

Botanical Survey of  
Kilauea Point National Wildlife Refuge  
Kauai, Hawaii

2013

Prepared for:  
United States Fish and Wildlife Service

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## OVERVIEW

Kilauea Point National Wildlife Refuge is located on the northernmost point of Kauai Island in the state of Hawaii.

The refuge was established in 1985, to preserve and enhance seabird nesting colonies, by transferring land at Kilauea Point and the historic lighthouse to the U.S. Fish and Wildlife Service from the U.S. Coast Guard. The refuge was expanded to include Crater Hill and Mokolea Point in 1988.

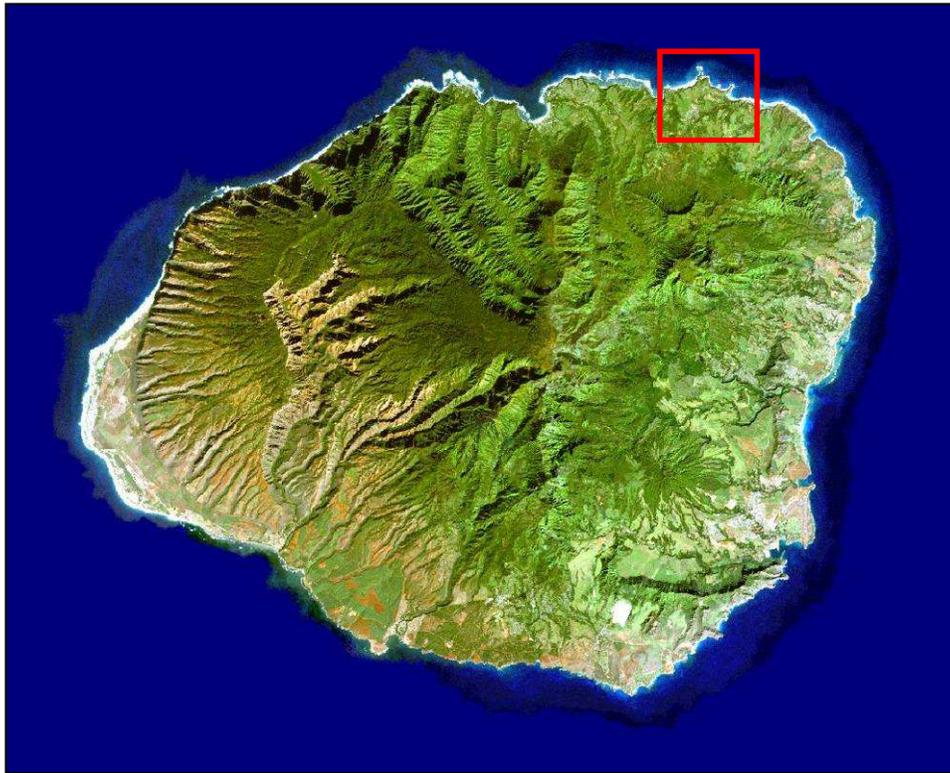
The dramatic backdrop of steep cliffs plunging to the ocean is one of the best places in the main Hawaiian Islands to view seabirds. Predator control and a fence around the perimeter of the refuge are necessary to protect breeding seabirds and Nene. Native and endangered plant reintroduction and invasive species removal is also ongoing.

The purpose of this survey is to provide a baseline inventory of the plants at Kilauea Pt. NWR, no refuge-wide botanical survey had previously been done. An emphasis was placed on non-native plants, especially invasive species that may be in low numbers and potentially addressed before becoming widely established at the refuge.

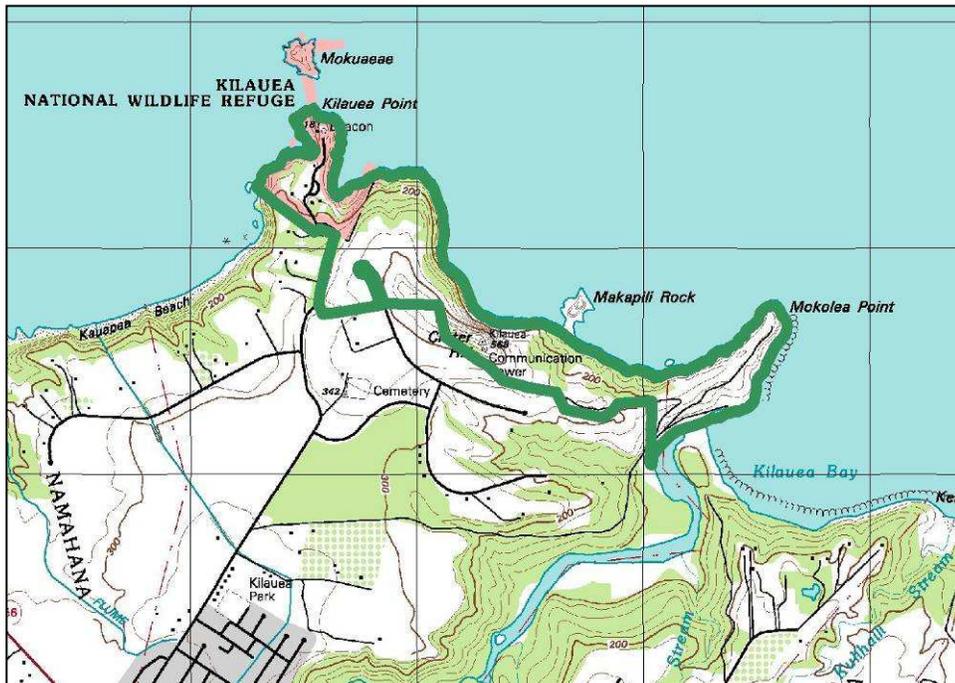


**Crater Hill and Mokolea Pt., the eastern portion of Kilauea Pt. NWR.**

## LOCATION

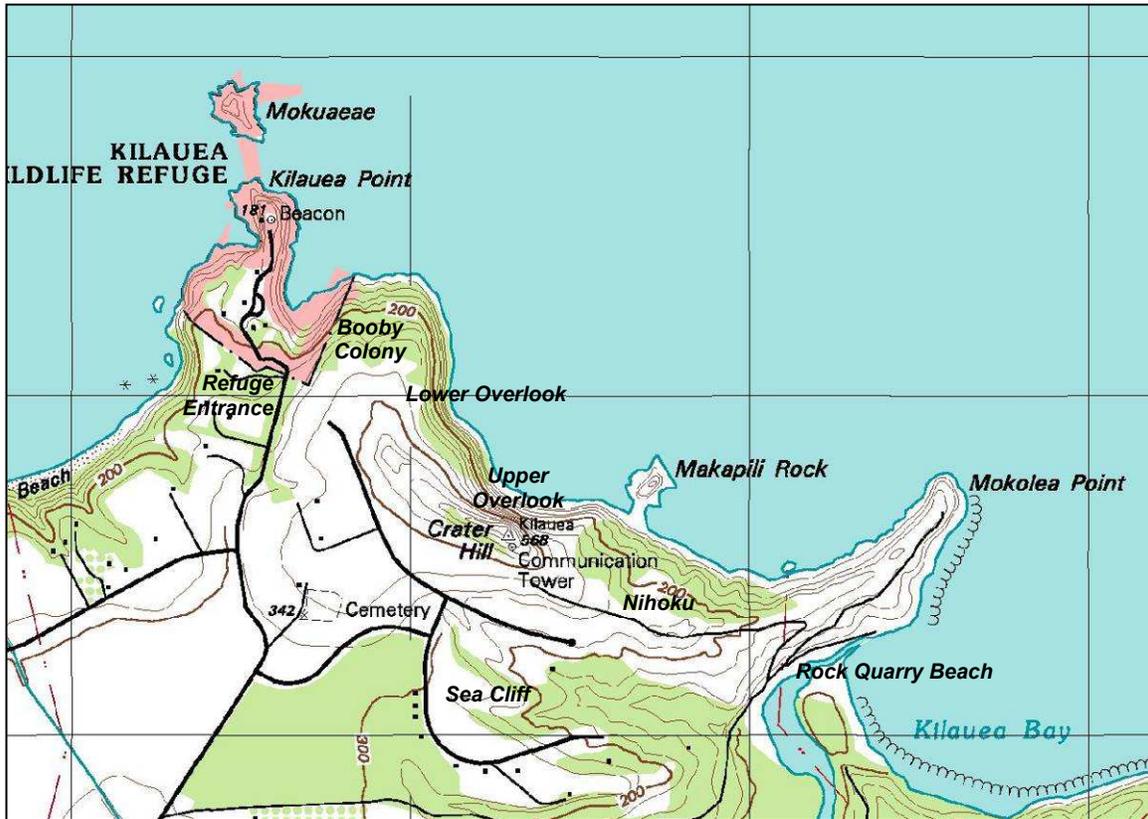


General location of Kilauea Pt. NWR, on the North Shore of Kauai.



Detailed location of Kilauea Pt. NWR, along the coast of Kilauea, Kauai.

## LOCATION NAMES

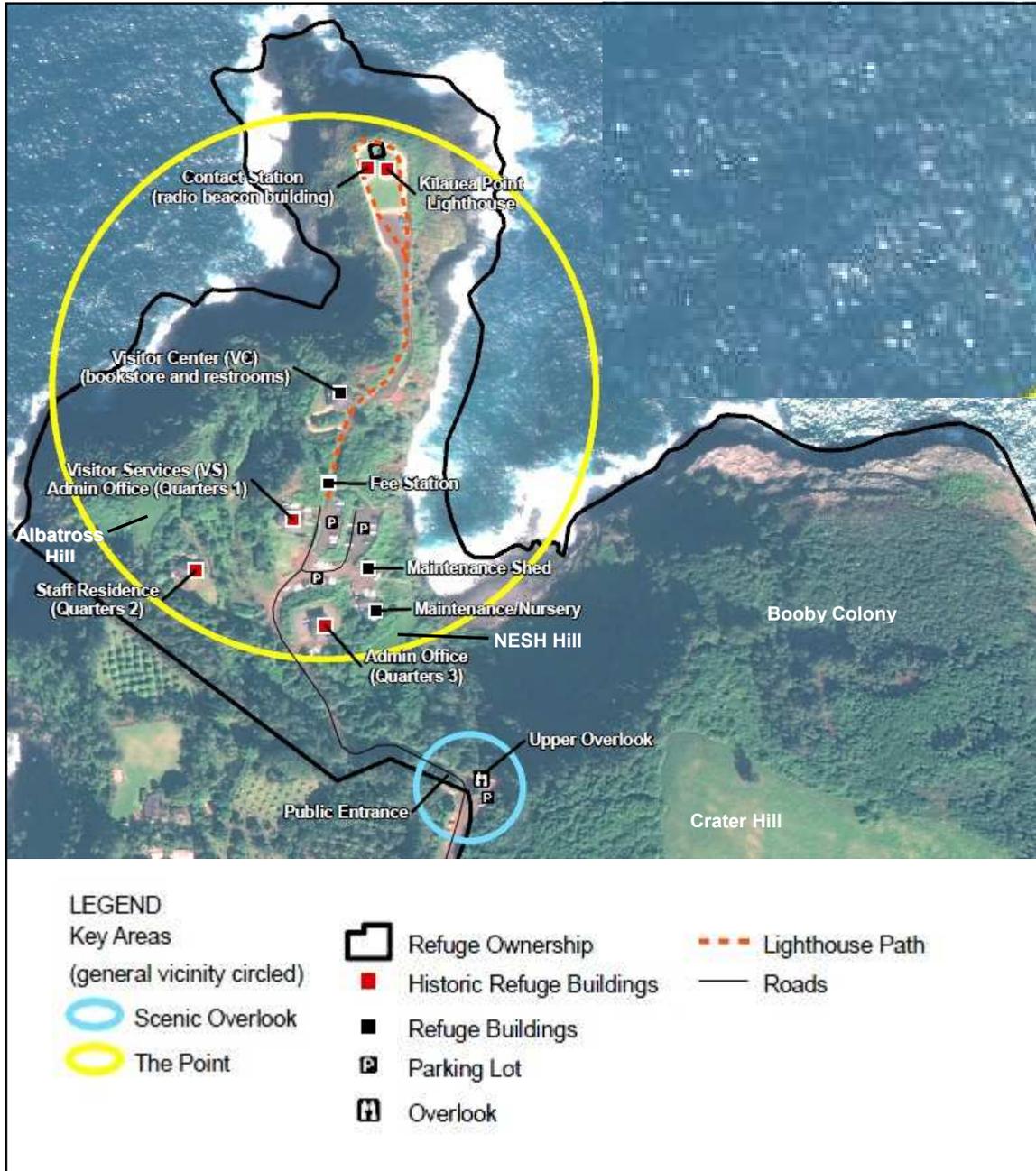


Location names used in the text.

The main areas of Kilauea Point NWR are:

- **Kilauea Point** - Kilauea Point contains the main developed area of Kilauea Point NWR, where virtually all 500,000 annual visitors go. The point includes the entrance, parking areas, buildings, walkways, and lighthouse.
- **Crater Hill** - For this report, Crater Hill is defined as the area of large cinder cone towering over the coast, stretching from the public overlook at the main refuge entrance, through the Red-footed Booby Colony, past the Lower and Upper Overlooks, eastward until Nihoku and Makapili Rock.
- **Mokolea Point** - Mokolea Point is the far eastern point of Kilauea Point NWR, extending from the eastern base of Crater Hill at Makapili Rock, through the Nihoku section and Mokolea Point, to Kilauea River.

## LOCATION NAMES - DETAIL



**Location names used in text, Kilauea Point detail.**

The bulk of the activity and named locations on the refuge are at Kilauea Point and nearby areas. The point includes administrative, visitor, and maintenance buildings, as well as paths, parking areas, and a historic lighthouse.

There are also birds nesting at many named locations on the point including Albatross Hill, NESH Hill, and the Booby Colony.

## METHODOLOGY

Two botanists, the authors, surveyed the refuge during March 18-22, 2013. A walk through survey method was used, taking paths of least resistance through representative locations and habitat types. Extra emphasis was placed on areas with high diversity and areas where management was most feasible.

In areas that were inaccessible, and there are quite a few on the refuge, the area was scanned from nearby vantage points with binoculars. High resolution zoomed in images were also used to help identify plants from a distance. Some areas were beyond the effective range of binoculars and cameras, and were not fully surveyed.

A global positioning system (GPS) unit was used to record locations when selected plants were encountered, with a focus on invasive species, any new or unknown plant species, collection locations, and some of the less common native plant species.

Collections were made to document new plant records and further work up plants not readily identifiable in the field. Photographs were taken of many of the plant species on the refuge, to provide for identification of individual species and to capture a record of the status of the general vegetation.



**Surveying near Kilauea Stream, the easternmost point of the refuge.**

## RESULTS

Kilauea Pt. NWR is a spectacular, and weedy, place. Some native plants exist in the most coastal and windward locations, and in a few cultivated settings, but for the most part the bulk of the refuge is dominated by non-native plants.

There are a few main habitat types: strand, cliff, shrubland, Christmas berry forest, ironwood forest, grassland, and developed land. To varying degrees, these habitat types are found in each of the three main areas of the refuge, Kilauea Point, Crater Hill, and Mokolea Point.

Kilauea Point has the bulk of the cultivated non-native plants and is where the visitors are focused. It also has a fair amount of native plants, the result of active restoration work. Crater Hill and Mokolea Point are relatively similar in composition, both are dominated in large parts by Christmas berry (*Schinus terebinthifolius*) and ironwood (*Casuarina equisetifolia*). Crater Hill also has broad areas of mowed non-native grassland.

On the steeper windward sections of all areas native plants such as akoko (*Euphorbia celastroides* subsp. *stokesii*) are locally common, even on the most sheer of cliffs. Hardy native coastal plants are the dominant vegetation closest to the ocean.

During the survey we came across 206 species of plants on the refuge. Of these, 54 (26%) were native and 152 (74%) were non-native. Of the 54 natives, a little over half, 29 (54%), were endemic, mainly the cultivated and recently planted plants; 19 (35%) were indigenous, mainly the common coastal species; and 6 (11%) were questionably indigenous, species for which it isn't fully certain whether it is native or not.

Of the 152 non-natives, 117 (78%) were naturalized, these are plants reproducing on their own in the wild and account for the bulk of the species on the refuge; 30 (20%) were cultivated, mostly at Kilauea Point; and 4 (2%) were Polynesian introductions, plants that were likely brought to Hawaii by early Hawaiians.

117 species on the refuge have references of being environmental weeds in the Global Compendium of Weeds (GCW), and 49 were deemed High Risk by the Hawaii Weed Risk Assessment (HWRA).

Many of these invasive species are either too widespread to completely remove from the refuge or are valuable for wildlife. There are however, a subset of potentially invasive species that appear to provide little wildlife value, are currently on the refuge in low numbers, and will likely continue to spread if no actions are taken.

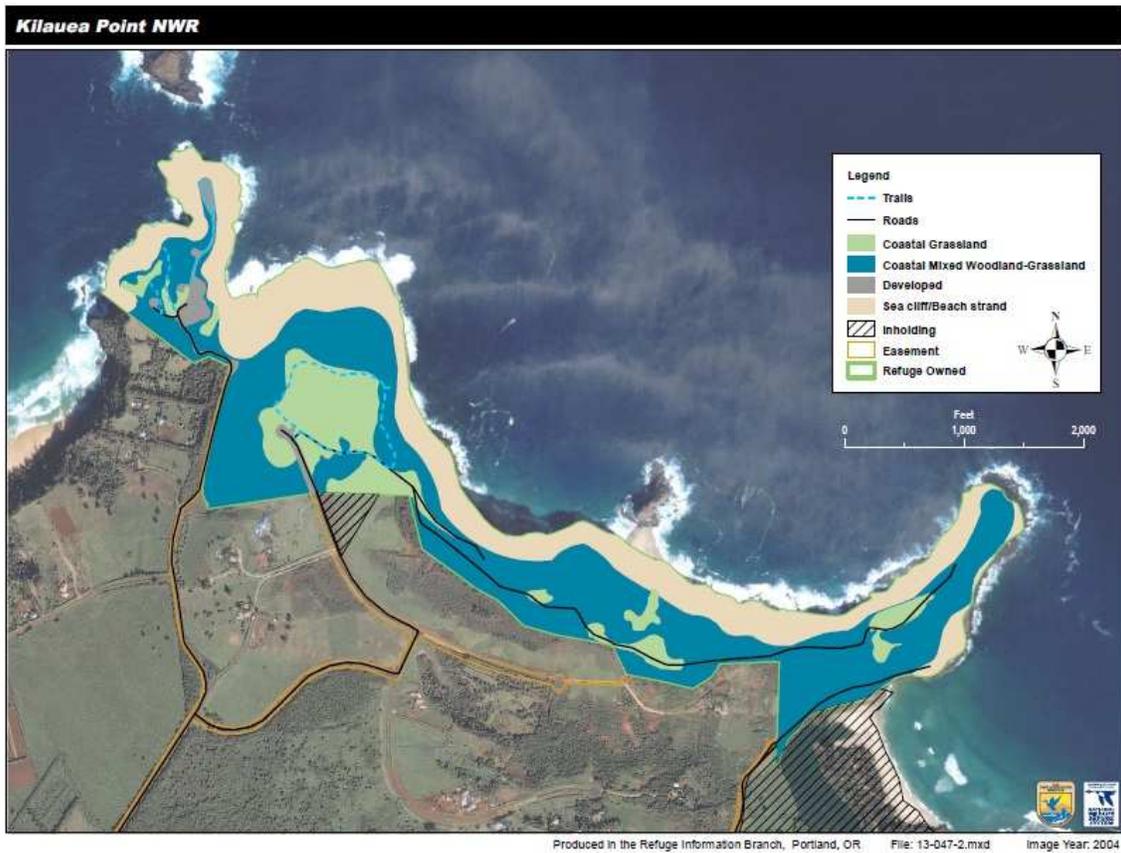
Along with removing undesirable vegetation, management actions should also include planting species that are optimally compatible with the wildlife at Kilauea. Birds are a primary factor in both guiding which species to plant where, and when surveys and management are best done. Insects, though often hidden in plain view, are another factor to take into consideration when planning vegetation management.

## VEGETATION / HABITAT TYPES

The vegetation types at Kilauea Point NWR are mostly determined by proximity to the ocean, steepness of the terrain, and current and past land use. The vegetation types are generally found in a concentric pattern starting at the coast and changing as the one moves upland. This occurs over the entire length of the refuge, which is flanked by steep cliffs plunging into the ocean.

The FWS refuge vegetation map below includes the following vegetation types, which are further discussed in the text. We have added a few subcategories to the coastal mixed woodland-grassland, to further refine the vegetation types. We describe them here, but did not do any habitat mapping.

- Beach Strand / Sea Cliffs
- Coastal Grassland
- Coastal Mixed Woodland-Grassland
  - Shrubland
  - Christmas berry Forest
  - Ironwood Forest
- Developed



**Major vegetation / habitat types at Kilauea Point NWR.**

## STRAND

The vegetation closest to the ocean is dominated by species adapted to the harsh conditions. Often these plants are native, the most common of which are akulikuli (*Sesuvium portulacastrum*) and naupaka (*Scaevola taccada*). Occasional stands of ohelo kai (*Lycium sandwicense*), ilima (*Sida fallax*), alena (*Boerhavia repens*), pohuehue (*Ipomoea pes-caprae* subsp. *brasiliensis*) and nehe (*Lipochaeta succulenta*) also occur in these areas. Less common in this area is pau o hiiaka (*Jacquemontia ovalifolia*), and ihi (*Portulaca lutea*).

Some non-native plants are able to also withstand the harsh strand conditions, including ironwood (*Casuarina equisetifolia*), which can create dense forests close to the ocean. Other non-native plants found in the strand area include pigweed (*Portulaca oleracea*) and Chinese Violet (*Asystasia gangetica*).



**Ohelo kai (*Lycium sandwicense*) is the closest plant to the ocean at Mokolea Point, along with naupaka (*Scaevola taccada*).**

## CLIFF

As one moves away from the coast, strand vegetation is replaced by species less tolerant of the coastal conditions. The vegetation on these steep slopes is similar to nearby shrubland and forest, but also includes native plants such as konakona grass (*Panicum torridum*), aweoweo (*Chenopodium oahuense*), and *Cyperus phleoides* that don't seem to occur in less open and dynamic areas. Akoko (*Euphorbia celastroides* subsp. *stokesii*) and naupaka seemed to a dominant in some of the more inhospitable cliff sites. Hala (*Pandanus tectorius*) was also found on cliff sites, but usually higher on the slope.

Non-natives such as Christmas berry (*Schinus terebinthifolius*) and ironwood can also be found on cliff areas, but are usually found in less vertical sites and those higher up on the slope.



**Akoko (*Euphorbia celastroides* var. *stokesii*) and other vegetation hanging on the cliffs of Crater Hill.**

## SHRUBLAND

As the terrain becomes less steep, the plants become taller and more dominated by non-natives. Generally, the closer to the ocean and prevailing winds the site is, the shorter and more native the vegetation is. Akoko (*Euphorbia celastroides* var. *stokesii*) is dominant in many places, as is naupaka (*Scaevola taccada*).

In other places, *Lantana* (*Lantana camara*) or haole koa (*Leucaena leucocephala*) is the dominant vegetation.



**Low growing akoko (*Euphorbia celastroides* var. *stokesii*) shrubs grade into lantana (*Lantana camara*) and Christmas berry (*Schinus terebinthifolius*) along much of the coastal windward slopes of the refuge.**

## **CHRISTMAS BERRY (SCHINUS) FOREST**

Further inland the vegetation height increases to over head high and is dominated by a few canopy species, most notably Christmas berry (*Schinus terebinthifolius*) and ironwood (*Casuarina equisetifolia*). Though both exclude most other vegetation, Christmas berry generally has more growing under and within it, mostly other non-native plants. Attempting to traverse through Christmas berry thickets, or determine what else is growing in the area, can be extremely challenging.



**Thick, short-statured Christmas berry forest covers a large portion of Kilauea Point NWR. Though tough to walk through and displacing native plants, this is prime Red-footed Booby nesting habitat.**

## IRONWOOD (CASUARINA) FOREST

Ironwoods (*Casuarina equisetifolia*) are the tallest trees at Kilauea Point NWR, can grow in virtually any location on the Refuge, and without control will likely become the dominant vegetation type over time. In areas where ironwood has been planted or established, virtually nothing else grows underneath the tall trees. Travel through areas of ironwood forest is generally easier than through *Schinus* forest and shrubland vegetation.



Little grows underneath a stand of ironwood (*Casuarina equisetifolia*), where Laysan Albatross seem to enjoy the open and shaded habitat the trees create.

