented Bulbul	Naturalized
Pycnonotus jocosus	Red-whiskered Bulbul	Naturalized
Acridotheres tristis	Common Myna	Naturalized
Francolinus erckelli	Erckel's Francolin	Naturalized

APPENDIX IV: SELECTED GPS LOCALITIES (WGS 84 datum, maximum error 4m)

FEATURE	LAT	LONG	NOTES
Wiliwili 1	21.31591	-158.054	USFWS Species of Concern
Wiliwili 2	21.31602	-158.054	USFWS Species of Concern
Wiliwili 3	21.31618	-158.054	USFWS Species of Concern
Wiliwili 4	21.31618	-158.054	USFWS Species of Concern
African Tulip trees	21.31623	-158.05	Invasive tree
Macfadyena	21.315	-158.052	Invasive vine
Pencil tree	21.31698	-158.049	Caustic sap
Hazard – Barb wire	21.31652	-158.05	Hazard
Hazard – Barb wire2	21.31593	-158.05	Hazard
Hazard – Open well	21.3152	-158.051	Hazard

APPENDIX V: TRACKS AND POINTS OF INTEREST