## GRASSLAND

There is very little area at Kilauea Point NWR that would be in open grasslands without regular mowing. These areas, mostly on terrain with mild slopes, are kept open for management of the Hawaiian Goose and include some native plantings. Kikuyu grass (*Pennisetum clandestinum*) is often found in these areas, a remnant from previous ranching operations on the site. A mix of other non-native plants can also be found scattered about the grasslands.



**A good portion of Crater Hill is kept in grassland through mowing. These open areas are managed for Nene and include native plantings.**

## DEVELOPED

Kilauea Point proper holds the bulk of the developed lands within the refuge, and is where most visitors and staff spend their time. The site includes old lighthouse structures, new structures built for refuge activities, and paved paths and parking lots. The vegetation is a mix of native and non-native plants, lawn, and abandoned ornamentals.



**Native plants have been planted near the visitor center and other frequented areas at Kilauea Point. Ironwood and other non-natives also occur here.**

## LOCATION DESCRIPTIONS

### KILAUEA POINT



**Kilauea Point from the public overlook. Visible are ironwood and naupaka, buildings and the lighthouse, and large areas of steep barren land.**

Kilauea Point contains the main developed area of Kilauea Point NWR, where virtually all 500,000 annual visitors go. The point includes the entrance road, parking areas, buildings, walkways, and lighthouse.

#### **Natives**

The plants in the main developed portion of Kilauea Pt. NWR are predominantly native, the result of years of restoration. Most common are the native shrubs naupaka (*Scaevola taccada*), ilima (*Sida fallax*), and akoko (*Euphorbia celastroides* var. *stokesii*).

The vining natives nehe (*Lipochaeta succulenta*), pohinahina (*Vitex rotundifolia*), and ulei (*Osteomeles anthyllidifolia*) twine amongst the shrubs. Native hala trees (*Pandanus tectorius*) can be found over much of the point, especially along the entrance drive and behind the staff residence.

Cliffs below Kilauea Pt. are dominated by akoko, naupaka, akulikuli (*Sesuvium portulacastrum*), ohelo kai (*Lycium sandwicense*), and nehe.

There is a greenhouse with a fair number of diverse native plants, such as alula (*Brighamia insignis*), mao (*Gossypium tomentosum*), ohai (*Sesbania tomentosa*), aalii (*Dodonaea viscosa*), and many more.

### **Non-Natives**

A mix of cultivated and naturalized non-native plants are found at Kilauea Point. In general, the more accessible areas have more cultivated and urban loving non-natives, and the less accessible areas have a smaller palette of more aggressive species.

Ironwood trees (*Casuarina equisetifolia*) line the boundary with the adjoining property and continue up through the entrance and lookout. They also form a ring around much of the coastal cliffs, especially on the western side of the point.

Non-native shrubby lantana (*Lantana camara*) is generally found in less accessible areas, forming thorny thickets over much of the less maintained shrubland habitat, along with Christmas berry (*Schinus terebinthifolius*) and haole koa (*Leucaena leucocephala*).

A tight lawn of seashore paspalum (*Paspalum vaginatum*) is used in high traffic areas around the point. In less maintained portions, or areas where there isn't enough moisture for a lawn, are a mix of common ephemeral weeds, especially ageratum (*Ageratum conyzoides*), which often dominated areas of seasonally bare ground. Narrowleaf plantain (*Plantago lanceolata*) was also common, and seemed to be a favored food of the Nene.

There are scattered persistent plants from long forgotten plantings. Be-still tree (*Thevetia peruviana*) is perhaps the one that has spread the furthest, creating tall thickets over much of the western part of the point. Many other garden plants that have jumped the fence at Kilauea Point including the vining golden pothos (*Epipremnum pinnatum*), which can be found entwined with naupaka and other plants.

Some of the abandoned cultivated plants haven't spread so much as they have just persisted over the years. A grove of old Coconut trees (*Cocos nucifera*) towers over the landscape near the Staff Residence. Mother in law's tongue (*Sansevieria fasciata*), flowering bulbs (*Hippeastrum*) and quite a few other ornamental plants can be found scattered about Kilauea Point, likely not far from where they were originally planted. The lone residence at Kilauea Point had recently started a number of vegetables, including basil, lettuce, corn, carrots, tomatoes, and other common garden vegetables.

Incipient non-native species just starting to get a foot hold at the point include the bird dispersed carrotwood (*Cupaniopsis anacardioides*) and autograph tree (*Clusia rosea*). There are mature plantings of the autograph tree visible on the adjoining property. It's uncertain where the carrotwood trees are originating from, but all the plants found on the refuge were relatively young.



**Main visitor parking area and roads at Kilauea Point. As in many places on the point, naupaka is prevalent. Hala and ironwood trees are visible in distance.**



**Akoko and other native plants line concrete paths in a landscaped area near the Gift Shop at Kilauea Point.**



**Nene are common at Kilauea Point. They like to nibble at the mostly non-native vegetation, such as plantain (*Plantago* spp.), in lawns and waysides.**



**Albatross Hill is a bit more wild portion of Kilauea Point. Some areas are still occasionally mowed, to keep a flyway open for albatross, but it is less visited and manicured than other areas of the point.**



**Native plant greenhouse at Kilauea Point.**



**Vegetable starts at residence at Kilauea Point.**

## CRATER HILL



**The ocean side of Crater Hill from Mokolea Point.**

Crater Hill is the large cinder cone towering over the coast, stretching from the public overlook at Kilauea Point eastward until Mokolea Point.

### **Natives**

Areas of Crater Hill closest to the ocean generally hold more native plants. Where salt spray is present, Akulikuli (*Sesuvium portulacastrum*) is often the closest plant to the ocean. Ohelo kai (*Lycium sandwicense*) can also be found near the coast. Further back naupaka is locally common and there are scattered hala trees.

In the most sheer areas akoko shrubs are able to survive, along with the konakona grass (*Panicum torridum*). In areas that aren't heavily managed, these are able to survive a bit inland on flatter ground, but generally are restricted to the most steep terrain.

Further away from the cliffs there are very few native plants. The only natives in the large grassy mowed areas of Crater Hill have been planted. Here there are groves of hala, milo (*Thespesia populnea*), and loulu (*Pritchardia* spp.) amongst the mowed lawn. The native coconut leafroller moth (*Omiodes blackburni*) was utilizing the planted loulu palms as a larval host plant.

## Non-natives

Ironwood dominates the sheer areas near the public overlook, continues eastward as a thin strip along the rim, and hangs precipitously off the most inaccessible cliffs. Where the land is less steep, Christmas berry generally dominates. Both of these species are heavily utilized as nesting sites by Red-footed Boobies.

Occasionally found in the understory of ironwood and Christmas berry trees are stands of coralberry (*Rivina humilis*) and coral creeper (*Barleria repens*). Also generally found under or on trees are the incipient bird dispersed species autograph tree (*Clusia rosea*), carrotwood (*Cupaniopsis anacardioides*), and Chinese banyan (*Ficus microcarpa*).

In areas beyond the thick ironwood or Christmas berry canopies, there are often low thickets of lantana (*Lantana camara*) with other non-natives, predominantly sour grass (*Digitaria insularis*), haole koa (*Leucaena leucocephala*), vervain (*Stachytarpheta cayennensis*), and sourbush (*Pluchea carolinensis*). The native akoko can also sometimes be found mixed in there.

The large mowed lawn area of Crater Hill is predominantly Kikuyu grass (*Cenchrus clandestinus*) with other common non-native lowland lawn plants, such as *Ageratum conyzoides*, *Paspalum* spp., lanceleaf plantain (*Plantago lanceolata*), obscure morning glory (*Ipomoea obscura*), and sensitive plant (*Mimosa pudica*).

Within the mowed areas are clumps of native plantings and some non-native patches of predominantly Christmas berry with lantana, guava (*Psidium guajava*), and the other species previously mentioned in the lawn area.



**Sheer cliffs form the least accessible areas of Crater Hill. Active management will likely never occur on this very steep terrain. Akoko, hala, naupaka, and other native plants cling here, as does ironwood.**



**The less than sheer areas of Crater Hill that can't be mowed are dominated by the non-native trees ironwood and Christmas berry, both of which provide the bulk of nesting habitat for Red-footed Boobies at the refuge.**



**The flattest terrain on Crater Hill is managed through mowing. There are also scattered clumps of native tree plantings and patches of Christmas berry. Nene frequent this area, as do migratory shorebirds.**



**This area of Christmas berry on the far end of Crater Hill didn't have any birds nesting in it and had been recently mowed down to make more Nene habitat.**



**Christmas berry trees form much of the main canopy in the Red-footed Booby colony on Crater Hill.**



**Ironwood trees cover much of Crater Hill. Not much usually grows under ironwood, but coral creeper (*Barleria repens*) has become established in a number of spots.**

## MOKOLEA POINT



**Looking east across Nihoku towards the tip of Mokolea Point.**

Mokolea Point is the far eastern point of Kilauea Point NWR, extending from the eastern base of Crater Hill at Makapili Rock, through the Nihoku section and Kilauea Point proper, to Kilauea River.

### **Natives**

The bulk of the native plants at Mokolea Point are found in pockets near the coast, though scattered patches of natives can be found in the higher slopes.

Akulikuli (*Sesuvium portulacastrum*) is once again generally the closest plant to the ocean, along with thickets of naupaka (*Scaevola taccada*) and occasional patches of nehe (*Lipochaeta succulenta*), beach pea (*Vigna marina*), pohuehue (*Ipomoea pes-caprae*), pau o Hiiaka (*Jacquemontia sandwicensis*), alena (*Boerhavia* sp.), ilima (*Sida fallax*), and ohelo kai (*Lycium sandwicense*).

Higher up the slopes naupaka continues in places, as does alena, ilima, and nehe. Groves of hala (*Pandanus tectorius*) are scattered about Mokolea Point, especially near Crater Hill, Nihoku, and along the 4WD road. Occasional windswept patches of ulei (*Osteomeles anthyllidifolia*) are also found on the slopes of Mokolea Point.

## Non-natives

The vegetation on Mokolea Point is predominantly non-native, mostly ironwood (*Casuarina equisetifolia*) and Christmas berry (*Schinus terebinthifolius*), both of which form extensive forests with mostly barren understories over much of the point.

In areas without a solid canopy, haole koa (*Leucaena leucocephala*), coral berry (*Rivina humilis*), lantana (*Lantana camara*), guava (*Psidium guajava*), sourbush (*Pluchea carolinensis*), Java plum (*Syzygium jambos*) and Guinea grass are commonly encountered. In open dry areas, especially those that are mowed, ageratum (*Ageratum conyzoides*) is quite prevalent.

The Nihoku saddle section has large areas of diverse non-native grasses, predominantly Hilo grass (*Paspalum conjugatum*) and sourgrass (*Digitaria insularis*). Patches of pendant senna (*Senna pendula*) can be found on the margins of Christmas berry thickets in this area, along with haole koa, lantana, naupaka, and guava.

Along the 4WD road to Nihoku Point there appears to have been yard trash thrown off the side at different times, with some of the clippings regrowing in their new locations. Slipper flower (*Pedilanthus tithymaloides*) is another cultivated plant perhaps discarded at Mokolea Point at some point.

Near the tip of Mokolea Point, the west side is sheer and mostly unvegetated with the exception of some ironwood trees on the rim, the east side is predominantly windswept thickets of haole koa, and the point terminates in a grove of ironwood. Tobacco (*Nicotiana tobacco*) persists in small patches, as does *Mirabilis jalapa*, and hoary abutilon (*Abutilon grandifolium*).

There is a small portion of refuge land that appears to run alongside the mouth of the Kilauea River. This lush area is very different from other parts of the refuge, dominated by red mangrove (*Rhizophora mangle*) and other wetland plants.

Incipient invasive species at Mokolea Point include those mentioned above at the presumed landscape dumping sites, the bird dispersed species carrotwood (*Cupaniopsis anacardiodes*) and inkberry (*Ardisia elliptica*), and species of unknown origin such as pendant senna.



Strand vegetation along the eastern shore of Mokolea Point is dominated by native naupaka (*Scaevola*), with akulikuli (*Sesuvium*) and ohelo kai (*Lycium*).



Christmas berry (*Schinus*) shrub forest, dominates much of the Nihoku section of Mokolea Point. A few hala (*Pandanus*) trees can be seen, as can a line of ironwood trees along the coast. Much of the lower portion of the cliffs is bare.



**There are a few flat mowed areas along the ridge of Mokolea point, comprised mostly of herbaceous non-native annuals and grasses. Laysan Albatross appear to use these areas for congregating and take off and landing.**



**Ironwood groves are found over much of Mokolea point, usually with very little growing underneath them. Albatross like to take shelter under individual ironwood trees and on the edges of ironwood forest.**



Near the tip of Mokolea Point windsept haole koa (*Leucaena*) thickets border both sides of the 4WD road and much of the eastern slopes.



Mokolea Point has fewer incipient species than Kilauea Point or Crater Hill, but new species are making inroads here as well, such as carrotwood (*Cupaniopsis*), with numerous saplings across a wide range of the refuge, but no large trees yet.

## GLOBAL COMPENDIUM OF WEEDS

Plant species at Kilauea Point NWR with top 25 highest number of references as an environmental weed in the Global Compendium of Weeds (GCW). The GCW has been compiled from worldwide reference sources by Rod Randall of the Western Australia Department of Agriculture. Each species is scored based on the number of worldwide GCW references to it being a weed. Generally, the higher the score, the greater the potential for a species to be a weed.

| <b>Species</b>                   | <b>Common name</b>     | <b>GCW</b> |
|----------------------------------|------------------------|------------|
| <i>Ardisia elliptica</i>         | Shoebuttan ardisia     | 13         |
| <i>Asparagus densiflorus</i>     | Asparagus fern         | 14         |
| <i>Canna indica</i>              | Indian shot, canna     | 12         |
| <i>Casuarina equisetifolia</i>   | Ironwood               | 18         |
| <i>Cupaniopsis anacardioides</i> | Carrot wood            | 10         |
| <i>Cynodon dactylon</i>          | Bermuda grass          | 17         |
| <i>Ficus microcarpa</i>          | Chinese banyan tree    | 12         |
| <i>Lantana camara</i>            | Lantana                | 28         |
| <i>Leucaena leucocephala</i>     | Koa haole              | 20         |
| <i>Melinis minutiflora</i>       | Molasses grass         | 16         |
| <i>Paspalum conjugatum</i>       | Hilo grass             | 10         |
| <i>Paspalum dilatatum</i>        | Dallis grass           | 15         |
| <i>Passiflora edulis</i>         | Passion fruit          | 16         |
| <i>Physalis peruviana</i>        | Poha, cape gooseberry  | 9          |
| <i>Plantago lanceolata</i>       | Narrow-leaved plantain | 12         |
| <i>Psidium cattleianum</i>       | Strawberry guava       | 18         |
| <i>Psidium guajava</i>           | Guava                  | 23         |
| <i>Ricinus communis</i>          | Castor bean            | 24         |
| <i>Rivina humilis</i>            | Coral berry            | 9          |
| <i>Schefflera actinophylla</i>   | Octopus tree           | 18         |
| <i>Schinus terebinthifolius</i>  | Christmas berry        | 30         |
| <i>Sonchus oleraceus</i>         | Sow thistle            | 12         |
| <i>Sphagneticola trilobata</i>   | Wedelia                | 10         |
| <i>Stenotaphrum secundatum</i>   | St. Augustine grass    | 16         |
| <i>Syzygium cumini</i>           | Java plum              | 12         |

## HAWAII WEED RISK ASSESSMENT

Plant species at Kilauea Point NWR determined to be High Risk by the Hawaii Weed Risk Assessment (HWRA) developed by the University of Hawaii. The HWRA uses 49 questions to obtain a score for each species. A high scoring plant poses a high risk of becoming invasive in Hawaii and other Pacific Islands.

| <b>Species</b>                   | <b>Common name</b>     | <b>HWRA</b> |
|----------------------------------|------------------------|-------------|
| <i>Aleurites moluccana</i>       | Kukui nut              | 12          |
| <i>Allamanda cathartica</i>      | Yellow allamanda       | 8           |
| <i>Ardisia elliptica</i>         | Shoebuttton ardisia    | 11          |
| <i>Asparagus densiflorus</i>     | Asparagus fern         | 15          |
| <i>Asystasia gangetica</i>       | Chinese violet         | 12          |
| <i>Canna indica</i>              | Indian shot, canna     | 17          |
| <i>Casuarina equisetifolia</i>   | Ironwood               | 21          |
| <i>Cecropia obtusifolia</i>      | Guarumo, trumpet tree  | 10          |
| <i>Chrysophyllum oliviforme</i>  | Satin leaf             | 7           |
| <i>Commelina diffusa</i>         | Honohono               | 23          |
| <i>Cupaniopsis anacardioides</i> | Carrot wood            | 9           |
| <i>Cynodon dactylon</i>          | Bermuda grass          | 22          |
| <i>Cyperus involucratus</i>      | Umbrella sedge         | 17          |
| <i>Digitaria insularis</i>       | Sourgrass              | 20          |
| <i>Epipremnum pinnatum</i>       | Golden pothos          | 9           |
| <i>Ficus microcarpa</i>          | Chinese banyan tree    | 10          |
| <i>Ipomoea obscura</i>           | Obscure morning glory  | 13          |
| <i>Justicia betonica</i>         | White shrimp plant     | 12          |
| <i>Lepidium virginicum</i>       | Peppergrass            | 17          |
| <i>Leucaena leucocephala</i>     | Koa haole              | 15          |
| <i>Melinis minutiflora</i>       | Molasses grass         | 18          |
| <i>Mirabilis jalapa</i>          | Four-oclock            | 15          |
| <i>Morinda citrifolia</i>        | Noni                   | 10          |
| <i>Neonotonia wightii</i>        | Glycine                | 7           |
| <i>Paspalum conjugatum</i>       | Hilo grass             | 28          |
| <i>Paspalum dilatatum</i>        | Dallis grass           | 12          |
| <i>Paspalum vaginatum</i>        | Seashore paspalum      | 7           |
| <i>Passiflora foetida</i>        | Love in a mist         | 26          |
| <i>Pluchea carolinensis</i>      | Sourbush               | 15          |
| <i>Pluchea indica</i>            | Indian fleabane        | 11          |
| <i>Psidium cattleianum</i>       | Strawberry guava       | 18          |
| <i>Psidium guajava</i>           | Guava                  | 21          |
| <i>Rhizophora mangle</i>         | Red mangrove           | 13          |
| <i>Ricinus communis</i>          | Castor bean            | 21          |
| <i>Rivina humilis</i>            | Coral berry            | 11          |
| <i>Sansevieria trifasciata</i>   | Mother in law's tongue | 9           |

|                                 |                     |    |
|---------------------------------|---------------------|----|
| <i>Schefflera actinophylla</i>  | Octopus tree        | 13 |
| <i>Schinus terebinthifolius</i> | Christmas berry     | 19 |
| <i>Solanum seaforthianum</i>    | Vining solanum      | 9  |
| <i>Sphagneticola trilobata</i>  | Wedelia             | 13 |
| <i>Stenotaphrum secundatum</i>  | St. Augustine grass | 15 |
| <i>Syzygium cumini</i>          | Java plum           | 9  |
| <i>Thespesia populnea</i>       | Milo                | 9  |
| <i>Thevetia peruviana</i>       | Be-still tree       | 9  |
| <i>Thunbergia fragrans</i>      | Sweet clock-vine    | 9  |

## POTENTIAL ERADICATION AND CONTROL TARGETS

Non-native plants form the dominant vegetation cover at Kilauea Point NWR. Many of these species are well established, such as ironwood and Christmas berry, and would be virtually impossible to completely remove from the refuge. However, there are a number of potentially invasive plant species found on the refuge in low numbers for which refuge wide management is more feasible. There is additional information about each of these species in the Annotated Checklist (Appendix A) and Maps (Appendix B).

### One or very few locations

For some of these species, it would be relatively easy to remove all the know individuals from the entire refuge, such as Star of Bethlehem (*Hippobroma longiflora*), which is restricted to less than a dozen plants in one small easily accessible patch at Kilauea Point. Funkien Tea (*Carmona retusa*) and umbrella sedge (*Cyperus involucratus*) could be similarly removed in a manner of minutes.

Species with one or very few locations that could be controlled in the course of other work or included in dedicated control efforts:

- *Andropogon bicornis* (West Indian foxtail)
- *Ardisia elliptica* (Inkberry)
- *Bougainvillea sp.* (Bougainvillea)
- *Canna indica* (Indian shot)
- *Carmona retusa* (Funkien tea)
- *Cyperus alternifolia* (Umbrella sedge)
- *Hippobroma longiflora* (Star of Bethlehem)
- *Melinis minutiflora* (Molasses grass)
- *Neonotonia wightii* (Glycine)
- *Passiflora edulis* (Passion fruit)
- *Passiflora foetida* (Love in a mist)
- *Passiflora laurifolia* (Water lemon)
- *Sansevieria trifasciata* (Mother in law's tongue)
- *Spathodea campanulata* (African tulip)
- *Syngonium podophyllum* (Arrowhead)
- *Tabebuia sp.* (Trupmet tree)
- *Tetragonia tetragonioides* (New Zealand spinach)
- *Xanthium strumarium* (Cocklebur)

### **A few established patches or locations**

Some species would require more than a few minutes, but not likely more than a few days to control all the known individuals once. These include Madagascar olive (*Noronhia emarginata*), octopus tree (*Schefflera actinophylla*), African tulip (*Spathodea campanulata*), and *Bougainvillea*.

Less widespread species that could be chipped away at, contained to the area they already occur in, or included in a dedicated control effort:

- *Abutilon grandifolium* (Hoary abutilon)
- *Cecropia obtusifolia* (Cecropia)
- *Justicia betonica* (White shrimp plant)
- *Kalanchoe pinnata* (Air plant)
- *Noronhia emarginata* (Madagascar olive)
- *Ricinus communis* (Castor bean)
- *Schefflera actinophylla* (Octopus tree)
- *Senna pendula* (Pendant senna)

### **Significant patches or numerous locations**

Other species are still limited in numbers, but are more widespread those previously mentioned, and may be more of a challenge to completely remove from the refuge. Carrotwood (*Cupaniopsis anacardioides*) is just starting to get a foothold in the refuge, there are numerous saplings across a wide area of the refuge, but there are no large trees yet. A concerted effort to control all the known carrotwood plants and search for missed ones would likely take many weeks.

Species with many locations, likely requiring a dedicated control effort and significant resources:

- *Clusia rosea* (Autograph tree)
- *Cupaniopsis anacardioides* (Carrotwood)
- *Ficus microcarpa* (Chinese banyan)
- *Thevetia peruviana* (Be-still tree)

## VEGETATION MANAGEMENT & RESTORATION

Suitability for wildlife, terrain, and resources available will likely be the major determinants of what management actions are taken at Kilauea Point NWR. The focus of this survey was on incipient invasive plants, species that have a history of invasiveness elsewhere, are known from the refuge, but are not yet widespread on the refuge.

### CONTROL WORK

Given the abundant native birds at Kilauea, extra emphasis should be placed on a given plants role in regards to wildlife, mostly seabirds and Nene. Though some species, such as Christmas berry (*Schinus terebinthifolius*), are highly invasive and controlled in natural areas elsewhere, at Kilauea they are a favored nesting tree of Red-footed Boobies and removal of all the Christmas berry from Kilauea would neither be possible, nor necessarily desirable. Other species such as lantana (*Lantana camara*) and be-still tree (*Thevetia peruviana*) seem to have less wildlife value at Kilauea, and putting effort into control of these sorts of species seems more compelling.

The terrain at Kilauea Point NWR ranges from flat landscaped areas, where control work can be done relatively easily, wildlife aside, to sheer crumbling cliffs that would be dangerous even with ropes and helmets. Species found in less steep terrain and those closer to roads and baseyards will be easier to address. Species able to live in less accessible terrain, such as those that are bird dispersed and germinate as epiphytes in cliffs or treetops, make refuge wide control less likely.

Along with species that can be eradicated from the entire refuge, local eradications also have value. There is a small satellite plant of golden pothos (*Epipremnum pinnatum*) establishing at an old yard waste dumpsite on Mokolea Point. Control of this small patch now would help prevent golden pothos from invading the area like it has at Kilauea Point.

There are numerous invasive species just beyond the refuge border. Some of these species are already common in the refuge, others are not, such as cat's claw (*Caesalpinia decapetala*), a very thorny climbing vine that forms impenetrable thickets. Many of the incipient species newly recorded from the refuge are spreading by birds from nearby properties. In some cases, these plants are intentionally cultivated by neighboring properties. In other cases, the plants are growing wild. Addressing high priority species beyond the refuge border when possible will help. Early detection and rapid response to new locations within the refuge is the next best step.

There are a number of plant control techniques, including hand-pulling, herbicide, and mowing available to manage vegetation. Each species and location will dictate the best approach. Some species will require a combination of methods. Many of these species will require follow up control after initial suppression. All of these species have the potential to be reintroduced through a variety of means.

## RESTORATION

In a wildlife dominated location, such as Kilauea Point NWR, vegetation management will depend on which wildlife is wanted in a particular area. For example, Red-footed Boobies seem to gravitate towards dense Christmas berry forest, but avoid grass lawn. In contrast, Nene prefer open grass areas with scattered shrubs and trees, and are not found in dense forested areas. Choosing which vegetation type to promote in an area will largely determine which bird species utilize that area.

Terrain will limit restoration to the less steep areas, as much of the refuge is too dangerous to access. Additionally, the refuge is large and areas where people regularly frequent will receive the most attention. Focusing restoration efforts in small discrete areas will be more successful than diffusing efforts across a broad landscape.

Resources will limit what can be done. The refuge has no staff dedicated to plant restoration, the only current activities are occurring through the help of volunteers. Though some plantings have been done, vast areas are mowed, and the landscape at Kilauea Point is maintained, much of the refuge is basically unmanaged for plants.

Wildlife is the main biological resource at Kilauea Point NWR. However, the FWS is also responsible for native plants. Volunteer efforts are doing a good job of native plant propagation and outplanting. Additionally, a detailed and ambitious restoration plan was written for the refuge, that includes plant species appropriate for the area and potential restoration locations and methods (Bruegmann and Castillo 1999).

Ultimately, which areas and species are focused on will be determined by what people are interested in and available funding. An example of this is the Nihoku predator-free enclosure, planned to be built between Crater Hill and Mokolea Point. Because the funding is specifically for Newell's Shearwater, that will guide where work is done and what is done with the vegetation in the area.

## BIRDS AND VEGETATION

When wildlife is the management priority, it becomes important to look not only at whether a given plant is native or not, but also how wildlife interacts with that plant. Below are our observations on interactions between the native bird species known to breed at Kilauea Point NWR and vegetation.

### Red-footed Booby (*Sula sula*)



Nests are built in small trees and large shrubs. At Kilauea, Christmas berry is the preferred nesting tree. Ironwood, especially younger trees, are also used. On Midway Red-footed Boobies also nest in naupaka, but don't seem to do so at Kilauea. Other vegetation, such as akoko is used to construct the nest. The most abundant seabird at Kilauea. Much of the terrain where they nest is very difficult to access.

### Laysan Albatross (*Phoebastria immutabilis*)



Nest is a scrape on the ground. Need open room to take off and land. Like some shade during the hot months. Ironwood (*Casuarina equisetifolia*) is highly invasive, yet is a preferred nesting area for Laysan Albatross at Kilauea.

### Newell's Shearwater (*Puffinus auricularis newelli*)



Nest is under uluhe ferns in mountain regions. Near the coast they have nested in naupaka and under the thick mat of leaves at the base of the prop roots of hala trees. Image by Brenda Zaun (FWS).

### Wedge-tailed Shearwater (*Puffinus pacificus*)



Nests in burrows under the ground. Doesn't need any vegetation, though will line nest with vegetation, such as ironwood. Prefers areas of loose soil to dig burrows.

**Red-tailed Tropicbird (*Phaethon rubricauda*)**



Nests on the ground under naupaka shrubs, at the base of ironwood trees, and on shelves in cliffs.

**Nene or Hawaiian Goose (*Branta sandvicensis*)**



Nests on the ground in tall grass, shrubs, or other hidden areas. Eats grasses and other tender vegetation. Grasses and other plants on Crater Hill can be easily mowed to keep large areas of vegetation open for the Nene, along with retaining or planting areas of shrubs and trees for the Nene to retreat into.

## INSECTS AND VEGETATION

Birds are not the only wildlife at Kilauea Point NWR. Below are some of the native and non-native insects observed during the botanical survey, along with a brief description of each insect and the plants they associate with.

### NATIVE

#### Yellow-faced Bees (*Hylaeus connectens*)



Native Yellow-faced Bees (*Hylaeus connectens*) were found on akoko (*Euphorbia celastroides* subsp. *stokesii*), nehe (*Lipochaeta succulenta*), and ilima (*Sida fallax*). A yellow mark can be seen on its face.

#### Native Mestolobes Moth (*Mestolobes* sp.)



We observed the native moth Mestolobes (*Mestolobes* sp.) in good number at Upper Overlook, visiting Christmas berry (*Schinus terebinthifolius*) flowers. There were many flying about. This moth is unique in that it is often active during the day, whereas other moths are usually active at night. We are not sure which species of *Mestolobes* this is or what its larval host plant is.

#### Coconut Leaf Roller (*Omiodes blackburni*)



The native palm moth (*Omiodes blackburni*) was observed on coconut (*Cocos nucifera*), and some of the larger planted *Pritchardia* palms, including *Pritchardia thurstonii* at the Lighthouse Pt. and *P. remota* at the Crater Hill out-planting. This image shows the typical feeding damage on a *P. remota*. Moths chew on leaves but will not cause much harm to the plant. Below are different life stages of the moth.



#### Green Darner (*Anax junius*)

The Green Darner (*Anax junius*), a native dragonfly, was flying about the refuge. It likely spent its immature stage in nearby wetlands.

## NON-NATIVE

### Small Carpenter Bee (*Ceratina cf. dentipes*)



The newly introduced small carpenter bee (*Ceratina cf. dentipes*) was found visiting the flowers of ilima (*Sida fallax*). Shown here, it has a white line on its forehead.

### Indian Bee (*Ceratina smaragdula*)



The also newly introduced Indian bee (*Ceratina smaragdula*), with a metallic green to bronze to purple hue, was also found visiting flowers of ilima.

### Lesser Grass Blue Butterfly (*Zizina otis*)



The states newest butterfly, the Lesser Grass Blue (*Zizina otis*), resting on grass. It was also observed on the flowers of *Ageratum conyzoides*. First reported in Hawaii on Oahu in 2008. Now also known on Kauai and Maui. It's one of the smaller blue Lycaenidae butterflies in Hawaii, dark blue above with pale undersides with small dark dots in rows.

### Bean Butterfly (*Lampides boeticus*)



A large Lycaenidae butterfly with two dark spots and hairstreaks, shown here visiting fuzzy rattlepod (*Crotalaria incana*). The larva feed on plants in the bean family.

### Lesser Lantana Butterfly (*Strymon bazochii*)



The smaller of the two Lycaenidae butterflies introduced for biological control of lantana (*Lantana camara*), *Strymon bazochii* is shown here visiting sourbush (*Pluchea carolinensis*) flowers. It was also observed visiting flower of ilima (*Sida fallax*). The wings are blue above and the undersides brown with brown spots. It has a sort of boxy appearance. Adults were observed ovipositing in the lush tips of lantana foliage.

### Beet Webworm Moth (*Spolodea recurvalis*)



We observed this non-native moth in the Crambidae family, the Beet Webworm (*Spolodea recurvalis*) flying about. It is a cosmopolitan species and known to feed on beets, chard, spinach, and various weeds such as *Amaranthus* and *Chenopodium* species (Butterflies and Moths of North America 2013). We have observed this moth feeding on aweoweo (*Chenopodium oahuense*) in the past.

### Cabbage Butterfly (*Pieris rapae*)



The cabbage butterfly (*Pieris rapae*) was observed flying about and is shown here visiting flowers of vervain (*Stachytarpheta cayennensis*).

### Fiery Skipper Butterfly (*Hylephila phyleus*)



The Fiery skipper (*Hylephila phyleus*) was observed flying about and visiting flowers of vervain (*Stachytarpheta cayennensis*). The males are orange or yellow with black spots while the females are dark brown with orange or yellow spots and the larva feed on grasses (Wikipedia 2013).

**Passion Vine Butterfly (*Agrius vanillae*)**



This large bright orange butterfly with black dots and silver undersides was observed flying about and visiting the flowers of sourbush (*Pluchea carolinensis*). The larvae hosts on passion vines (*Passiflora* sp.), of which there are numerous species in the area.

**Pandanus Hole Cutter Moth (*Trissodoris honorariella*)**



Image showing holes cut in hala (*Pandanus tectorius*) by the Pandanus hole cutter moth (*Trissodoris honorariella*) that were located near the Red-footed Bobby colony on Crater Hill. The larva cut holes in the spent leaves and sew them together then pupate inside. This moth is native to the Pacific region, but is not native in Hawaii (Nishida 2002).

**Christmas berry Seed Feeding Wasp (*Megastigmus transvaalensis*)**



We observed damage (holes in seeds) made by the non-native Christmas berry (*Schinus terebinthifolius*) seed feeding Chalcid wasp (*Megastigmus transvaalensis*) on fruits of Christmas berry.

## CHECKLIST OF PLANTS OBSERVED

| <b>Species</b>                                     | <b>Common name</b>      | <b>Family</b>  | <b>Status</b> |
|--|-------------------------|----------------|---------------|
| <i>Abutilon grandifolium</i>                       | Hairy abutilon          | Malvaceae      | Naturalized   |
| <i>Acacia koa</i>                                  | Koa                     | Fabaceae       | Endemic       |
| <i>Ageratum conyzoides</i>                         | Maile honohono          | Asteraceae     | Naturalized   |
| <i>Aleurites moluccana</i>                         | Kukui nut               | Euphorbiaceae  | Naturalized   |
| <i>Allamanda cathartica</i>                        | Yellow allamanda        | Apocynaceae    | Cultivated    |
| <i>Amaranthus viridis</i>                          | Slender amaranth        | Amaranthaceae  | Naturalized   |
| <i>Anagallis arvensis</i>                          | Scarlet pimpernel       | Primulaceae    | Naturalized   |
| <i>Andropogon bicornis</i>                         | West Indian foxtail     | Poaceae        | Naturalized   |
| <i>Ardisia elliptica</i>                           | Shoebuttton ardisia     | Primulaceae    | Naturalized   |
| <i>Argemone glauca</i>                             | Pua kala                | Papaveraceae   | Endemic       |
| <i>Asparagus densiflorus</i>                       | Asparagus fern          | Asparagaceae   | Naturalized   |
| <i>Aster subulatus</i> var.<br><i>sandwicensis</i> | Annual saltmarsh aster  | Asteraceae     | Naturalized   |
| <i>Asystasia gangetica</i>                         | Chinese violet          | Acanthaceae    | Naturalized   |
| <i>Bacopa monnieri</i>                             | Aeae                    | Plantaginaceae | Indigenous    |
| <i>Barleria repens</i>                             | Barleria                | Acanthaceae    | Naturalized   |
| <i>Bidens alba</i> var. <i>radiata</i>             | Beggartick              | Asteraceae     | Naturalized   |
| <i>Boerhavia coccinea</i>                          | Boerhavia               | Nyctaginaceae  | Naturalized   |
| <i>Boerhavia repens</i>                            | Alena                   | Nyctaginaceae  | Indigenous    |
| <i>Bothriochloa pertusa</i>                        | Pitted beardgrass       | Poaceae        | Naturalized   |
| <i>Bougainvillea</i> sp.                           | Bougainvillea           | Nyctaginaceae  | Cultivated    |
| <i>Brassica oleracea</i>                           | Brussel sprouts         | Brassicaceae   | Cultivated    |
| <i>Brighamia insignis</i>                          | Olulu, pu aupaka, alula | Campanulaceae  | Endemic       |
| <i>Caesalpinia kavaiensis</i>                      | Uhi uhi, kawau, kea     | Fabaceae       | Endemic       |
| <i>Canavalia cathartica</i>                        | Maunaloa                | Fabaceae       | Naturalized   |
| <i>Canna indica</i>                                | Indian shot, canna      | Cannaceae      | Naturalized   |
| <i>Capsicum annuum</i>                             | Pepper                  | Solanaceae     | Cultivated    |
| <i>Cardamine flexuosa</i>                          | Bittercress             | Brassicaceae   | Naturalized   |
| <i>Carica papaya</i>                               | Papaya                  | Caricaceae     | Cultivated    |
| <i>Carmona retusa</i>                              | Fukien tea              | Boraginaceae   | Naturalized   |
| <i>Casuarina equisetifolia</i>                     | Ironwood                | Casuarinaceae  | Naturalized   |
| <i>Cecropia obtusifolia</i>                        | Guarumo, trumpet tree   | Urticaceae     | Naturalized   |
| <i>Cenchrus clandestinus</i>                       | Kikuyu grass            | Poaceae        | Naturalized   |
| <i>Chamaecrista nictitans</i>                      | Partridge pea           | Fabaceae       | Naturalized   |
| <i>Chenopodium murale</i>                          | Lamb's quarters         | Amaranthaceae  | Naturalized   |
| <i>Chenopodium oahuense</i>                        | Aweoweo                 | Amaranthaceae  | Endemic       |
| <i>Chloris barbata</i>                             | Swollen fingergrass     | Poaceae        | Naturalized   |
| <i>Chrysalidocarpus lutescens</i>                  | Areca palm              | Arecaceae      | Naturalized   |
| <i>Chrysophyllum oliviforme</i>                    | Satin leaf              | Sapotaceae     | Naturalized   |
| <i>Chrysopogon aciculatus</i>                      | Golden beardgrass       | Poaceae        | Indigenous?   |

| <b>Species</b>                                     | <b>Common name</b>  | <b>Family</b>    | <b>Status</b> |
|--|---------------------|------------------|---------------|
| <i>Citrus x latifolia</i>                          | Tahitian lime       | Rutaceae         | Cultivated    |
| <i>Clusia rosea</i>                                | Autograph tree      | Clusiaceae       | Naturalized   |
| <i>Cocos nucifera</i>                              | Coconut palm, niu   | Arecaceae        | Polynesian    |
| <i>Codiaeum variegatum</i>                         | Croton              | Euphorbiaceae    | Cultivated    |
| <i>Colubrina asiatica</i>                          | Anapanapa           | Rhamnaceae       | Indigenous    |
| <i>Commelina diffusa</i>                           | Honohono            | Commelinaceae    | Naturalized   |
| <i>Conyza bonariensis</i>                          | Hairy horseweed     | Asteraceae       | Naturalized   |
| <i>Cordia subcordata</i>                           | Kou                 | Boraginaceae     | Indigenous    |
| <i>Cordyline fruticosa</i>                         | Ti leaf, ki         | Asparagaceae     | Polynesian    |
| <i>Crinum asiaticum</i>                            | Spider lily         | Liliaceae        | Cultivated    |
| <i>Crotalaria incana</i>                           | Fuzzy rattle pod    | Fabaceae         | Naturalized   |
| <i>Cupaniopsis anacardioides</i>                   | Carrot wood         | Sapindaceae      | Cultivated    |
| <i>Cyanea</i> sp.                                  | Haha, cyanea        | Campanulaceae    | Endemic       |
| <i>Cyanthillium cinereum</i>                       | Little ironweed     | Asteraceae       | Naturalized   |
| <i>Cynodon dactylon</i>                            | Bermuda grass       | Poaceae          | Naturalized   |
| <i>Cyperus involucratus</i>                        | Umbrella sedge      | Cyperaceae       | Naturalized   |
| <i>Cyperus javanicus</i>                           | Ahuawa              | Cyperaceae       | Indigenous    |
| <i>Cyperus phleoides</i>                           | Cyperus             | Cyperaceae       | Endemic       |
| <i>Cyperus polystachyos</i>                        | Pycreus             | Cyperaceae       | Indigenous    |
| <i>Cyperus rotundus</i>                            | Purple nut sedge    | Cyperaceae       | Naturalized   |
| <i>Daucus carota</i> subsp. <i>sativus</i>         | Carrots             | Apiaceae         | Cultivated    |
| <i>Desmanthus pernambucanus</i>                    | Slender mimosa      | Fabaceae         | Naturalized   |
| <i>Desmodium incanum</i>                           | Spanish clover      | Fabaceae         | Naturalized   |
| <i>Desmodium triflorum</i>                         | Tick clover         | Fabaceae         | Naturalized   |
| <i>Dianella sandwicensis</i>                       | Ukiuki              | Xanthorrhoeaceae | Endemic       |
| <i>Digitaria ciliaris</i>                          | Henry's crab grass  | Poaceae          | Naturalized   |
| <i>Digitaria insularis</i>                         | Sourgrass           | Poaceae          | Naturalized   |
| <i>Dodonaea viscosa</i>                            | Aalii               | Sapindaceae      | Indigenous    |
| <i>Dracaena marginata</i>                          | Money tree          | Asparagaceae     | Cultivated    |
| <i>Dracaena reflexa</i>                            | Dracaena            | Asparagaceae     | Cultivated    |
| <i>Dypsis decaryi</i>                              | Triangle palm       | Arecaceae        | Cultivated    |
| <i>Eclipta prostrata</i>                           | False daisy         | Asteraceae       | Naturalized   |
| <i>Eleusine indica</i>                             | Wire grass          | Poaceae          | Naturalized   |
| <i>Emilia fosbergii</i>                            | Pualele             | Asteraceae       | Naturalized   |
| <i>Epipremnum pinnatum</i>                         | Golden pothos       | Araceae          | Naturalized   |
| <i>Eragrostis pectinacea</i>                       | Carolina love grass | Poaceae          | Naturalized   |
| <i>Erigeron bellioides</i>                         | Daisy fleabane      | Asteraceae       | Naturalized   |
| <i>Erythrina sandwicensis</i>                      | Wiliwili            | Fabaceae         | Endemic       |
| <i>Euphorbia celastroides</i> var. <i>stokesii</i> | Akoko               | Euphorbiaceae    | Endemic       |
| <i>Euphorbia hypericifolia</i>                     | Graceful spurge     | Euphorbiaceae    | Naturalized   |

| <b>Species</b>  | <b>Common name</b>    | <b>Family</b>    | <b>Status</b> |
|---|-----------------------|------------------|---------------|
| <i>Euphorbia serpens</i>  | Matted sandmat        | Euphorbiaceae    | Naturalized   |
| <i>Euphorbia thymifolia</i>                                     | Spurge                | Euphorbiaceae    | Naturalized   |
| <i>Ficus elastica</i>   | Rubber tree           | Moraceae         | Cultivated    |
| <i>Ficus microcarpa</i>   | Chinese banyan tree   | Moraceae         | Naturalized   |
| <i>Fimbristylis cymosa</i>                                      | Mauu akiaki           | Cyperaceae       | Indigenous    |
| <i>Gossypium tomentosum</i>                                     | Mao, hawaiian cotton  | Malvaceae        | Endemic       |
| <i>Hibiscus clayi</i>   | Hawaiian red hibiscus | Malvaceae        | Endemic       |
| <i>Hibiscus kokio</i>   | Kokio ula             | Malvaceae        | Endemic       |
| <i>Hibiscus rosa-sinensis</i>                                   | Hibiscus              | Malvaceae        | Cultivated    |
| <i>Hibiscus tiliaceus</i>                                       | Hau                   | Malvaceae        | Indigenous?   |
| <i>Hippeastrum striatum</i>                                     | Barbados lily         | Amaryllidaceae   | Naturalized   |
| <i>Hippobroma longiflora</i>                                    | Star of bethlehem     | Campanulaceae    | Naturalized   |
| <i>Hyptis pectinata</i>   | Comb hyptis           | Lamiaceae        | Naturalized   |
| <i>Ipomoea obscura</i>  | Obscure morning glory | Convolvulaceae   | Naturalized   |
| <i>Ipomoea pes-caprae</i> subsp. <i>brasiliensis</i>            | Pohuehue              | Convolvulaceae   | Indigenous    |
| <i>Jacquemontia sandwicensis</i>                                | Pau o hiiaka          | Convolvulaceae   | Endemic       |
| <i>Justicia betonica</i>  | White shrimp plant    | Acanthaceae      | Naturalized   |
| <i>Kalanchoe pinnata</i>  | Air plant             | Crassulaceae     | Naturalized   |
| <i>Kyllinga brevifolia</i>                                      | Green kyllinga        | Cyperaceae       | Naturalized   |
| <i>Lactuca sativa</i>   | Lettuce               | Asteraceae       | Naturalized   |
| <i>Lantana camara</i>   | Lantana               | Verbenaceae      | Naturalized   |
| <i>Lepidium virginicum</i>                                      | Peppergrass           | Brassicaceae     | Naturalized   |
| <i>Leucaena leucocephala</i>                                    | Koa haole             | Fabaceae         | Naturalized   |
| <i>Lipochaeta succulenta</i>                                    | Nehe                  | Asteraceae       | Endemic       |
| <i>Lycium sandwicense</i>                                       | Ohelo kai             | Solanaceae       | Indigenous    |
| <i>Malvastrum coromandelianum</i> subsp. <i>coromandelianum</i> | False mallow          | Malvaceae        | Naturalized   |
| <i>Megathyrsus maximus</i>                                      | Guinea grass          | Poaceae          | Naturalized   |
| <i>Melinis minutiflora</i>                                      | Molasses grass        | Poaceae          | Naturalized   |
| <i>Metrosideros polymorpha</i>                                  | Ohia                  | Myrtaceae        | Endemic       |
| <i>Mimosa pudica</i>  | Sensitive plant       | Fabaceae         | Cultivated    |
| <i>Mirabilis jalapa</i>   | Four-oclock           | Nyctaginaceae    | Naturalized   |
| <i>Morinda citrifolia</i>                                       | Noni                  | Rubiaceae        | Polynesian    |
| <i>Myoporum sandwicense</i>                                     | Naio                  | Myoporaceae      | Indigenous    |
| <i>Neonotonia wightii</i>                                       | Glycine               | Fabaceae         | Naturalized   |
| <i>Nephrolepis brownii</i>                                      | Asian sword fern      | Lomariopsidaceae | Naturalized   |
| <i>Nicotiana tabacum</i>  | Tobacco               | Solanaceae       | Naturalized   |
| <i>Noronhia emarginata</i>                                      | Madagascar olive      | Oleaceae         | Naturalized   |
| <i>Nototrichium humile</i>                                      | Kului                 | Amaranthaceae    | Endemic       |
| <i>Nototrichium sandwicense</i>                                 | Kului                 | Amaranthaceae    | Endemic       |
| <i>Ocimum basilicum</i>   | Sweet basil           | Lamiaceae        | Cultivated    |

| <b>Species</b>                                   | <b>Common name</b>              | <b>Family</b>  | <b>Status</b> |
|--|---------------------------------|----------------|---------------|
| <i>Ocimum basilicum</i> var. <i>thrysiflorum</i> | Thai basil                      | Lamiaceae      | Cultivated    |
| <i>Osteomeles anthyllidifolia</i>                | Ulei, Hawaiian rose             | Rosaceae       | Indigenous    |
| <i>Oxalis corniculata</i>                        | Yellow wood sorrel              | Oxalidaceae    | Polynesian?   |
| <i>Pandanus tectorius</i>                        | Hala, screwpine                 | Pandanaceae    | Indigenous?   |
| <i>Panicum torridum</i>                          | Konakona                        | Poaceae        | Endemic       |
| <i>Parthenium hysterophorus</i>                  | Santa Maria                     | Asteraceae     | Naturalized   |
| <i>Paspalum conjugatum</i>                       | Hilo grass                      | Poaceae        | Naturalized   |
| <i>Paspalum dilatatum</i>                        | Dallis grass                    | Poaceae        | Naturalized   |
| <i>Paspalum vaginatum</i>                        | Seashore paspalum               | Poaceae        | Naturalized   |
| <i>Passiflora edulis</i>                         | Passion fruit                   | Passifloraceae | Cultivated    |
| <i>Passiflora foetida</i>                        | Love in a mist                  | Passifloraceae | Naturalized   |
| <i>Passiflora laurifolia</i>                     | Yellow water lemon              | Passifloraceae | Naturalized   |
| <i>Pedilanthus tithymaloides</i>                 | Slipper flower                  | Euphorbiaceae  | Cultivated    |
| <i>Philodendron</i> sp.                          | Philodendron                    | Araceae        | Cultivated    |
| <i>Phyllanthus debilis</i>                       | Phyllanthus                     | Phyllanthaceae | Naturalized   |
| <i>Phymatosorus grossus</i>                      | Lauae, maile scented fern       | Polypodiaceae  | Naturalized   |
| <i>Physalis peruviana</i>                        | Poha, cape gooseberry           | Solanaceae     | Naturalized   |
| <i>Pilea microphylla</i>                         | Artillery plant                 | Urticaceae     | Naturalized   |
| <i>Pisonia</i> sp.                               | Papala kepau                    | Nyctaginaceae  | Endemic       |
| <i>Pisum sativum</i> var. <i>macrocarpum</i>     | Pea                             | Fabaceae       | Cultivated    |
| <i>Pittosporum</i> sp.                           | Pittosporum                     | Pittosporaceae | Endemic       |
| <i>Plantago lanceolata</i>                       | Narrow-leaved plantain          | Plantaginaceae | Naturalized   |
| <i>Plantago major</i>                            | Broad-leaved or common plantain | Plantaginaceae | Naturalized   |
| <i>Plectranthus parviflorus</i>                  | Alaala wai nui wahine           | Lamiaceae      | Indigenous    |
| <i>Pluchea carolinensis</i>                      | Sourbush                        | Asteraceae     | Naturalized   |
| <i>Pluchea indica</i>                            | Indian fleabane                 | Asteraceae     | Naturalized   |
| <i>Pluchea x fosbergii</i>                       | Marsh fleabane                  | Asteraceae     | Naturalized   |
| <i>Polyscias racemosa</i>                        | Munroidendron                   | Araliaceae     | Endemic       |
| <i>Portulaca lutea</i>                           | Ihi                             | Portulacaceae  | Indigenous    |
| <i>Portulaca oleracea</i>                        | Pigweed                         | Portulacaceae  | Naturalized   |
| <i>Portulaca pilosa</i>                          | Pigweed                         | Portulacaceae  | Naturalized   |
| <i>Pritchardia limahuliensis</i>                 | Loulu                           | Arecaceae      | Endemic       |
| <i>Pritchardia napaliensis</i>                   | Loulu                           | Arecaceae      | Endemic       |
| <i>Pritchardia remota</i>                        | Nihoa fan palm                  | Arecaceae      | Endemic       |
| <i>Pritchardia thurstonii</i>                    | Fiji fan palm                   | Arecaceae      | Cultivated    |
| <i>Pseuderanthemum carruthersii</i>              | Golden eldorado                 | Acanthaceae    | Cultivated    |
| <i>Pseudognaphalium</i> sp.                      | Gnaphalium                      | Asteraceae     | Naturalized   |
| <i>Psidium cattleianum</i>                       | Strawberry guava                | Myrtaceae      | Naturalized   |
| <i>Psidium guajava</i>                           | Guava                           | Myrtaceae      | Naturalized   |

| <b>Species</b>                                       | <b>Common name</b>      | <b>Family</b>   | <b>Status</b> |
|--|-------------------------|-----------------|---------------|
| <i>Rauvolfia sandwicensis</i>                        | Hao                     | Apocynaceae     | Endemic       |
| <i>Rhizophora mangle</i>                             | Red mangrove            | Rhizophoraceae  | Naturalized   |
| <i>Richardia brasiliensis</i>                        | Richardia               | Rubiaceae       | Naturalized   |
| <i>Ricinus communis</i>                              | Castor bean             | Euphorbiaceae   | Naturalized   |
| <i>Rivina humilis</i>                                | Coral berry             | Phytolaccaceae  | Naturalized   |
| <i>Sansevieria trifasciata</i>                       | Mother in law's tongue  | Asparagaceae    | Naturalized   |
| <i>Scaevola taccada</i>                              | Naupaka                 | Goodeniaceae    | Indigenous    |
| <i>Schefflera actinophylla</i>                       | Octopus tree            | Araliaceae      | Naturalized   |
| <i>Schiedea verticillata</i>                         | Nihoa schiedea          | Caryophyllaceae | Endemic       |
| <i>Schinus terebinthifolius</i>                      | Christmas berry         | Anacardiaceae   | Naturalized   |
| <i>Senna pendula</i>                                 | Pendant senna           | Fabaceae        | Naturalized   |
| <i>Sesbania tomentosa</i>                            | Ohai                    | Fabaceae        | Endemic       |
| <i>Sesuvium portulacastrum</i>                       | Akulikuli, sea purslane | Aizoaceae       | Indigenous    |
| <i>Setaria parviflora</i>                            | Yellow foxtail          | Poaceae         | Naturalized   |
| <i>Sida acuta</i>                                    | Sida                    | Malvaceae       | Naturalized   |
| <i>Sida ciliaris</i>                                 | Red ilima               | Malvaceae       | Naturalized   |
| <i>Sida fallax</i>                                   | Ilima                   | Malvaceae       | Indigenous    |
| <i>Sida rhombifolia</i>                              | Cuban jute              | Malvaceae       | Naturalized?  |
| <i>Solanum americanum</i>                            | Glossy nightshade       | Solanaceae      | Indigenous?   |
| <i>Solanum lycopersicum</i> var. <i>lycopersicum</i> | Tomato                  | Solanaceae      | Cultivated    |
| <i>Solanum seaforthianum</i>                         | Vining solanum          | Solanaceae      | Naturalized   |
| <i>Sonchus oleraceus</i>                             | Sow thistle             | Asteraceae      | Naturalized   |
| <i>Sphagneticola trilobata</i>                       | Wedelia                 | Asteraceae      | Naturalized   |
| <i>Spinacia oleracea</i>                             | Spinach                 | Amaranthaceae   | Cultivated    |
| <i>Sporobolus africanus</i>                          | Dropseed                | Poaceae         | Naturalized   |
| <i>Sporobolus pyramidatus</i>                        | Dropseed                | Poaceae         | Naturalized   |
| <i>Stachys arvensis</i>                              | Staggerweed             | Lamiaceae       | Naturalized   |
| <i>Stachytarpheta cayennensis</i>                    | Vervain                 | Verbenaceae     | Naturalized   |
| <i>Stenotaphrum secundatum</i>                       | St. Augustine grass     | Poaceae         | Naturalized   |
| <i>Synedrella nodiflora</i>                          | Node weed               | Asteraceae      | Naturalized   |
| <i>Syngonium</i> sp.                                 | Syngonium               | Araceae         | Cultivated    |
| <i>Syzygium cumini</i>                               | Java plum               | Myrtaceae       | Naturalized   |
| <i>Tabebuia</i> sp.                                  | Trumpet tree            | Bignoniaceae    | Cultivated    |
| <i>Terminalia catappa</i>                            | Tropical almond         | Combretaceae    | Naturalized   |
| <i>Tetragonia tetragonioides</i>                     | New zealand spinach     | Aizoaceae       | Naturalized   |
| <i>Thespesia populnea</i>                            | Milo                    | Malvaceae       | Indigenous?   |
| <i>Thevetia peruviana</i>                            | Be-still tree           | Apocynaceae     | Naturalized   |
| <i>Thunbergia fragrans</i>                           | Sweet clock-vine        | Acanthaceae     | Naturalized   |
| <i>Unknown poaceae</i>                               | Unknown grass           | Poaceae         | Naturalized   |
| <i>Urochloa mutica</i>                               | California grass        | Poaceae         | Naturalized   |
| <i>Veitchia merrillii</i>                            | Manila palm             | Arecaceae       | Cultivated    |

| <b>Species</b>                                      | <b>Common name</b> | <b>Family</b> | <b>Status</b> |
|---|--------------------|---------------|---------------|
| <i>Verbena litoralis</i>                            | Vervain            | Verbenaceae   | Naturalized   |
| <i>Vigna marina</i>                                 | Nanea              | Fabaceae      | Indigenous    |
| <i>Vitex rotundifolia</i>                           | Pohinahina         | Lamiaceae     | Indigenous    |
| <i>Waltheria indica</i>                             | Uhaloa             | Malvaceae     | Indigenous?   |
| <i>Wikstroemia uva-ursi</i>                         | Akia               | Thymelaeaceae | Endemic       |
| <i>Xanthium strumarium</i> var.<br><i>canadense</i> | Cocklebur          | Asteraceae    | Naturalized   |
| <i>Zea mays</i>                                     | Corn               | Poaceae       | Cultivated    |

## LIST OF APPENDICES

The appendices in this report include the following elements to help provide further information about the status of plants on Kilauea Point NWR:

- **Appendix A: Annotated Checklist Of Plants:** Further discussion about each species. A brief narrative is included for each species, with the plant's name, a picture if available, and historical and current botanical information.
- **Appendix B: Maps Of Selected Species:** Distribution maps are provided for selected species showing locations encountered during our survey of March 2013. Emphasis is on incipient invasive non-native species and uncommon native plants.

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## **APPENDIX A: ANNOTATED PLANT CHECKLIST**

The following annotated checklist includes detailed information on all of the vascular plants known from Kilauea Point National Wildlife Refuge, Kauai, Hawaii. This annotated checklist is a product of a botanical survey done by Forest Starr & Kim Starr from Mar. 18-22, 2013.

The checklist is listed in alphabetical order by species. Wagner et al. (1999), Palmer (2003), and Imada (2012) were used as the source for nomenclature, distribution, and status in Hawaii.

Collection information was attained by reviewing the following specimen databases: Bishop Museum (BISH), Smithsonian Institute (US), and the Pacific Tropical Botanical Garden (PTBG).

Listed for each species is the following information: Scientific name, common name, family name, native status, distribution at Kilauea Point NWR, and relevant notes pertaining to previous voucher collections, restoration, control, or any other items of importance.

For each species, there is a thumbnail photo. Where possible, images from Kilauea Pt. NWR were used, however not all the images were taken at Kilauea Point. Images from the Plants of Hawaii website (Starr Environmental 2013) were also used, to best show the distinguishing plant characters.

***Abutilon grandifolium* (Hairy abutilon) - Malvaceae - Non-Native**



A few scattered patches of this shrub were found near the tip of Mokolea Pt. This plant can form thickets, similar to haole koa (*Leucaena leucocephala*), and was a weed target on Midway Atoll where it was forming large stands in some areas and impeding access for birds (Starr & Starr 2008).

***Acacia koa* (Koa) - Fabaceae - Native**



There was a single planted koa tree found near the Lower Overlook on Crater Hill. It seemed to be doing fine.

***Ageratum conyzoides* (Maile honohono) - Asteraceae - Non-Native**



This small smelly annual herb was found to be a common groundcover in open areas of the preserve and was observed at all sites surveyed including the Lighthouse Point, Crater Hill, and Mokolea Pt. It seems to handle being mowed and does not seem to hinder the birds.

***Aleurites moluccana* (Kukui nut) - Euphorbiaceae - Non-Native**



A large unhealthy tree was found outside the Staff Residence and appeared to have been planted many years ago along with other ornamental palms and garden type plants. Several seedlings were observed growing nearby. Kukui nut is a nice ornamental shade tree with cultural value, but can be messy in a landscape setting and a bit aggressive in drainages and gullies.

***Allamanda cathartica* (Yellow allamanda) - Apocynaceae - Non-Native**



There was a single plant observed in a naupaka (*Scaevola taccada*) hedge by the Admin. Office.

***Amaranthus viridis* (Slender amaranth) - Amaranthaceae - Non-Native**



We observed a few small plants located near the edge of the cliff at the Lower Overlook on Crater Hill. There is likely more of this ephemeral disturbance loving amaranth in similar sites.

***Anagallis arvensis* (Scarlet pimpernel) - Primulaceae - Non-Native**



A small herb that was found occasionally in various parts of the preserve.

Previous collection: 2013, Jan 21. Kilauea National Wildlife Refuge, Nihoku Fenceline. Tiny herb, up to 3" tall, patches, salmon color flowers, black dots to underside of leaf. Natalia Tangalin #3424 (PTBG).

***Andropogon bircornis* (West Indian foxtail) - Poaceae - Non-native**



A lone clump of what is presumed to be this grass was found in a naupaka (*Scaevola taccada*) clearing off the side of the 4WD Crater Hill road, just past the Nihoku section, on the way to Mokolea Pt. There are a number of similar looking non-native grasses on Kauai. It would be good to make a collection of this at some point to confirm the identity, and probably wouldn't be too hard to remove.

***Ardisia elliptica* (Shoebuttton ardisia) - Primulaceae - Non-Native**



One small not so healthy tree was found in the Nihoku saddle area of Crater Hill / Mokolea Pt. This plant forms thickets elsewhere on the island and is spread by fruit eating birds. It is fairly widespread in distribution on the north coast of Kauai, but is not yet well established on the refuge. Keeping an eye out for plants that pop up in the future, along with swift control, will help to prevent a dense stand from forming.

***Argemone glauca* (Pua kala) - Papaveraceae - Native**



Pua kala was being grown in the Nursery at Kilauea Pt. It is attractive with its white blooms, but is also fairly prickly.

***Asparagus densiflorus* (Asparagus fern) - Asparagaceae - Non-Native**



This landscaping ornamental fern tends to spread from cultivation by fruit eating birds and was occasionally found at the refuge usually near buildings and in the understory of surrounding areas. It was also observed along the road to Mokolea Pt. near the communications tower.

***Aster subulatus* var. *sandwicensis* (Annual saltmarsh aster) - Asteraceae - Non-Native**



A small patch of what is believed to be this annual herb was found in an open area of the Nihoku section of Crater Hill. There were many small plants in the patch, but none had yet flowered. It would be good to return when the plants are in flower to confirm the ID.

***Asystasia gangetica* (Chinese violet) - Acanthaceae - Non-Native**



This aggressive groundcover with showy flowers was found in patches along the sloped coastal side of Mokolea Pt. It was common near Rock Quarry Beach mixed with other coastal groundcovers such as the native nehe (*Lipochaeta succulenta*) and pohuehue (*Ipomoea pes-caprae* subsp. *brasiliensis*).

Previous collections: 2013, Jan 21. Kilauea National Wildlife Refuge, Nihoku Fenceline. Herb, thin purple flower, fading white. Natalia Tangalin #3422 (PTBG).

***Bacopa monnieri* (Aeae) - Plantaginaceae - Native**



This native wetland herb was found near the Kilauea River at Rock Quarry Beach growing into the water and on the banks in large patches.

***Barleria repens* (Barleria) - Acanthaceae - Non-Native**



Barleria is a popular landscape bedding plant that often escapes from cultivation. We found several patches of this garden escape around the refuge greenhouse and in the understory of wooded areas, such as ironwood (*Casuarina equisetifolia*), Christmas berry (*Schinus terebinthifolius*), and hala (*Pandanus tectorius*). The distribution ranged from the upper areas of the Lighthouse Point along the coastal woodland over to Crater Hill

to the Red-footed Booby colony. There were also a few other locations found in the wooded areas of Crater Hill and along the road to Mokolea Pt.

***Bidens alba* var. *radiata* (Beggartick) - Asteraceae - Non-Native**



An annual herb that was found in mostly open areas from Crater Hill to Mokolea Pt. Seeds stick to things to spread around.

Previous collections: 2013, Jan 21. Kilauea National Wildlife Refuge, Nihoku Fenceline. Subshrub, white daisy looking. Natalia Tangalin #3423 (PTBG).

***Boerhavia coccinea* (Boerhavia) - Nyctaginaceae - Non-Native**



There were a few scattered patches of this plant in disturbed sites of the Lighthouse Point, such as near parking areas and the gate. Differentiated from look-alike natives by having red rather than white or pink flowers.

***Boerhavia repens* (Alena) - Nyctaginaceae - Native**



We observed several healthy patches of this native groundcover along the coast at Rock Quarry Beach and on the windward slopes above the beach area of Mokolea Pt. The plant intertwined with Chinese Violet (*Asystasia gangetica*) and the native nehe (*Lipochaeta succulenta*), pohuhue (*Ipomoea pes-caprae* subsp. *brasiliensis*), and naupaka (*Scaevola taccada*).

On Midway, this plant was sometimes a dominant in the understory of ironwood (*Casuarina equisetifolia*). The small seeds are somewhat sticky and can hitch a ride on birds to disperse.

Plants in this genera are taxonomically confusing. Wagner et al. (1999) had this to say: "The taxonomy of these often polymorphic and intergrading species is very difficult and, at present, unsatisfactory. The native Hawaiian species are all polymorphic and intergrade with each other."

We called the *Boerhavia* we saw at Kilauea Point *Boerhavia repens*, but plants we saw had characteristics of both *B. repens* and *B. acutifolia*. Specimens (see below) have been collected from Kilauea Pt. previously which have been identified as *B. acutifolia*. It is possible both are present as well as intermediates between the two.

Previous collections, as *B. acutifolia*: 1997, Jun 6. Kilauea Point National Wildlife Refuge, on summit of Mokolea Point; coastal herbaceous vegetation on basalt cliff tops with *Boerhavia*, *Lipochaeta*, *Ipomoea pes-caprae*, *Digitaria*, *Fimbristylis dichotoma*, *Cynodon dactylon*, elevation 20-25 m. Lorence, D. H., Flynn, T. W., Asquith, A. #7996 (PTBG, US).

2004, Jul 21. Kilauea National Wildlife Refuge, past Crater Hill on cliff overlooking Makapili Rock on Mokolea Point. N 22 deg 13' 56.3" W 159 deg 23' 07.7" Associated Species: W/ *Boerhavia glabrata*, *Nicotiana tabacum*, *Chenopodium oahuense*, *Chamaesyce celastroides* var. *stokesii*, *Lantana*, *Casuarina*, *Portulaca pilosa*, *Ipomoea pes-caprae* subsp. *brasiliensis*. Natalia Tangalin #134 (PTBG).

***Bothriochloa pertusa* (Pitted beardgrass) - Poaceae - Non-Native**



This small clump grass was occasionally found at Mokolea Pt. near the cliff edge and at the Nihoku saddle area of Crater Hill.

Previous collection: 2013, Jan. 21. Kilauea National Wildlife Refuge, Nihoku Fenceline. Grass, clumping, not dominant. Natalia Tangalin #3428 (PTBG).

***Bougainvillea* sp. (Bougainvillea) - Nyctaginaceae - Non-Native**



We found this thorny ornamental vine growing in a naupaka (*Scaevola taccada*) hedge outside of the refuge Administration Office building by the parking lot. It is showy, but doesn't provide much wildlife habitat, is spiny, and could be relatively easily removed.

***Brassica oleracea* (Brussel sprouts) - Brassicaceae - Non-Native**



Brussel sprouts were one of about a dozen or so crops being grown in pots at the Staff Residence. Most of the plants had been recently sown and were in the small seedling stage.

***Brighamia insignis* (Olulu, pu aupaka, alula, haha) - Campanulaceae - Native**



This charismatic plant is a Kauai endemic and is listed as an Endangered species. Several alulu were observed being grown in the greenhouse at the refuge. There were many seedlings and larger plants in pots. According to Thomas Myers, who volunteers at Kilauea Point NWR, they are relatively easy to grow in pots but do not do well once outplanted in the ground. It is uncertain why this is the case. Lilleng-Rosenberger (2005) reports that plants do well as container plants if transplanted into larger pots when needed. She further reports that slugs and spider mites can be pests. We did see spider mites on leaves of alulu in the greenhouse. She suggests horticultural oils to combat spider mites and slug bait to manage slugs. For outplanting, she suggests black cinder rock gardens or in mounds of cinder and rock. Previous attempts were made at outplanting hundreds of these at Kilauea, however, they did not establish.

***Caesalpinia kawaiiensis* (Uhi uhi, kawau, kea) - Fabaceae - Native**



Uhiuhi, an endemic Hawaiian dry forest tree that is listed as endangered, was being grown in pots in the refuge greenhouse.

***Canavalia cathartica* (Maunaloa) - Fabaceae - Non-Native**



This non-native vine was occasionally observed sprawling in hedges of naupaka (*Scaevola taccada*) in areas around Kilauea Point. It was also observed sprawling in scrub at Rock Quarry Beach and Crater Hill.

***Canna indica* (Indian shot, canna) - Cannaceae - Non-Native**



A few clumps of this plant were found among the naupaka (*Scaevola taccada*) hedges near the coastal cliff areas of Kilauea Pt. They likely persist from old plantings.

***Capsicum annuum* (Pepper) - Solanaceae - Non-Native**



Pepper was one of the plants being grown in pots at the Staff Residence.

***Cardamine flexuosa* (Bittercress) - Brassicaceae - Non-Native**



A small weedy plant found coming up in pots and other areas of the Nursery at Kilauea Pt.

***Carica papaya* (Papaya) - Caricaceae - Non-Native**



There were a few unhealthy plants left over from an older planting in the backyard of the Staff Residence.

***Carmona retusa* (Fukien tea) - Boraginaceae - Non-Native**



A single plant was found under the kou (*Cordia subcordata*) in the gully towards the ocean near the Staff Residence. This plant is cultivated for use as a tea and as an ornamental and is known to spread by fruit eating birds. This plant could be removed and looked for in the future. It has become weedy at the Waihee Coastal Dunes Preserve on Maui, where it forms tall thickets.

***Casuarina equisetifolia* (Ironwood) - Casuarinaceae - Non-Native**



A dominant component of coastal areas of the refuge. Some control is being done at Albatross Hill on the steep slopes by the ocean to keep the flyway open for albatross. While ironwood is known to form thickets, the birds do seem to utilize it. Laysan Albatross were nesting underneath ironwoods at Albatross Hill and were hanging out under the shade of ironwoods at Mokolea Pt., Red-footed Boobies were observed nesting in the tops of ironwood trees along the coast, and Wedge-tailed Shearwaters were observed burrowing at the edges of ironwood patches. This plant is very widespread and eliminating it completely would be hard to do, especially with nesting birds and very steep terrain. Local control where birds aren't utilizing the trees seems a good strategy.

Previous collection: 1965, May 6. Kilauea Point. Long, C.R., W. King, V. Horeman #3018 (US).

***Cecropia obtusifolia* (Guarumo, trumpet tree) - Urticaceae - Non-Native**



There were a few unhealthy trees mixed in with the papayas and other abandoned plants in the backyard of the Staff Residence. There was also a plant found near the Lower Overlook on Crater Hill and a small naturalized sapling found near the Public Overlook. This is a weedy tree that is cultivated and naturalized in the area and will likely continue to show up at the refuge. The few trees that are on the refuge could be relatively easily removed and folks could keep an eye out for any new ones that show up.

***Cenchrus clandestinus* (Kikuyu grass) - Poaceae - Non-Native**



The dominant groundcover on Crater Hill where there are no trees. Apparently planted when the area was grazed with cattle. The Nene seem to do fine with this grass, they are able to graze on it and the mix of mostly non-native plants that grow with it. It is easily mowed/managed.

***Chamaecrista nictitans* (Partridge pea) - Fabaceae - Non-Native**



This was occasionally found as a small herb in open areas at Crater Hill and Mokolea Pt.

Previous collection: 2013, Jan 21. Kilauea National Wildlife Refuge, Nihoku Fenceline. Small herb, yellow flower, leaflets smaller toward apex. Natalia Tangalin #3413 (PTBG).

***Chenopodium murale* (Lamb's quarters) - Amaranthaceae - Non-Native**



A few sparse plants were observed in the ironwood understory at Albatross Hill and along the coast at Mokolea Pt.

Previous collection: 1965, May 6. Kilauea Pt. Long, C.R., W. King, V. Horeman

***Chenopodium oahuense* (Aweoweo) - Amaranthaceae - Native**



This endemic shrub was found along the steep coastal cliffs. It was also being cultivated in the Nursery and was found in a few of the outplanting sites. Red-footed Boobies were observed taking branches for nesting materials. This seems like a good restoration species.

Previous collections: 1965, Apr 10. One mile east of Kilauea Point Long, C.R. #3000 (BISH).

1978, Jun 21. Kilauea Crater Hill. Along crest of hill, with *Lipochaeta*, *Euphorbia*, and *Portulaca*. Corn, C. #s.n. (BISH)

2001, Jul 27. Kilauea Point with *Casuarina* and *Schinus*. 4' shrub; stems pale green; leaves dark green above with paler veins, below glaucous medium grey-green; inflorescence green olive green; stamens yellow. Flynn, T., R. Langdon #6912 (BISH, PTBG).

2004, Jul 21. Kilauea National Wildlife Refuge, next to Crater Hill lookout point structure above the cliffs North of Makapili Rock and before Mokolea Point. N 22 deg 13' 56.3" W 159 deg 23' 07.7" Associated Species: w/ *Boerhavia glabrata*, *Nicotiana tabacum*, *Chamaesyce celastroides* var. *stokesii*, *Lantana*, *Casuarina*, *Portulaca pilosa*, *Ipomoea pes-caprae* subsp. *brasiliensis*. Natalia Tangalin #135 (PTBG).

***Chloris barbata* (Swollen fingergrass) - Poaceae - Non-Native**



A few clumps of this grass were observed at Rock Quarry Beach. It can be quite common in dry lowland disturbed areas.

***Chrysalidocarpus lutescens* (Areca palm) - Arecaceae - Non-Native**



There was a clump of this ornamental palm located near the back yard of the Staff Residence. It appeared to have been planted a while ago, looked abandoned, and was languishing along other ornamental trees.

***Chrysophyllum oliviforme* (Satin leaf) - Sapotaceae - Non-Native**



Common in wooded areas of Crater Hill and along the road to Mokolea Pt. Widely naturalized in the area.

Previous collection: 2013, Jan 21. Kilauea National Wildlife Refuge, Nihoku Fenceline. Small tree, golden hairs on undersides of leaves, white sap. Natalia Tangalin #3411 (PTBG).

***Chrysopogon aciculatus* (Golden beardgrass) - Poaceae - Native**



A few clumps of this grass were found in the Nihoku section of Mokolea Pt.

***Citrus x latifolia* (Tahitian lime) - Rutaceae - Non-Native**



Cultivated in the side yard of the Staff Residence. Appears to have been planted a while ago with other ornamental trees and palms.

***Clusia rosea* (Autograph tree) - Clusiaceae - Non-Native**



This tree is cultivated and naturalized in the general Kilauea area, including properties adjacent to the refuge. The seeds are spread by fruit eating birds, sometimes germinating and growing epiphytically in other trees, such as ironwood (*Casuarina equisetifolia*), Christmas berry (*Schinus terebinthifolius*), and java plum (*Syzygium cumini*). There were several young plants on Albatross Hill that presumably spread from the mature cultivated trees visible nearby in the adjacent parcel. We were able to pull a few of the smaller ones. Larger ones will need to be cut and treated. Saplings were also found near the coast at Crater Hill near the Red-footed Booby colony.

***Cocos nucifera* (Coconut palm, niu) - Arecaceae - Non-Native**



Coconuts were mainly found at Kilauea Point planted in the areas between the Staff Residence and the parking lots. A few plants were also found at Mokolea Pt. and appeared to be there persisting after being dumped with other yard debris. The falling nuts and debris pose a threat to wildlife and people underneath and appear to be of limited wildlife value for birds, though they are a larval host plant for the native palm leaf roller moth (*Omiodes blackburni*). Feeding signs of the native palm leaf roller moth were observed on both coconut and loulu (*Pritchardia* spp.) in the refuge.

***Codiaeum variegatum* (Croton) - Euphorbiaceae - Non-Native**



There is a small hedge of croton by the Staff Residence building. Presumably a former landscaping plant. These are not known to spread.

***Colubrina asiatica* (Anapanapa) - Rhamnaceae - Native**



This glossy native sprawler was being grown in the nursery. Care should be taken if planning to outplant it, as it can be quite aggressive if it finds the site particularly inviting.

***Commelina diffusa* (Honohono) - Commelinaceae - Non-Native**



Succulent ground cover found in a few areas at Kilauea Point and Nihoku area of Mokolea Pt.

***Conyza bonariensis* (Hairy horseweed) - Asteraceae - Non-Native**



Occasional in some of the more unmaintained border areas of Crater Hill.

***Conyza canadensis* (Hairy horseweed) - Asteraceae - Non-Native**



We did not come across this species, but it was previously collected at the Nihoku area of Crater Hill, and could have been overlooked.

Previous collection: 2013, Jan 21. Kilauea National Wildlife Refuge, Nihoku Fenceline. Tall herb, white flowers, sweet skunk smell. Natalia Tangalin #3425 (PTBG).

***Cordia subcordata* (Kou) - Boraginaceae - Native**



This tree was found planted at Kilauea Point near the staff Residence building. It was also being propagated in the nursery and being outplanted at Crater Hill.

***Cordyline fruticosa* (Ti leaf, ki) - Asparagaceae - Non-Native**



A clump of ti leaves were found amongst a thicket of Christmas berry (*Schinus terebinthifolius*) along the recently cleared fenceline bordering Kilauea Rd.

***Crinum asiaticum* (Spider lily) - Liliaceae - Non-Native**



A few scattered individuals were found at Kilauea Pt., on Crater Hill, near the abandoned trail near the Red-footed Booby colony, and on the windward slope on Mokolea Pt. These likely persist from old plantings or from dumped yard debris.

***Crotalaria incana* (Fuzzy rattle pod) - Fabaceae - Non-Native**



We found a few plants of this legume in an open flattish spot on Mokolea Pt. that appeared to have been cleared in recent years.

***Cupaniopsis anacardioides* (Carrot wood) - Sapindaceae - Non-Native**



Found throughout the refuge from upper areas of Kilauea Point over to Crater Hill, but not on the tip of Mokolea Pt. Though previously not reported as naturalized on Kauai, we found dozens of mostly small saplings, many less than 1 m in height, some 1-2 m, and only a few taller saplings 3-4 m in height that were in flower. We drove around surrounding neighborhoods and did find other small saplings in Sea Cliff, but not other parts of Kilauea town, and never did find any large obvious parent trees.

Seemingly bird dispersed, numerous plants were found under trees and structures. We saw several Shama thrush (*Copsychus malabaricus*) birds resting on the communication tower along the Crater Hill Rd. leading to Mokolea Pt., below were dozens of seedlings.

This species looks well adapted to the coastal wooded areas of Kilauea Pt. and Crater Hill and is just getting established. Carrot wood is a major pest in Florida where it was spread by fruit eating birds and invades disturbed and natural areas including coastal scrub, wetlands, and woodlands (PCA 2013). Removal of all plants at Kilauea Point is possibly still doable. We pulled several plants that were small enough but larger ones will require a dedicated control effort.

In Hawaii, previously known to be naturalized on the islands of Oahu and Maui. Now also known from Kauai. A specimen was collected from one of the larger flowering plants located at Kilauea Pt. It will be sent to Bishop Museum and documented as a new island record for Kauai.

***Cyanea* sp. (Haha, cyanea) - Campanulaceae - Native**



Native plant grown in the greenhouse. Kilauea Point NWR is probably not the optimal environment for it, but it seems to be surviving.

***Cyanthillium cinereum* (Little ironweed) - Asteraceae - Non-Native**



This small annual aster was found in the Nihoku section of Mokolea Pt., along what appeared to be an old road.

***Cynodon dactylon* (Bermuda grass) - Poaceae - Non-Native**



Mat forming grass that was found in the Nihoku section of Mokolea Pt.

***Cyperus involucratus* (Umbrella sedge) - Cyperaceae - Non-Native**



A single clump of this plant was found just outside the Visitors Services Administration Office, in the moist area below the roof line. This plant was a major weed in wetlands of Midway Atoll where it was filling wetlands and being controlled (Starr & Starr 2008). This plant likely won't be as invasive at the drier Kilauea Point, but could easily be removed by digging it up.

***Cyperus javanicus* (Ahuawa) - Cyperaceae - Native**



This indigenous sedge was found on the Rock Quarry Beach side of the 4WD road that goes to the tip of Mokolea Pt. A small patch of plants that mostly appeared as dry and brown was found, though a few green plants remained along with some seedheads. Seems to be a drier spot than it would prefer.

***Cyperus phleoides* (Cyperus) - Cyperaceae - Native**



This small endemic sedge was found on coastal slopes east of NESH Hill, and likely occurs elsewhere in moist pockets on open, likely steep, terrain.

***Cyperus polystachyos* (Pycneus) - Cyperaceae - Native**



An indigenous sedge found in moist lawn areas of Kilauea Pt.

***Cyperus rotundus* (Purple nut sedge) - Cyperaceae - Non-Native**



Weedy sedge found just off the path of Kilauea Pt. Only found in the more developed portions of the refuge.

***Daucus carota* subsp. *sativus* (Carrots) - Apiaceae - Non-Native**



One of many vegetables grown in pots outside the Staff Residence building.

***Desmanthus pernambucanus* (Slender mimosa) - Fabaceae - Non-Native**



There were a few small patches of slender mimosa found in the scrub at Mokolea Pt. and along the road at Rock Quarry Beach Rd. These patches formed small dense thickets that were about head high.

***Desmodium incanum* (Spanish clover) - Fabaceae - Non-Native**



A small patch was found in the scrub along the road from Crater Hill to Mokolea Pt. This easy to overlook legume is also likely found elsewhere, mostly in open disturbed sites.

Previous collection: 2013, Jan 21. Kilauea National Wildlife Refuge, Nihoku Fenceline. Herb/subshrub, Fab, flw dark purple, lvs 3 often w/whitish center. Natalia Tangalin #3415 (PTBG).

***Desmodium triflorum* (Tick clover) - Fabaceae - Non-Native**



This diminutive low growing weed was found in an open flattish spot at Mokolea Pt.

***Dianella sandwicensis* (Ukiuki) - Xanthorrhoeaceae - Native**



Native lily that was occasionally found at a few outplanting sites at Kilauea Pt. and Crater Hill.

***Digitaria ciliaris* (Henry's crab grass) - Poaceae - Non-Native**



A creeping grass that was occasionally found at Mokolea Pt. and along the coast at Rock Quarry Beach.

Previous collection: 1997, Jun 6. Kilauea Point National Wildlife Refuge, on summit of Mokolea Point; coastal herbaceous vegetation on basalt cliff tops with *Boerhavia*, *Lipochaeta*, *Ipomoea pes-caprae*, *Digitaria*, *Fimbristylis dichotoma*, *Cynodon dactylon*, elevation 20-25 m. Flynn, T. W., Asquith, A. #7997 (US, PTBG).

***Digitaria insularis* (Sourgrass) - Poaceae - Non-Native**



An upright clumping grass that was occasional to common on most parts of the refuge.

Previous collection: 2013, Jan 21. Kilauea National Wildlife Refuge, Nihoku Fenceline. Grass, common, flower like a silky tuff. Natalia Tangalin #3427 (PTBG).

***Dodonaea viscosa* (Aalii) - Sapindaceae - Native**



This native shrub was being grown in the Nursery. Aalii is a good restoration species. It makes a nice shrub, seems to not have many weeds growing below it, and tends to self-propagate once established. Could be incorporated in some out-plantings. It is the larval host plant of the koa butterfly (*Udara blackburni*).

***Dracaena marginata* (Money tree) - Asparagaceae - Non-Native**



A single plant located in the yard at the Staff Residence. Appears to be an ornamental planting from a while ago. These are not known to spread.

***Dracaena reflexa* (Dracaena) - Asparagaceae - Non-Native**



A single plant located in the yard at the Staff Residence. Appears to be an ornamental planting from a while ago. Another that does not seem to spread.

***Dypsis decaryi* (Triangle palm) - Arecaceae - Non-Native**



Ornamental palm previously planted in the yard at the Staff Residence. Looks a bit unhealthy.

***Eclipta prostrata* (False daisy) - Asteraceae - Non-Native**



A small amount was found in the coastal areas by Rock Quarry Beach. Prefers moist areas.

***Eleusine indica* (Wire grass) - Poaceae - Non-Native**



Occasionally found along the coast at Rock Quarry Beach and also in grassy disturbed areas of Mokolea Pt.

Previous collection: 1965, May 6. Kilauea Point. Long, C.R. W.King & V.Horeman #3034 (BISH).

***Emilia fosbergii* (Pualele) - Asteraceae - Non-Native**



A few plants observed in the coastal flats at Rock Quarry Beach. An annual weed that comes and goes, occupying bare ground after the winter rains.

***Epipremnum pinnatum* (Golden pothos) - Araceae - Non-Native**



This aggressive vine was common at Kilauea Pt. where it was sprawling in naupaka (*Scaevola taccada*) and climbing in hala (*Pandanus tectorius*). Some areas that were cleared had lots of stems/runners still on the ground. We also found an outlier location on the Mokolea Pt. side of the Nihoku section on the north side of the road. It was found with some other unusual species for this location, such as coconut (*Cocos nucifera*) and *Syngonium* sp. It appeared to be a persistent patch from an old planting or from yard debris that was dumped. This is a somewhat weedy vine of presumably little wildlife value. Parts of the plant may regrow where thrown, so it should be disposed of with care.

***Eragrostis pectinacea* (Carolina love grass) - Poaceae - Non-Native**



A small patch found in an open grassy areas near the Nihoku section of Crater Hill near where cars drive and park. Generally found in compacted high-traffic areas where other grasses and plants aren't able to grow.

***Erigeron bellioides* (Daisy fleabane) - Asteraceae - Non-Native**



A few plants found near the Staff Residence building in the cracks of the foot path leading towards the back.

***Erythrina sandwicensis* (Wiliwili) - Fabaceae - Native**



Native dry forest tree that was observed in pots at the Nursery at Kilauea Pt. Culturally significant.

***Euphorbia celastroides* var. *celastroides* (Akoko) - Euphorbiaceae - Native**

Not observed during this survey. Known from a single previous collection. It would be interesting to revisit the collection at Bishop Museum to see if it was indeed *E. c. celastroides*, or if it could have been *E. c. stokesii*. If it was indeed *E. c. celastroides*, then this and potential hybrids with *E. c. stokesii* should be looked for.

Previous collection: 1978, Jun 21. Kilauea, Crater Hill. Along crest of hill, with *Lipochaeta*, *Portulaca*, and *Chenopodium*. Corn, C. #s.n. (BISH).

***Euphorbia celastroides* var. *stokesii* (Akoko) - Euphorbiaceae - Native**



Dominant shrub on the coast on steep coastal cliffs below the lighthouse at Kilauea Pt. and surrounding cliffs. Also a common feature in most of the shrubby areas of the refuge where it was found mixed in with lantana (*Lantana camara*), naupaka, and sometimes Christmas berry (*Schinus terebinthifolius*), especially in the section between Crater Hill and Mokolea Pt. It was also being propagated in the Nursery. This attractive hearty

silvery endemic plant could be a good replacement plant for when undesirable non-native trees and shrubs are removed. A few areas could also be chosen where non-natives are slowly removed to allow the akoko to spread into the newly opened areas. We observed Red-footed Boobies nesting in it and using it for nesting materials. Apparently Nene (*Branta sandwicensis*) eat it as well. We also saw native bees (*Hylaeus conncetens*) visiting the flowers. Plants in the area had small bumps on the leaves that appear to be galls formed possibly by a native psyllid, but it is currently not known what creature causes these bumps.

Previous collections: 1972, Feb 24. Kilauea Pt., low, spreading, much branched shrub with gray green foliage. Herbst, D.R. #2352 (BISH).

2006, May 23. Kilauea Lighthouse. End of Kilauea Road, Crater Hill overlook. Growing along edge of cliff. Natalia Tangalin #765 (PTBG).

***Euphorbia hypericifolia* (Graceful spurge) - Euphorbiaceae - Non-Native**



Found in the grassy coastal margin at Rock Quarry Beach. One of many non-descript spurges found on the refuge.

***Euphorbia serpens* (Matted sandmat) - Euphorbiaceae - Non-Native**



Occasionally found along the rocky coastal margin near the parking at Rock Quarry beach and at the Nihoku section of Crater Hill. Distinguished by glabrous stems.

***Euphorbia thymifolia* (Spurge) - Euphorbiaceae - Non-Native**



Non-native creeping spurge that was found near the walkways at Kilauea Pt. One of the more pubescent spurges.

***Ficus microcarpa* (Chinese banyan tree) - Moraceae - Non-Native**



This giant strangling tree, which is spread by birds and can grow epiphytically on trees, cliffs, and structures was found to be in the early stages of establishment at the refuge. There was one plant in the naupaka hedge outside the Administration Offices. There were also a few plants near Albatross Hill, and quite a few on the upper slopes of the Red-footed Booby colony on Crater Hill, where several saplings were observed ranging in size from 1-4 m tall and seem to be gaining a foothold. There were also large trees in an adjacent property and around Kilauea town.

For some reason, Chinese banyan trees seems to be less preferred by Red-footed Boobies for nesting than Christmas berry and ironwood. We saw a few Red-footed Boobies sitting in *Ficus* trees, but it did not appear any were nesting, and the *Ficus* trees seemed conspicuously empty compared to nearby Christmas berry trees packed with birds.

This strangling fig has bird dispersed fruit. We documented it spreading rapidly on Midway Atoll, where it was later targeted for control by USFWS, because of the tree's strangling nature, and ability to damage buildings and structures. It would be wise to

control Chinese banyans at Kilauea Point NWR when they are found growing on buildings or other infrastructure. It would also be good to confirm the decreased preference of this species for nesting by Red-footed Boobies, and perhaps focus control in areas that are the easiest to manage and would provide the most wildlife benefit.

***Fimbristylis cymosa* (Mauu akiaki) - Cyperaceae - Native**



This diminutive native sedge was found growing on the windward cinder slopes at the tip of Mokolea Pt., mixed with other native coastal species such as ilima (*Sida fallax*) and pohuehue (*Ipomoea pes-caprae* subsp. *brasiliensis*).

***Gossypium tomentosum* (Mao, hawaiian cotton) - Malvaceae - Native**



This shrub of native dry coastal areas was being grown in pots in the Nursery at Kilauea Pt. It might do ok in areas where shrubland would be desirable for the wildlife.

***Hibiscus clayi* (Hawaiian red hibiscus) - Malvaceae - Native**



Being grown in the Nursery at Kilauea Pt. in pots. Nice ornamental plant with little red Hibiscus flowers. Thick upright growth useful as hedge.

***Hibiscus kokio* (Kokio ula) - Poaceae - Non-Native**



The native red flowered hibiscus was being grown in the Nursery at Kilauea Pt. A bit more of a sprawler than the previous Hibiscus.

***Hibiscus rosa-sinensis* (Hibiscus) - Malvaceae - Non-Native**



A few cultivated plants were observed near buildings, and are unlikely to spread beyond that.

***Hibiscus tiliaceus* (Hau) - Malvaceae - Native**



Observed along the Kilauea River at Rock Quarry Beach. Forms dense thickets in wet areas. Wood is very light and was used on canoes and in other applications where light wood is desirable.

***Hippeastrum striatum* (Barbados lily) - Amaryllidaceae - Non-Native**



Showy ornamental bulb found in various parts of Kilauea Pt. This plant produces bulbils that spread on their own and is known to naturalize in tropical areas such as Hawaii (Pacific Bulb Society 2013, Wagner et al. 1999). Will likely persist near current locations, but does not seem like a huge threat to plants or wildlife at this time.

***Hippobroma longiflora* (Star of bethlehem) - Campanulaceae - Non-Native**



A small patch was found in the backyard of the Staff Residence, where the roof eaves dripped. The residents reported they believe the plant showed up about two years ago and that it is elsewhere in Kilauea town and nearby. We later also observed naturalized plants beyond the refuge, along the coast near Anini Beach, suggesting the plant is somewhat widespread on the north coast of Kauai and may occasionally show up on the refuge.

It would not take much to remove the small patch, less than a dozen plants. Care should be taken when removing as all parts of the plant contain diphenyl lobelidiol, a central nervous system stimulant and extremely irritating alkaloid. This toxin can be absorbed through intact skin and cause a rash (Scott and Thomas 2000).

***Hyptis pectinata* (Comb hyptis) - Lamiaceae - Non-Native**



A few small patches of this plant were found in open areas of Crater Hill and Mokolea Pt.

Previous collection: 2013, Jan 21. Kilauea National Wildlife Refuge, Nihoku Fenceline. Herb, mint, pungent smell, small purple flowers. Natalia Tangalin #3418 (PTBG).

***Ipomoea obscura* (Obscure morning glory) - Convolvulaceae - Non-Native**



This weedy vine with white flowers was found in open areas of Crater Hill and Mokolea Pt.

Previous collection: 2013, Jan 21. Kilauea National Wildlife Refuge, Nihoku Fenceline. Vine, white flower w/purple. Natalia Tangalin #3414 (PTBG).

***Ipomoea pes-caprae* subsp. *brasiliensis* (Pohuehue) - Convolvulaceae - Native**



A common indigenous creeping groundcover that was found along the coast of Rock Quarry Beach and on the lower slopes of Mokolea Pt. Some native yellow-faced bees (*Hylaeus* spp.) are known to visit flowers of this species.

***Jacquemontia sandwicensis* (Pau o hiiaka) - Convolvulaceae - Native**



A small patch of this endemic groundcover with tiny purplish flowers was found along the flats at Rock Quarry Beach. It was also found on the slopes above the beach at Mokolea Pt. mixed with other native coastal plants such as pohuehue.

***Justicia betonica* (White shrimp plant) - Acanthaceae - Non-Native**



An ornamental flowering shrub that often persists long after cultivation and forms shrubby thickets in moist warm lowlands. A fair sized patch was found filling a gully above the Red-footed Booby colony on Crater Hill.

***Kalanchoe pinnata* (Air plant) - Crassulaceae - Non-Native**



A fair sized patch is spreading around an old concrete structure on the coastal cliff by Albatross Hill. Each leaf of this plant can create a new plant. The area where it grows includes some relatively steep areas.

***Kyllinga brevifolia* (Green kyllinga) - Cyperaceae - Non-Native**



A few small plants were found in the lawn section by the septic leach field. Prefers moist sites.

***Lactuca sativa* (Lettuce) - Asteraceae - Non-Native**



One of the plants being grown in pots at the Staff Residence. Lettuce is not the most invasive plant, but if left to go to seed, it will re-seed itself and spread around a bit.

***Lantana camara* (Lantana) - Verbenaceae - Non-Native**



This thorny shrub dominates much of Kilauea Point NWR. It was especially prevalent in the Red-footed Booby colony on Crater Hill, on the ocean side of Albatross Hill at Kilauea Pt. and on the slopes at Mokolea Pt.

Lantana can crowd out native plants and nesting seabirds. In the Galapagos, it has taken over the nesting grounds of the Dark-rumped Petrels on Floreana Islands, making it difficult for the birds to enter and exit their burrows (Luis Ortis, Charles Darwin Research Station, Galapagos, Ecuador) (Motooka et al. 2003, Starr & Starr 2008).

Complete removal would be difficult due to the widespread distribution of Lantana and the terrain on the refuge. As resources allow though, lantana could be selectively removed in high value and easily accessible sites, such as where birds are observed to have trouble nesting or along visitor paths. The endemic akoko (*Euphorbia celastroides* var. *stokesii*) makes a great thornless replacement for lantana.

***Lepidium virginicum* (Peppergrass) - Brassicaceae - Non-Native**



Small herb found at Rock Quarry Beach and at Mokolea Pt.

***Leucaena leucocephala* (Koa haole) - Fabaceae - Non-Native**



Forms shrubby thickets in most parts of the refuge, where it mixes with other non-native trees and shrubs such as lantana (*Lantana camara*), ironwood (*Casuarina equisetifolia*), and Christmas berry (*Schinus terebinthifolius*). Given how widespread it is, control could be focused in high value areas.

One place where a bit of control may help is on the 4WD road to the tip of Mokolea Point. Here, a few corridors cut through the haole koa may help create flyways and walkways for the birds.

***Lipochaeta lobata* (Nehe) - Asteraceae - Native**



Not observed during this survey. Previously known from collections only. It could have been overlooked, no longer present, or may have been misidentified previously. There are no records of this species from Kauai in other literature. Perhaps the specimen at Bishop Museum should be revisited, to determine whether the collection is in error, or if Kauai needs to be added to the locations this species is known from.

Previous collection: 1978, Jun 21. Kilauea Crater Hill. Along crest of hill, with *Euphorbia*, *Portulaca*, and *Chenopodium*. Corn, C. #s.n. (BISH).

***Lipochaeta succulenta* (Nehe) - Asteraceae - Native**



We found this succulent coastal native growing in many locations of the refuge. It was growing wild at Rock Quarry Beach and on the slopes above Mokolea Pt. It was also growing at Kilauea Point, where it has been planted. This species seems to do best in salty areas near the ocean. We saw native yellow-faced bees (*Hyleus connectens*) visiting flowers at Kilauea Pt.

Previous collections: 1975, Feb 11. S of light house, Kilauea Pt. Common on steep slope, below Red-footed Booby nesting area. Plants sprawling on slope. Gardner, R.C. #358 (BISH).

1997, Jun 6. Kilauea Point National Wildlife Refuge, summit of Mokolea Point. Coastal herbaceous vegetation on basalt cliff tops with *Boerhavia*, *Lipochaeta*, *Ipomoea pes-caprae*, *Digitaria*, *Fimbristylis dichotoma*, *Cynodon dactylon*. Perennial herb, stems trailing, succulent. Leaves fleshy, medium green. Inflorescences with yellow disc and ray florets. Endemic, locally abundant. Lorence, D.H. T. Flynn & A. Asquith #7998 (BISH)

2004, Jul 21. Kilauea National Wildlife Refuge, Past Crater Hill on Mokolea Point. N 22 deg 13' 56.3" W 159 deg 23' 07.7" Associated Species: w/ *Boerhavia glabrata*, *Nicotiana tabacum*, *Chenopodium oahuense*, *Chamaesyce celastroides* var. *stokesii*, *Lantana*, *Casuarina*, *Portulaca pilosa*, *Ipomoea pes-caprae* subsp. *brasiliensis*. Natalia Tangalin #133 (PTBG).

2004, Jul 21. From cultivated area above dirt parking lot in front of Kilauea Lighthouse. Nurseryman reports all cultivated material collected from "around this area" plants seen on Mokolea point. Planted w/ *Osteomeles anthyliidifolia*, *Wilkstroemia uva-ursi* var. *uva-ursi*. Natalia Tangalin #136 (PTBG).

***Lipochaeta succulenta* x *Lipochaeta integrifolia* (Hybrid Nehe) - Asteraceae - Native**  
Not observed during this survey. Wagner et al. (1999) report there was a plant collected by T. Flynn from Crater Hill which appeared to be a hybrid between *Lipochaeta succulenta* and *L. integrifolia* that had smaller heads than the parents and had glabrate, semisucculent leaves usually larger than those of *L. integrifolia*. We did not come across *L. integrifolia*, or anything that looked like a hybrid, but the refuge is a big place and folks should keep an eye out for these taxa.

Previous collections: 1983, Nov 30. Kilauea. Crater Hill, directly behind Makapili rock on the NE slope. In open area growing with *Lipochaeta succulenta*, *Scaevola*, *Euphorbia*, exotic grasses, lantana, Christmas berry, ironwood, etc. Round prostrate mat ca. 1 m in diameter & 6 cm high. Bottomley, R. # s.n. (BISH, US).

1984, June. Kilauea. Crater Hill. On bluff above ocean. Low mat forming herb. woody base, flowers bright yellow. Flynn, T. #809 (BISH).

***Lycium sandwicense* (Ohelo kai) - Solanaceae - Native**



An endemic fruit bearing plant that grows near the ocean. One plant was observed with fruit at Rock Quarry Beach and through binoculars it was seen forming mats near the ocean at the base of the sea cliffs and on slopes at Crater Hill and Kilauea Pt. Does best near the coast.

***Malvastrum coromandelianum* subsp. *coromandelianum* (False mallow) - Malvaceae - Non-Native**



An occasional plant was observed at Kilauea Pt. This is a common plant in lowland disturbed sites.

***Megathyrus maximus* (Guinea grass) - Poaceae - Non-Native**



This large clumping grass was observed along the road and fence at Rock Quarry Beach and in the mowed lawn of Crater Hill and over much of Mokolea Pt. Could control in high value areas where it is causing a problem. May provide good Nene nesting habitat in the right situations.

***Melinis minutiflora* (Molasses grass) - Poaceae - Non-Native**



Only a single small patch was found on the refuge, though it likely is elsewhere on the refuge and will occasionally show up in open areas. The lone patch was found in the lantana (*Lantana camara*) and Christmas berry (*Schinus terebinthifolius*) border just beyond the public Sunset Overlook. Molasses grass is invasive, has sticky sap, and is a fire hazard. It would be good to control this lone patch and be on the lookout for more.

***Mimosa pudica* (Sensitive plant) - Fabaceae - Non-Native**



This thorny creeping legume has leaves that close when touched. It is occasionally found over much of the refuge. We found this curious yet prickly creeper at Kilauea Pt. near the Administration Office, at Crater Hill on the fringes of mowed areas, and at Mokolea Pt. near the tip.

***Mirabilis jalapa* (Four-oclock) - Nyctaginaceae - Non-Native**



We came across a single patch of this plant at Mokolea Pt. on the slope facing Rock Quarry Beach. It was mixed in with lantana (*Lantana camara*). There were a few live plants and what appeared to be old dead dry plants nearby. A garden escape, perhaps from abandoned building sites on Mokolea Point. Wedge-tailed Shearwater burrows occur nearby.

***Morinda citrifolia* (Noni) - Rubiaceae - Non-Native**



Noni was sparingly naturalized in a gully near the Red-footed Booby colony on Crater Hill. We saw a few boobies resting in it as well as some chickens that were going after the fruit. It was also found in the hala (*Pandanus tectorius*) understory on the makai side of the road near the vehicle gate to Kilauea Point.

***Myoporum sandwicense* (Naio) - Myoporaceae - Native**



Being propagated in the Nursery and planted at out-planting sites. There is a new non-native thrip (*Klambothrips myopori*) that deforms and kills naio on the Big Island. We did not see any thrip damage on the refuge during our survey.

***Neonotonia wightii* -- Glycine -- Fabaceae -- Non-Native**



This very aggressive vine, notorious for over-running much of Ulupalakua on Maui, was observed along the fence and recently cleared Christmas berry (*Schinus terebinthifolius*) that borders Kilauea Road. It was also along the road to Rock Quarry Beach, climbing on the refuge fence, and draping trees in surrounding areas of Kilauea. It may be worth it to attempt control of the small populations of this on the refuge while they are still small.

***Nephrolepis brownii* (Asian sword fern) - Lomariopsidaceae - Non-Native**



Naturalizing around the Nursery, where it grew opportunistically at the base of buildings, in wall cracks inside the nursery, and in pots. Ferns prefer moist environments, and the Greenhouse is one of the moistest on the refuge.

***Nicotiana tabacum* (Tobacco) - Solanaceae - Non-Native**



A few patches were observed on coastal cliffs and slopes of Mokolea Pt. and Kilauea Pt.

Previous collections: 1997, Jun 6. Kilauea Point National Wildlife Refuge, on summit of Mokolea Point *Nicotiana tabacum* Coastal herbaceous vegetation on basalt cliff tops with *Boerhavia*, *Lipochaeta*, *Ipomoea pes-caprae*, *Digitaria*, *Fimbristylis dichotoma*, *Cynodon dactylon*. Herb 1.5-2 m., all parts glandular-sticky. Corolla tube pale green, limb pink. Capsules green ripening brown. Naturalized, small population locally, elevation 20-25 m. Lorence, D.H., T. Flynn & A. Asquith #7999 (BISH).

2004, Jul 21. Kilauea National Wildlife Refuge, Past Crater Hill on Mokolea Point. N 22 deg 13' 56.3" W 159 deg 23' 07.7" w/ *Lantana*, *Casuarina*, *Solanaceae*, *Portulaca pilosa*, Natalia Tangalin #132 (PTBG).

***Noronhia emarginata* (Madagascar olive) - Oleaceae - Non-Native**



Sparingly naturalized in gully that comes off Albatross Hill. Several saplings 1-2 m in height are spreading in this gully from cultivated trees on the neighboring property. This species can form thickets in moist areas, as can be observed along the road to Anini Beach. Would be good to remove the plants while they are small and easy to address.

***Nototrichium humile* (Kului) - Amaranthaceae - Native**



An endemic cultivated plant, that looked like a bonsai shrub, was being grown in a planter box outside the Contact Station. Seems to do well at the refuge. Could be propagated for outplanting.

***Nototrichium sandwicense* (Kului) - Amaranthaceae - Native**



Planted at a few sites on Crater Hill and Kilauea Pt. Another native that seems to survive when outplanted on the refuge.

***Ocimum basilicum* (Sweet basil) - Lamiaceae - Non-Native**



Found outside the Staff Residence, along with Thai basil (*Ocimum basilicum* var. *thyrsiflorum*). Appeared to be reseeding itself from an abandoned planting.

***Ocimum basilicum* var. *thyrsiflorum* (Thai basil) - Lamiaceae - Non-Native**



Found outside the Staff Residence, along with sweet basil (*Ocimum basilicum*). Appeared to be reseeding itself from an abandoned planting.

***Osteomeles anthyllidifolia* (Ulei, Hawaiian rose) - Rosaceae - Native**



This mat forming native plant grows near the coast at Albatross Hill. There is also a fair sized patch in the Nihoku section between Crater Hill and Mokolea Point. We watched Red-footed Boobies tear branches off to use as nesting material. Propagated at the Nursery and planted around the refuge.

Previous collection: 1965, Apr 10. One mi. E of Kilauea Pt. Long, C.R. #3003 (BISH).

***Oxalis corniculata* (Yellow wood sorrel) - Oxalidaceae - Non-Native**



A small patch was found at the Nihoku section of Crater Hill / Mokolea Pt.

***Pandanus tectorius* (Hala, screwpine) - Pandanaceae - Native**



The dominant native tree at the refuge, hala groves were found throughout the refuge, especially on the slopes and steep coastal cliffs of Crater Hill, Nihoku, and the entrance to Kilauea Pt., where it forms large groves with an understory full of old fallen leaves and not much else. Hala was outplanted on Crater Hill in little groves.

Anecdotally, the Red-footed boobies seemed to much prefer Christmas berry (*Schinus terebinthifolius*) and ironwood (*Casuarina equisetifolia*) to nest and roost in over hala. However, the Newell's Shearwater apparently likes to nest at the base of the hala roots under the thick mat of leaves and Nene are able to find quick shelter under them.

***Panicum torridum* (Konakona) - Poaceae - Native**



This inconspicuous and short-lived native grass with furry leaves was found growing near the coastal cliffs of Crater Hill from the Red-footed Booby colony over to the Lower and Upper Lookouts, along with aweoweo (*Chenopodium oahuense*), lantana (*Lantana camara*) and akoko (*Euphorbia celastroides* subsp. *stokesii*).

Previous collections: 1951, Dec 29. Kilauea, on ledges on farthest point overlooking ocean. Degener, O. #21510 (NMNH).

1965, Apr 10. One mile east of Kilauea Pt. Long, C.R. #3001 (BISH).

***Parthenium hysterophorus* (Santa Maria) - Asteraceae - Non-Native**



This upright plant with white flowers was found in a mowed flat area of Mokolea Pt. It was also found in parking area along Kilauea Rd. This species can create thickets in some situations, such as horse paddocks.

***Paspalum conjugatum* (Hilo grass) - Poaceae - Non-Native**



A few patches were found in the Nihoku section of Crater Hill along side the road to Mokolea Pt. and further down on the slope.

***Paspalum dilatatum* (Dallis grass) - Poaceae - Non-Native**



Found in the lawn sections of Crater Hill mixed in with other grasses.

***Paspalum vaginatum* (Seashore paspalum) - Poaceae - Non-Native**



The main lawn grass at Kilauea Pt.. Also found along side the Kilauea River at Rock Quarry Beach. A low growing easy to maintain non-native grass that the Nene like to browse in. There was an especially lush flat section of this grass at the septic leach field that was covered with Nene poop.

***Passiflora edulis* (Passion fruit) - Passifloraceae - Non-Native**



Small vines of this tasty fruit were found on the refuge. One was at Kilauea Pt. near the Visitor Center bathrooms. Also found at Crater Hill along the recently cleared road through the Christmas berry (*Schinus terebinthifolius*) that runs parallel to Kilauea Rd.

***Passiflora foetida* (Love in a mist) - Passifloraceae - Non-Native**



A few small plants were found, one at Kilauea Pt. along the walk by a fence and another at the Nihoku section of Crater Hill by the road that leads to Mokolea Pt.

Previous collection: 2013, Jan 21. Kilauea National Wildlife Refuge, Nihoku Fenceline. Vine, all parts w/glandular hairs, smell, flw small wt w/purple. Natalia Tangalin #3416 (PTBG).

***Passiflora laurifolia* (Yellow water lemon) - Passifloraceae - Non-Native**



A few patches were observed along the road to Mokolea Pt. It is uncertain whether these were planted, naturalized in the area, or from yard clippings or discarded fruit.

***Pedilanthus tithymaloides* (Slipper flower) - Euphorbiaceae - Non-Native**



A single plant was found in the Nihoku section of Crater Hill near the coast by some ironwood (*Casuarina equisetifolia*). Care should be taken to avoid contact with sap when handling this plant.

***Philodendron* sp. (Philodendron) - Araceae - Non-Native**



Found growing in an abandoned rock garden behind the Staff Residence. Appears to be a leftover from a previous planting.

***Phyllanthus debilis* (Phyllanthus) - Phyllanthaceae - Non-Native**



No where common, but this small weed of disturbed areas was occasionally found in most areas of the refuge.

Previous collection: 2013, Jan 21. Kilauea National Wildlife Refuge, Nihoku Fenceline. Subshrub, leaflets dk green above, white green below, flw&fruit line along. Natalia Tangalin #3417 (PTBG).

***Phymatosorus grossus* (Lauae, maile scented fern) - Polypodiaceae - Non-Native**



Found behind the Staff Residence building along with other ornamental plants. Likely persisting from a previous planting. It was also a weed in the Nursery.

***Physalis peruviana* (Poha, cape gooseberry) - Solanaceae - Non-Native**



A few small plants were found at Kilauea Pt. One near the Visitor Center bathrooms and the other in a weedy gully located near the top of Albatross Hill where other weedy plants are spreading from neighboring cultivated trees. The fruit are poisonous green but taste good when ripe.

***Pilea microphylla* (Artillery plant) - Urticaceae - Non-Native**



This tiny low growing plant was found as a weed in pots and other areas of the Nursery at Kilauea Pt. It was also found growing in the paver cracks in the foot path behind the Staff Residence and near an abandoned concrete structure near the coast below Albatross Hill.

***Pisonia* sp. (Papala kepau) - Nyctaginaceae - Native**



Being grown in the Nursery at Kilauea Pt. We are not sure which species was being grown or how it will do at the refuge, but it seems to be surviving so far.

***Pisum sativum* var. *macrocarpum* (Pea) - Fabaceae - Non-Native**



Cultivated at Kilauea Pt. at the Staff Residence in pots along with other vegetables.

***Pittosporum* sp. (Hoawa) - Pittosporaceae - Native**



The native hoawa was being propagated at the Nursery and was found at several outplanting sites at Kilauea Pt. and Crater Hill. Plants were not flowering or fruiting and it is not certain which species is being grown.

***Plantago lanceolata* (Narrow-leaved plantain) - Plantaginaceae - Non-Native**



Found to be common over much of Crater Hill and in disturbed open areas of Kilauea Pt. Anecdotally a favored browsing food of Nene.

Previous collection: 1965, May 6. Kilauea Pt., Long, C.R., W. King, V. Horeman #3033 (BISH).

***Plantago major* (Broad-leaved or common plantain) - Plantaginaceae - Non-Native**



Occasionally found in developed area of Kilauea Pt.

Previous collection: 1965, May 6. Kilauea Pt. Long, C.R., W. King, V. Horeman #3026 (BISH).

***Plectranthus parviflorus* (Alaala wai nui wahine) - Lamiaceae - Native**



A few wild plants on east side of Kilauea Pt. near NESH Hill. Also cultivated in the Nursery and seemed to be naturalizing in the area.

***Pluchea carolinensis* (Sourbush) - Asteraceae - Non-Native**



This odorous shrub was common over much of the refuge. It has longer furrier leaves than the other *Pluchea* species.

***Pluchea indica* (Indian fleabane) - Asteraceae - Non-Native**



Uncommon on Mokolea Pt. It has non-furry serrated and smaller leaves than *P. carolinensis*.

***Pluchea x fosbergii* (Marsh fleabane) - Asteraceae - Non-Native**



A hybrid between the two species mentioned above. There was a patch found above Rock Quarry Beach. This hybrid forms spontaneously when the other two species are in the same location, has no viable seeds, and spreads by rooting at the nodes of sprawling limbs.

***Polyscias racemosa* (Munroidendron) - Araliaceae - Native**



This dry forest tree was being propagated in the Nursery and planted at Crater Hill. Seemed to be doing fine.

***Portulaca lutea* (Ihi) - Portulacaceae - Native**



The indigenous ihi was found near an old concrete structure near the coast on the slopes below Albatross Hill. First reported from Kauai by Ken Wood who found in on nearby Moku Aea and reports seeing this species in coastal areas from Princeville to Hanalei (Wood 2006). Distinguished from the related non-native *Portulaca oleracea* by larger flowers with more stamens and corky stems. The two species hybridize.

***Portulaca oleracea* (Pigweed) - Portulacaceae - Non-Native**



The non-native pigweed was more common than the related endemic ihi. We found this species along the coast at Rock Quarry Beach and Mokolea Pt. Some specimens were young and couldn't be assigned to either species. If one looked closely, it's likely there are hybrids as well.

***Portulaca pilosa* (Pigweed) - Portulacaceae - Non-Native**



Uncommon on Mokolea Pt., at the Nihoku section of Crater Hill, and at the Upper Overlook.

Previous collection: 1978, Jun 21. Kilauea Crater Hill. Along crest of hill, with *Lipochaeta*, *Chenopodium*, and *Euphorbia*. Corn, C. #s.n. (BISH).

***Pritchardia limahuliensis* (Loulu) - Arecaceae - Native**



Noted by Tom Myers, a volunteer with the refuge, as being amongst the smaller more recently planted loulu palms at Crater Hill outplantings. The palms are all still quite young and we weren't able to distinguish the native species.

***Pritchardia napaliensis* (Loulu) - Arecaceae - Native**



Noted by Tom Myers, a volunteer with the refuge, as being amongst the smaller more recently planted loulu palms at Crater Hill outplantings. The palms are all still quite young and we weren't able to distinguish the native species.

***Pritchardia remota* (Nihoa fan palm) - Arecaceae - Native**



Noted by Tom Myers, a volunteer with the refuge, as being the older, larger planted loulu palms at Crater Hill. There were several 2 m tall plants at the upland outplanting site on Crater Hill we presume are *P. remota*. The native loulu moth (*Omiodes blackburni*) was hosting on these trees, with recent signs of chewing, frass, and webbing.

***Pritchardia thurstonii* (Fiji fan palm) - Arecaceae - Non-Native**



A medium sized Fiji fan palm was planted in the native plant section near the Visitors Center. It is distinguished by the long inflorescences and small sized fruit. We observed signs that the native loulu moth (*Omiodes blackburni*) had previously used this palm as a larval host plant.

***Pseudognaphalium* sp. (Gnaphalium) - Asteraceae - Non-native**



Small annual found in the Nihoku section of Crater Hill.

***Psidium cattleianum* (Strawberry guava) - Myrtaceae - Non-Native**



Strawberry guava was present along the road to Mokolea Pt., in the wooded area near the Communication Tower, where it was mixing with satin leaf (*Chrysophyllum oliviforme*) and coral berry (*Rivina humilis*). A few plants were also found in the Nihoku section of Crater Hill. Can create dense thickets in moist setting. Seeds are spread by fruit eating birds and pigs.

***Psidium guajava* (Guava) - Myrtaceae - Non-Native**



An occasional guava tree was found in the scrub borders of Crater Hill, Nihoku, Mokolea Pt., and along the road at Rock Quarry Beach. It is likely being spread by birds and humans.

***Rauvolfia sandwicensis* (Hao) - Apocynaceae - Native**



Hao was found planted at restoration sites at Kilauea Pt. and Crater Hill. Though predominantly thought of as a dry forest tree, it seems to do well in coastal settings.

***Rhizophora mangle* (Red mangrove) - Rhizophoraceae - Non-Native**



Present along the shoreline of Kilauea River at Rock Quarry Beach.

***Richardia brasiliensis* (Richardia) - Rubiaceae - Non-Native**



This low growing plant was occasionally found in disturbed open areas, such as next to walking paths, at Kilauea Pt.

***Ricinus communis* (Castor bean) - Euphorbiaceae - Non-Native**



A small patch was found on the west side of the tip of Kilauea Pt. It was also found at Rock Quarry Beach along the roadside scrub with sourbush (*Pluchea carolinensis*) and guava (*Psidium guajava*), and at Mokolea Pt. mixed with lantana (*Lantana camara*). The seeds are highly toxic.

***Rivina humilis* (Coral berry) - Phytolaccaceae - Non-Native**



The dominant understory plant over much of the refuge. It was especially prevalent near the Red-footed Booby colony on Crater Hill.

Previous collection: 2013, Jan 21. Kilauea National Wildlife Refuge, Nihoku Fenceline. Herb/subshrub, dominating understory, wilted look, small red berries. Natalia Tangalin #3419 (PTBG).

***Sansevieria trifasciata* (Mother in law's tongue) - Asparagaceae - Non-Native**



A clump persists in the naupaka on the north tip of Kilauea Pt. Likely from plantings abandoned long ago.

***Scaevola taccada* (Naupaka) - Goodeniaceae - Native**



A dominant shrub over much of the refuge, especially in steep areas near the coast and much of the main visitor area. Useful to wildlife and able to grow in extreme situations, naupaka is also very aggressive and should be planted with caution near areas with rare plants or things that don't mind being overrun by this vigorous native.

***Schefflera actinophylla* (Octopus tree) - Araliaceae - Non-Native**



A few young plants observed at Kilauea Pt. and Crater Hill. We were able to pull up a couple of them. But others remain. It was spreading from neighboring properties by birds, sometimes germinating and growing in other trees. This tree can also invade steep terrain. There is very little of this on the refuge now, but it may be a more conspicuous element of the flora in the future, especially if not occasionally kept in check.

***Schiedea verticillata* (Nihoa schiedea) - Caryophyllaceae - Native**



Cultivated in the Nursery at Kilauea Pt. Seems to be doing fine.

***Schinus terebinthifolius* (Christmas berry) - Anacardiaceae - Non-Native**



A dominant tree over much of the refuge. Favored nesting tree of Red-footed Boobies. Large areas of Christmas berry were recently chipped with a tractor on parts of Crater Hill away from the coast, where the boobies don't nest, for Nene habitat. Because the tree is so widespread and utilized by boobies, local control in high value sites where it's causing trouble is the only recommendation we have for this species at Kilauea Pt. NWR.

Previous collection: 1965, May 6. Kilauea Pt. Horeman, V. #3027 (BISH).

***Senna pendula* (Pendant senna) - Fabaceae - Non-Native**



This yellow flowered shrub was found to be uncommon, with scattered patches in the Nihoku area of Crater Hill.

Previous collection : 2013, Jan 21. Kilauea National Wildlife Refuge, Nihoku Fenceline. Small tree, yellow flowers, upright or weakly ascending. Natalia Tangalin #3421 (PTBG).

***Sesbania tomentosa* (Oahi) - Fabaceae - Native**



Oahi was being grown in the Nursery at Kilauea Pt. This is a food plant for the native yellow-faced bees (*Hylaeus* spp.).

***Sesuvium portulacastrum* (Akulikuli, sea purslane) - Aizoaceae - Native**



A creeping salt loving native plant with succulent leaves found near the coast over much of the refuge. It is often the closest plant to the ocean.

***Setaria parviflora* (Yellow foxtail) - Poaceae - Non-Native**



This non-native grass was occasionally found on Crater Hill.

Previous collection: 2013, Jan 21. Kilauea National Wildlife Refuge, Nihoku Fenceline. Grass. Natalia Tangalin #3412 (PTBG).

***Sida acuta* (Sida) - Malvaceae - Non-Native**



We found a few plants on Mokolea Pt. mixed in with ageratum (*Ageratum conyzoides*).

***Sida ciliaris* (Red ilima) - Malvaceae - Non-Native**



A few plants were found at Kilauea Pt. in open areas.

***Sida fallax* (Ilima) - Malvaceae - Native**



Ilima was found to be common at Kilauea Pt., especially along the main path to the lighthouse. It was also found here and there near the coast in most parts of the refuge. Native yellow faced bees (*Hylaeus connectens*) were observed visiting flowers. This hearty native would also be good to propagate and outplant.

***Sida rhombifolia* (Cuban jute) - Malvaceae - Non-Native**



A few plants were found in the grassy areas by beach at Rock Quarry Beach.

***Solanum americanum* (Glossy nightshade) - Solanaceae - Native**



Observed at the gravely flat near the beach at Rock Quarry Beach.

***Solanum lycopersicum* var. *lycopersicum* (Tomato) - Solanaceae - Non-Native**



Tomato was being cultivated in pots at the Staff Residence. One wild plant was observed near the parking area at the Nihoku section of Crater Hill.

***Solanum seaforthianum* (Vining solanum) - Solanaceae - Non-Native**



Occasional vine sprawling through vegetation, especially on Crater Hill near the Communication Tower and the Nihoku section, and Mokolea Pt. on the slopes down to Rock Quarry Beach.

Previous collection: 2013, Jan 21. Kilauea National Wildlife Refuge, Nihoku Fenceline. Vine, flw purple, climbing vine. Natalia Tangalin #3420 (PTBG).

***Sonchus oleraceus* (Sow thistle) - Asteraceae - Non-Native**



This weedy annual was found along the road at Rock Quarry Beach.

Previous collection: 1965, May 6. Kilauea Point. King, W. V. Horeman #3036 (BISH).

***Sphagneticola trilobata* (Wedelia) - Asteraceae - Non-Native**



This creeping groundcover was found at Kilauea Pt. near the gully above the be still tree (*Thevetia peruviana*) patches. It was also found at Rock Quarry Beach near the Kilauea River; at Crater Hill near borders of the mowed lawn and scrub as well as in the open lawn in some areas; and in the Nihoku saddle area. Outside the refuge, it was planted in mass as a groundcover by the ditch at the Sea Cliff subdivision.

***Spinacia oleracea* (Spinach) - Amaranthaceae - Non-Native**



Being grown in pots at the Staff Residence.

***Sporobolus africanus* (Dropseed) - Poaceae - Non-Native**



This grass was occasionally found in disturbed sites of Kilauea Pt., along the road to Mokolea Pt. in the Nihoku section, and the grassy areas of Crater Hill.

Previous collections: 2013, Jan 21. Kilauea National Wildlife Refuge, Nihoku Fenceline. Grass, common, tall and thin single narrow spike. Natalia Tangalin #3426 (PTBG).

***Sporobolus pyramidatus* (Dropseed) - Poaceae - Non-Native**



Found in the gravelly flat near the beach at Rock Quarry Beach.

***Stachys arvensis* (Staggerweed) - Lamiaceae - Non-Native**



A few patches of this low growing herb were found outside the Administration Office. It was also observed in the ironwood (*Casuarina equisetifolia*) understory on the Upper Overlook road.

***Stachytarpheta cayennensis* (Vervain) - Verbenaceae - Non-Native**



This plant was occasional to common at Kilauea Pt., Crater Hill, and Mokolea Pt.

***Stenotaphrum secundatum* (St. Augustine grass) - Poaceae - Non-Native**



A creeping grass that was occasionally found at Rock Quarry Beach, Crater Hill, and Mokolea Pt. Does particularly well near the coast and in the shade compared to other grasses.

***Synedrella nodiflora* (Node weed) - Asteraceae - Non-Native**



An occasional plant was observed in disturbed areas of Kilauea Pt. and at Rock Quarry Beach.

***Syngonium podophyllum* (Arrowhead plant) - Araceae - Non-Native**



Found growing from presumably old dump pile on Crater Hill. A viney sort of plant that can climb up vegetation or blanket the ground. Could probably be removed relatively easily.

***Syzygium cumini* (Java plum) - Myrtaceae - Non-Native**



Common over much of the refuge, especially on Crater Hill.

***Tabebuia* sp. (Trumpet tree) - Bignoniaceae - Non-Native**



One undetermined species of trumpet tree poking out of a naupaka (*Scaevola taccada*) hedge at intersection to Staff Residence.

***Terminalia catappa* (Tropical almond) - Combretaceae - Non-Native**



Large tree near a kou (*Cordia subcordata*) found in the gully above the be still tree (*Thevetia peruviana*) patches at Kilauea Pt. It was also found naturalized near Kilauea River at Rock Quarry Beach.

***Tetragonia tetragonioides* (New zealand spinach) - Aizoaceae - Non-Native**



One patch was found at Rock Quarry Beach. This species is invasive in the Farallon Islands and was eradicated from Midway Atoll. Pieces of plant can break off and grow.

***Thespesia populnea* (Milo) - Malvaceae - Native**



Milo was being propagated in the Nursery and was planted out in small groves on Crater Hill. There was also a tree in the Staff Residence that appeared to be planted a while ago along with other ornamental trees.

***Thevetia peruviana* (Be-still tree) - Apocynaceae - Non-Native**



Large thickets occur on the west side of Kilauea Pt, presumably escaped from old abandoned plantings. This species seemingly provides no wildlife value and is in a relatively high value area, with lots of Wedge-tailed Shearwaters and Laysan Albatross that could better utilize the area if this species were gone. Some control being done in the gully.

***Thunbergia fragrans* (Sweet clock-vine) - Acanthaceae - Non-Native**



This vine was occasionally observed at the refuge. It was observed along the road at Rock Quarry Beach, at Crater Hill along the fence bordering Kilauea Rd., in the understory above the Red-Footed Booby colony, and at Kilauea Pt. in the gully between Kilauea Point and Albatross Hill.

**Unknown Poaceae (Unknown grass) - Poaceae - Non-Native**



A grass unknown to us and with less than ideal fertile material was found in a flat open section of Nihoku on Crater Hill. Spending more time surveying the refuge would likely turn up more grass species and surveying at different times would allow for fertile material to be found to help further identifications.

***Urochloa distachya* (Tropical signal grass) - Poaceae - Non-native**

Collected by Flynn, Lorence, and Asquith as *Brachiaria subquadripara* in 1997. We did not observe this species, but may have overlooked it, or were unable to identify it. See also, Unknown Poaceae (above).

Previous collection: 1997, Jun 6. Kilauea Point National Wildlife Refuge, Mokolea Point. Secondary vegetation of Bermuda, *Medicago*, and *Digitaria insularis*. Creeping herb, freely rooting at nodes, forming a thick mat; blades dark glossy green. Scattered in area. Flynn, T., D.H. Lorence & A. Asquith #6164 (BISH, PTBG, US).

***Urochloa mutica* (California grass) - Poaceae - Non-Native**



We found this weedy grass in a few spots. At Kilauea Pt. a patch was found near the coast in front of Albatross Hill. Another patch was found at Rock Quarry Beach. Prefers moist locations.

***Veitchia merrillii* (Manila palm) - Arecaceae - Non-Native**



A lone tree was found cultivated at the Staff Residence at Kilauea Pt. It appears to have been planted a while ago with other ornamental palms and trees and then abandoned.

***Verbena litoralis* (Vervain) - Verbenaceae - Non-Native**



An occasional plant was found in open areas of Kilauea Pt.

***Vigna marina* (Nanea) - Fabaceae - Native**



A few plants were found near the coast at the Nihoku section of Crater Hill. Nanea is a native viney groundcover with yellow pea like flowers.

***Vitex rotundifolia* (Pohinahina) - Lamiaceae - Native**



Cultivated at Kilauea Pt. A rambling vine with fragrant foliage and purple flowers.

***Waltheria indica* (Uhaloa) - Malvaceae - Native**



Occasional on Crater Hill, just past the Sunset overlook, and in the Nihoku section.

***Wikstroemia uva-ursi* (Akia) - Thymelaeaceae - Native**



Akia was being propagated in the Nursery and cultivated at planting sites at Kilauea Pt.

***Xanthium strumarium* var. *canadense* (Cocklebur) - Asteraceae - Non-Native**



We found a patch of cocklebur in low point along road to Mokolea Pt.

***Zea mays* (Corn) - Poaceae - Non-Native**



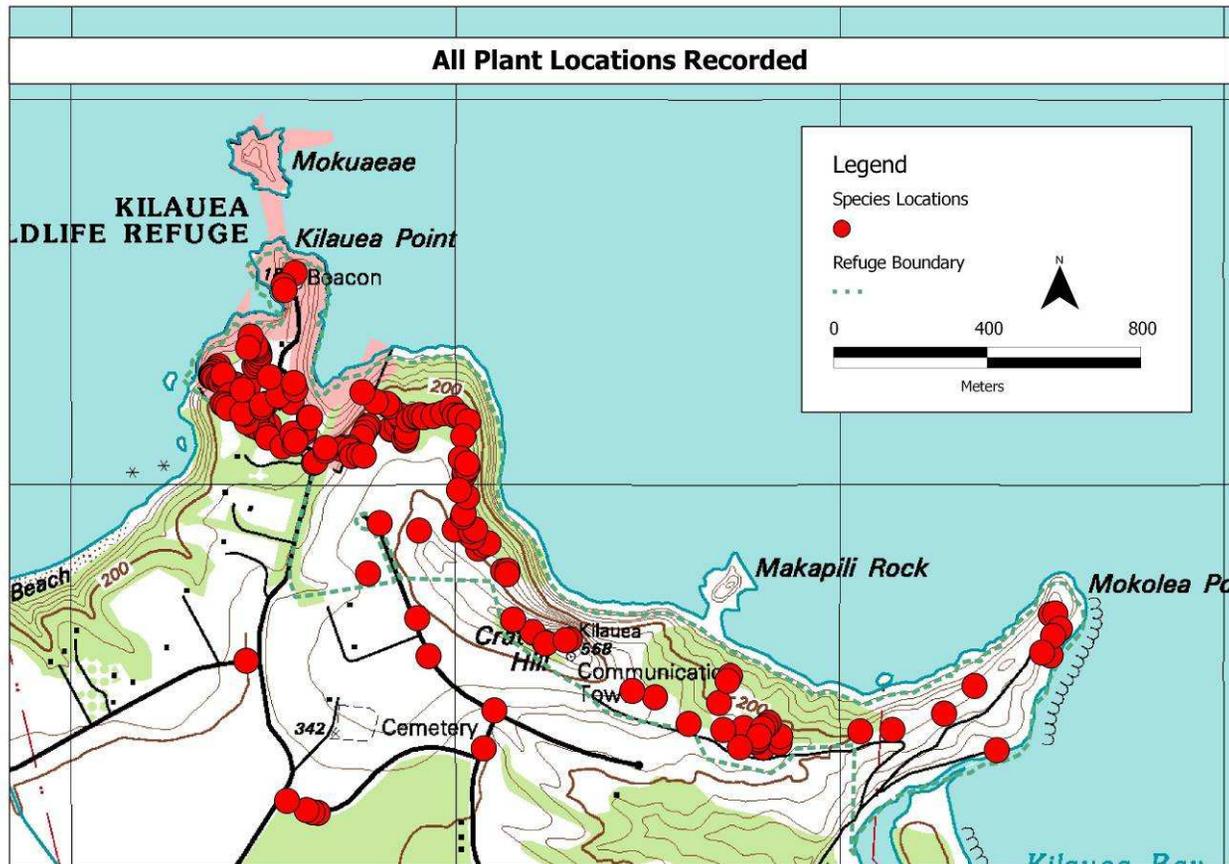
One of the vegetables being grown in pots at the Staff Residence. Seedlings were getting eaten by Nene, so the growers had to place the pots higher up off the ground.

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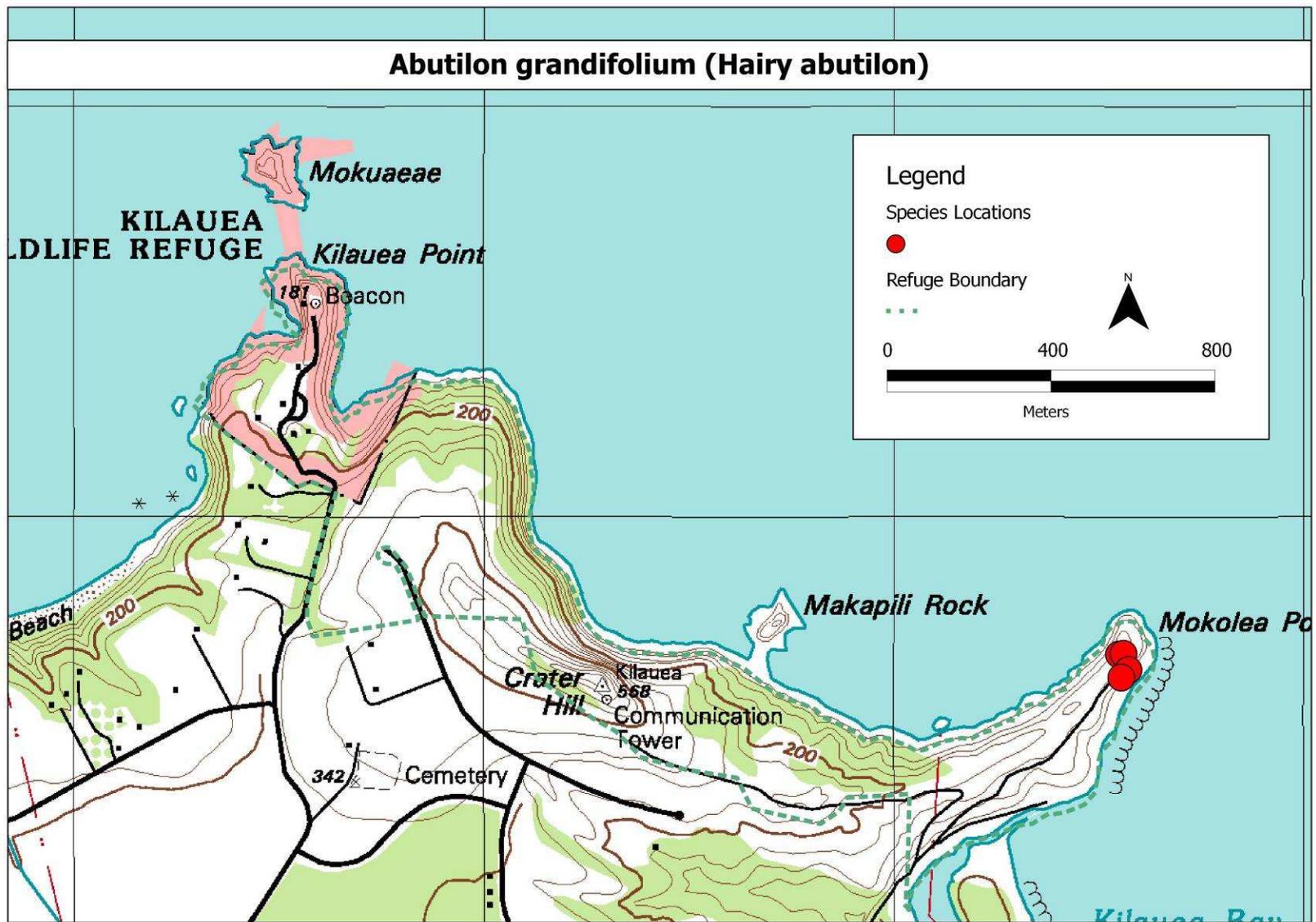
## APPENDIX B: MAPS OF SELECTED SPECIES

What follows are distribution maps for selected species showing distribution at Kilauea Pt. NWR in 2013. Emphasis is on incipient invasive non-native plant species and uncommon native plants. 190 locations were collected for 39 species, 30 non-native and nine native. Most points were collected using a Garmin etrex Legend H GPS, though a few locations were hand drawn using high resolution satellite imagery.

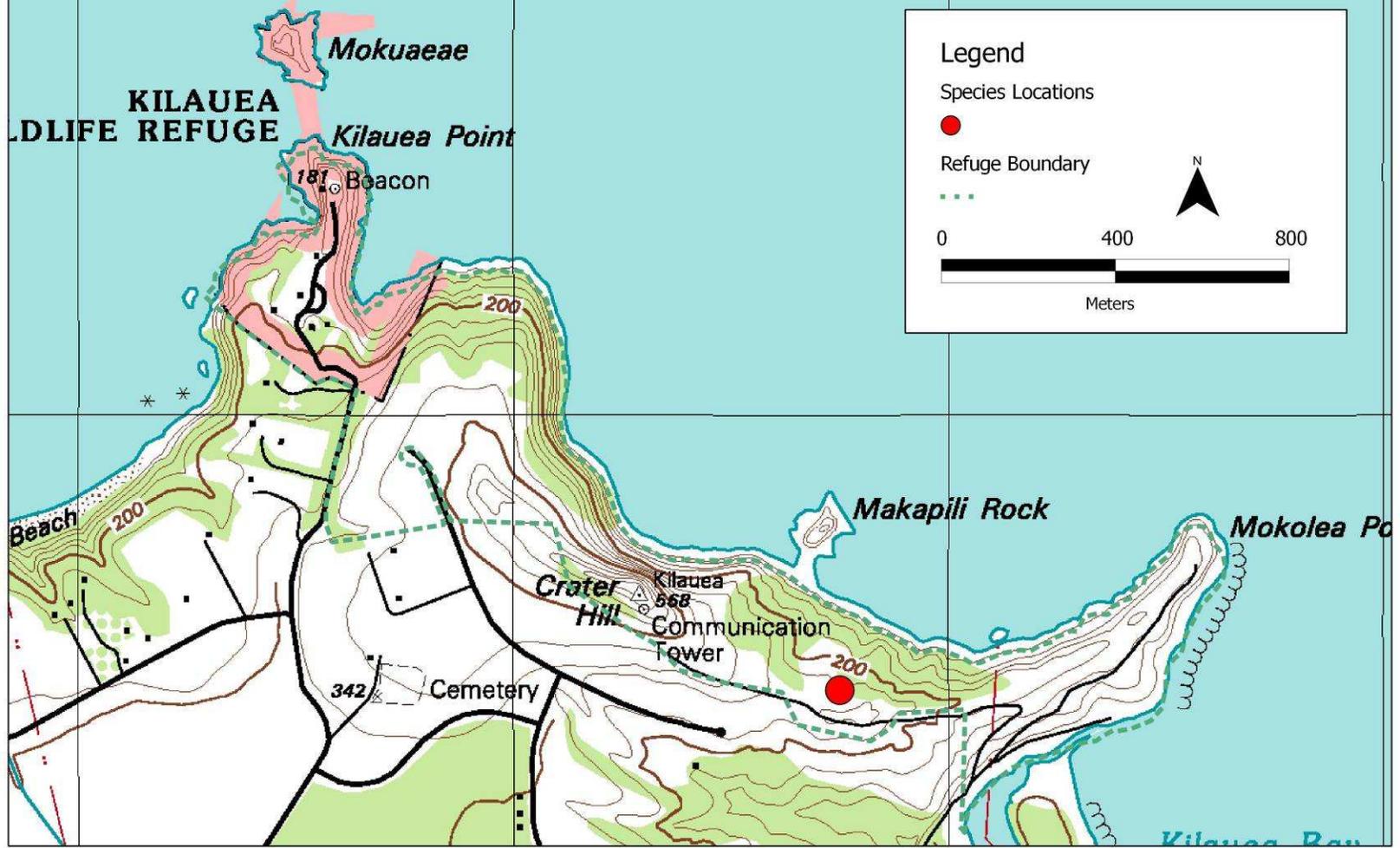


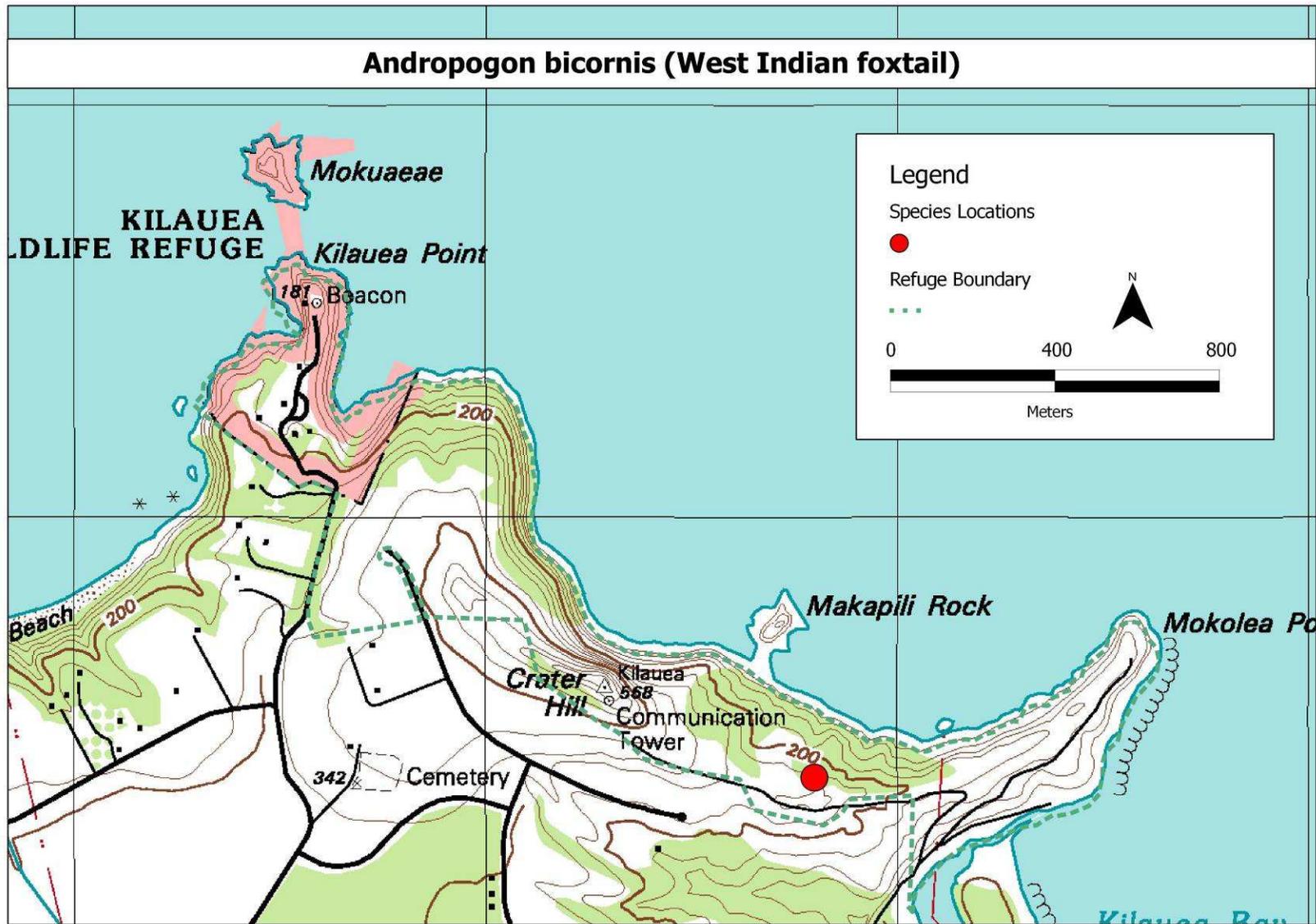
## NON - NATIVES

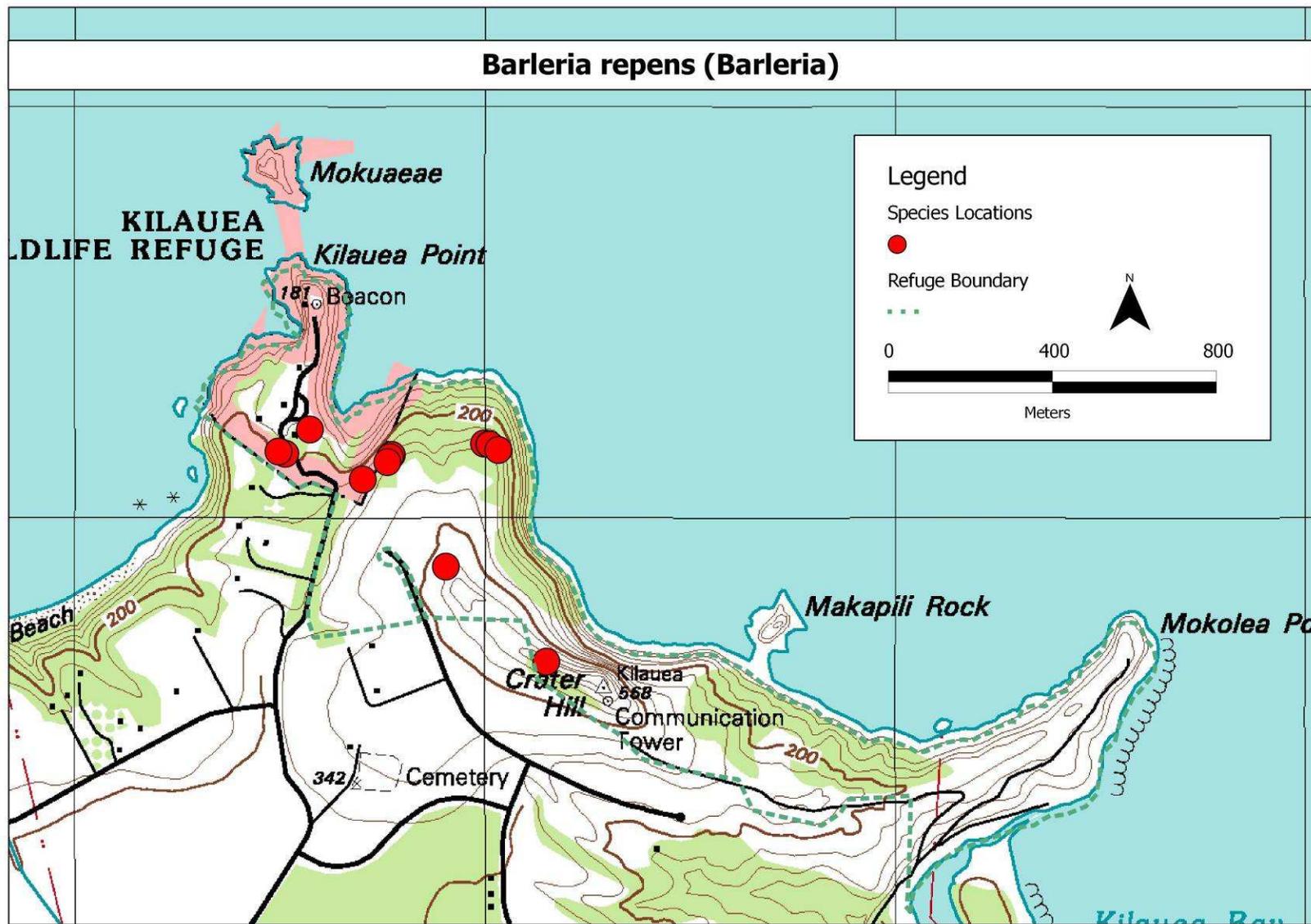
- *Abutilon grandifolium* (Hairy abutilon)
- *Andropogon bicornis* (West Indian foxtail)
- *Ardisia elliptica* (Shoebuttan ardisia)
- *Barleria repens* (Baleria)
- *Bougainvillea* sp. (Bougainvillea)
- *Canna indica* (Indian shot)
- *Carmona retusa* (Funkien tea)
- *Cecropia obtusifolia* (Trumpet tree)
- *Clusia rosea* (Autograph tree)
- *Cupaniopsis anacardioides* (Carrotwood)
- *Cyperus involucratus* (Umbrella sedge)
- *Epipremnum pinnatum* (Golden pothos)
- *Ficus microcarpa* (Chinese banyan)
- *Hippobroma longiflora* (Star of Bethlehem)
- *Justicia betonia* (White shrimp plant)
- *Kalanchoe pinnata* (Air plant)
- *Nicotiana tabacum* (Tobacco)
- *Noronhia emarginata* (Madagascar olive)
- *Passifolra edulis* (Passion fruit)
- *Passiflora foetida* (Love in a mist)
- *Passiflora laurifolia* (Water lemon)
- *Sansevieria trifasciata* (Mother in law's tongue)
- *Schefflera actinophylla* (Octopus tree)
- *Senna pendula* (Pendant senna)
- *Spathodea campanulata* (African tulip tree)
- *Syngonium podophyllum* (Nephthytis)
- *Tabebuia* sp. (Trumpet tree)
- *Tetragonia tetragonioides* (New Zealand spinach)
- *Thevetia peruviana* (Be-still tree)
- *Xanthium strumarium* (Cocklebur)

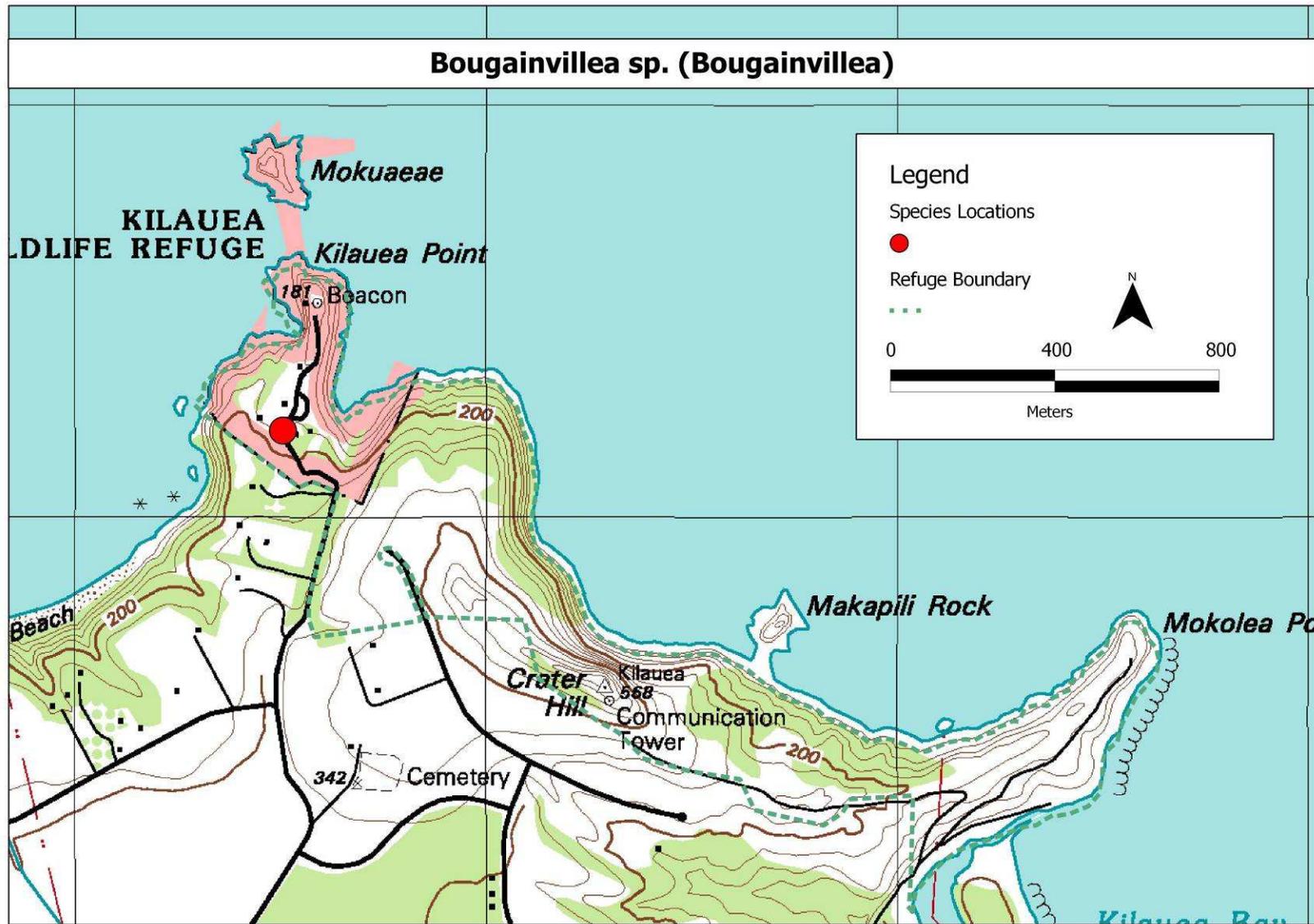


# Ardisia elliptica (Shoebuttan ardisia)

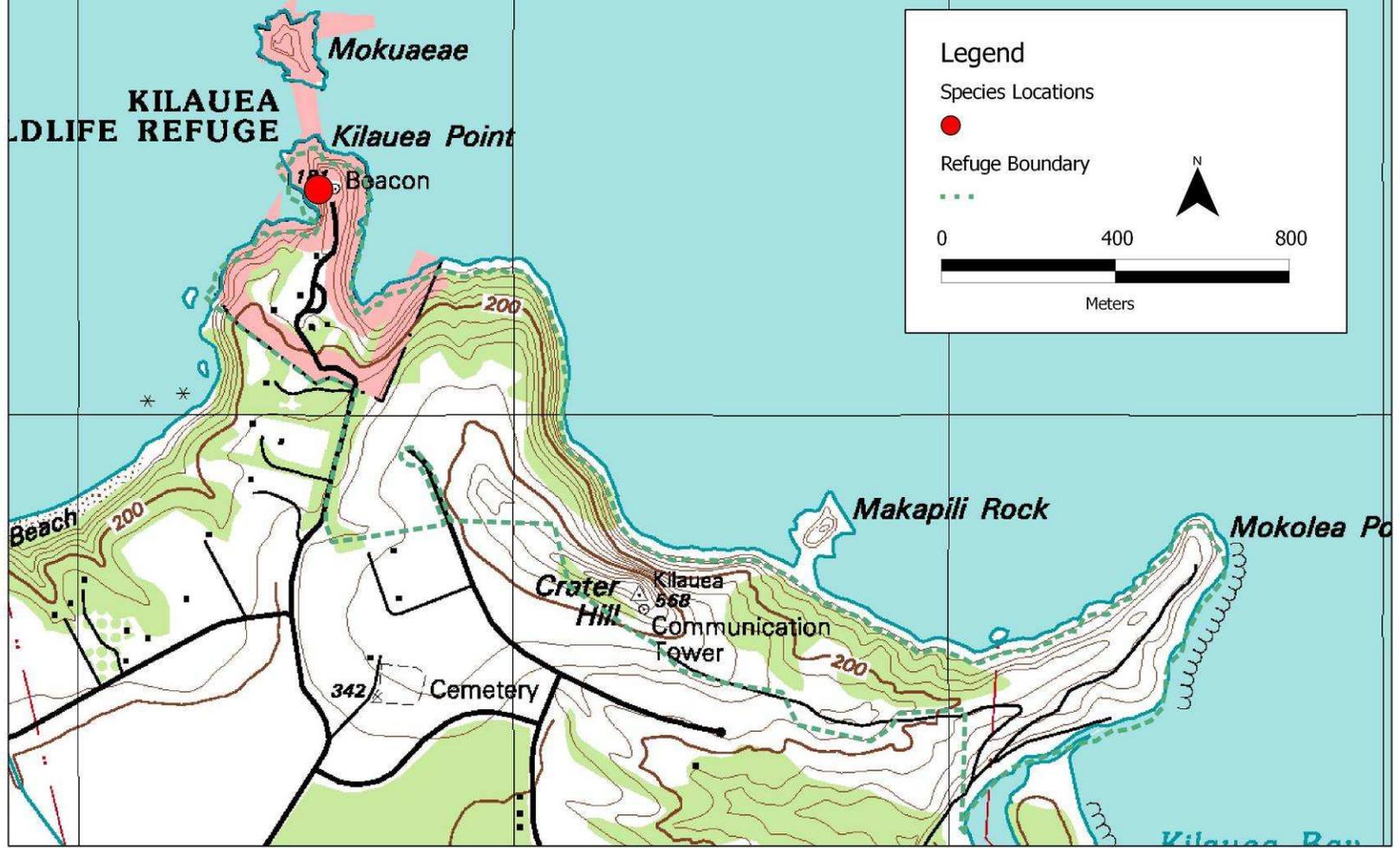




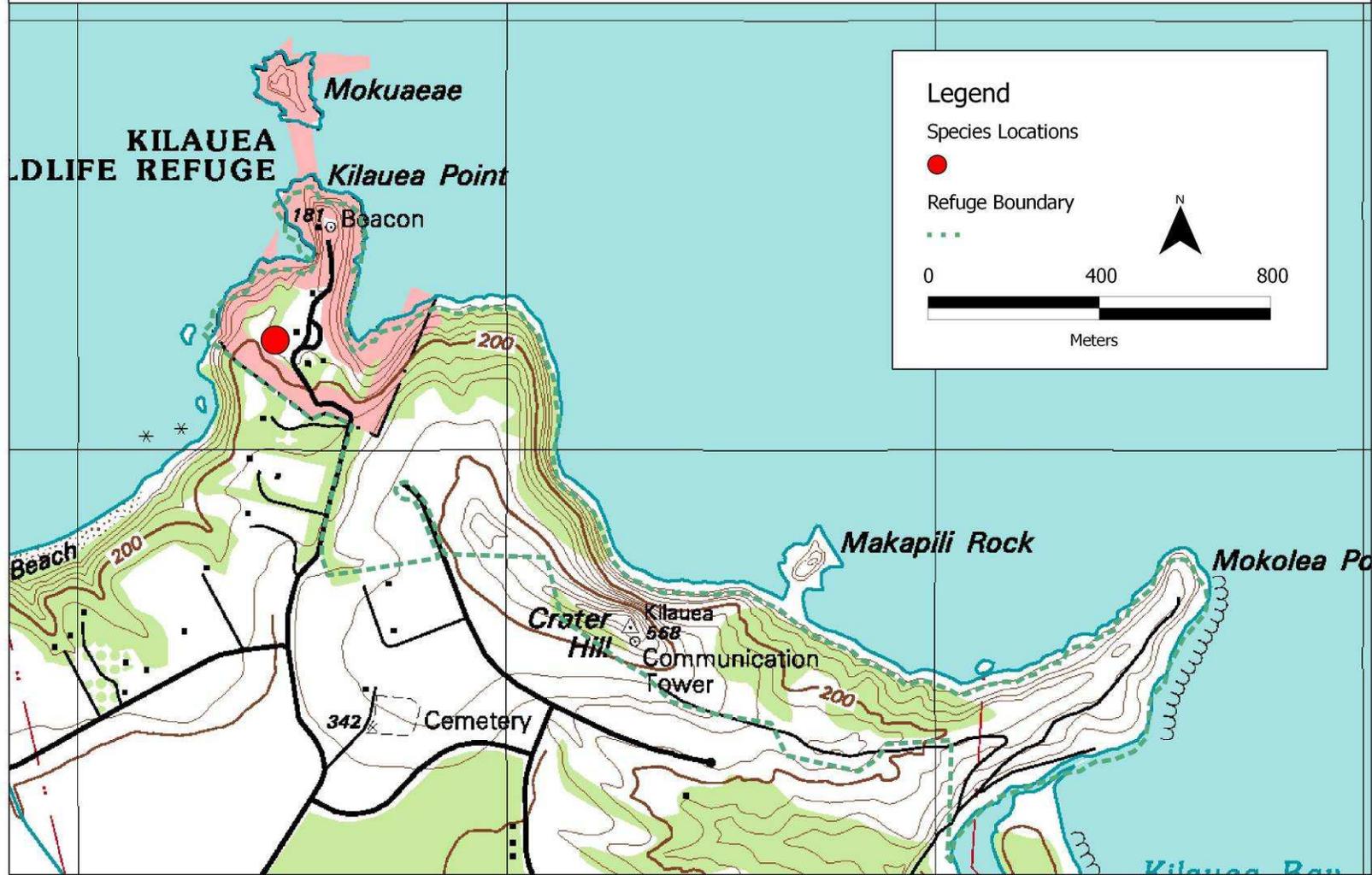




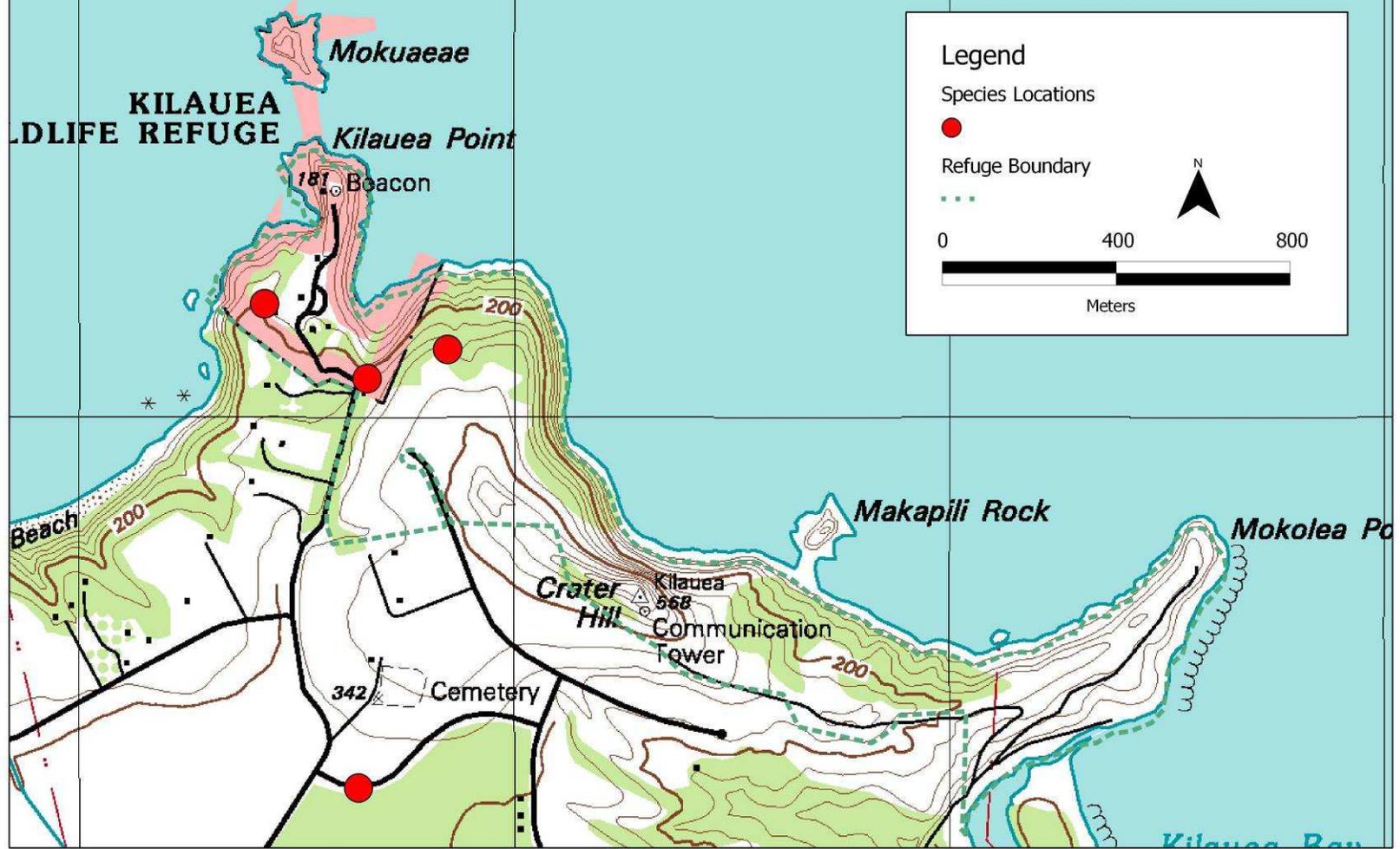
### Canna indica (Indian shot)

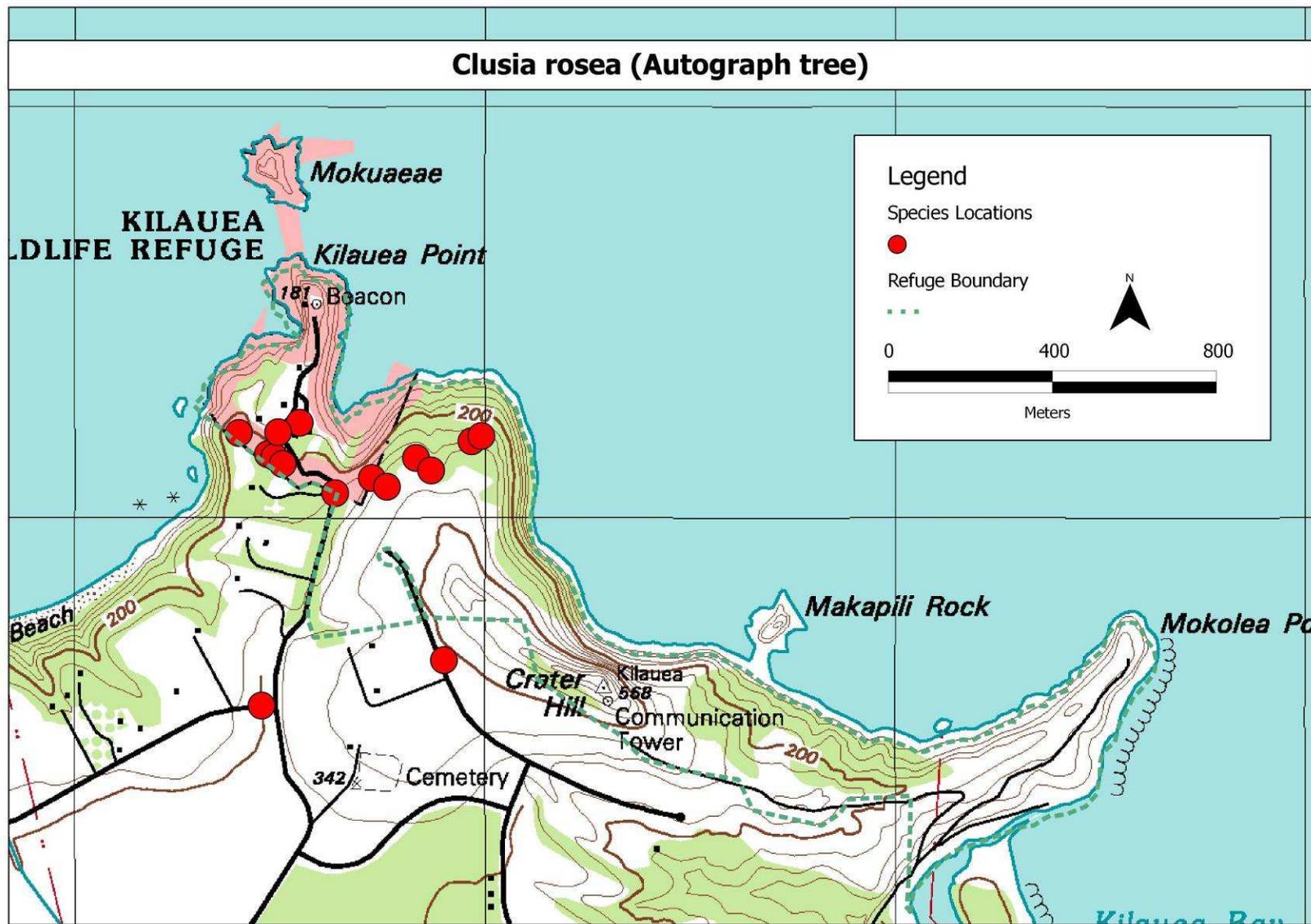


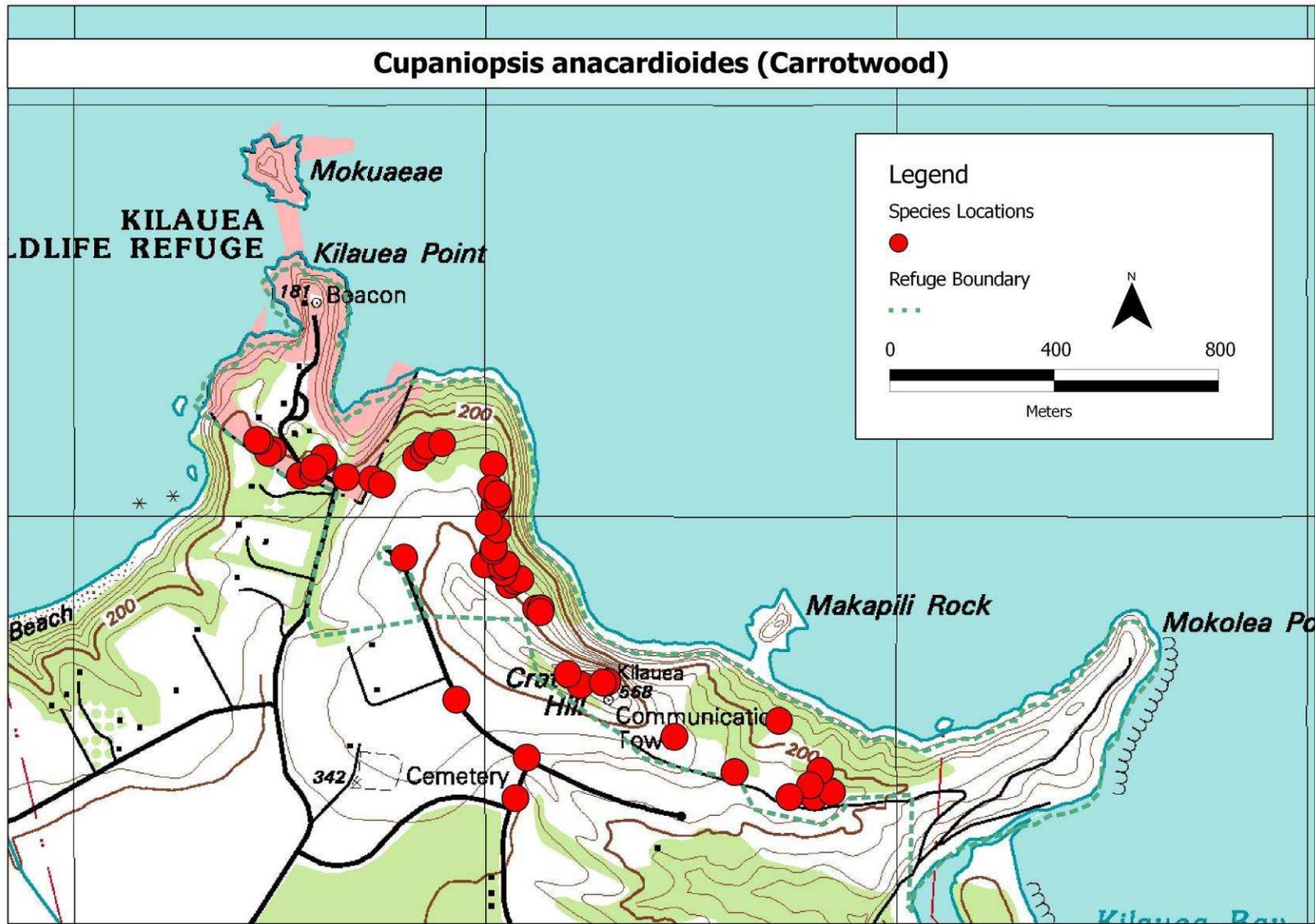
**Carmona retusa (Fukien tea, Philippine tea)**

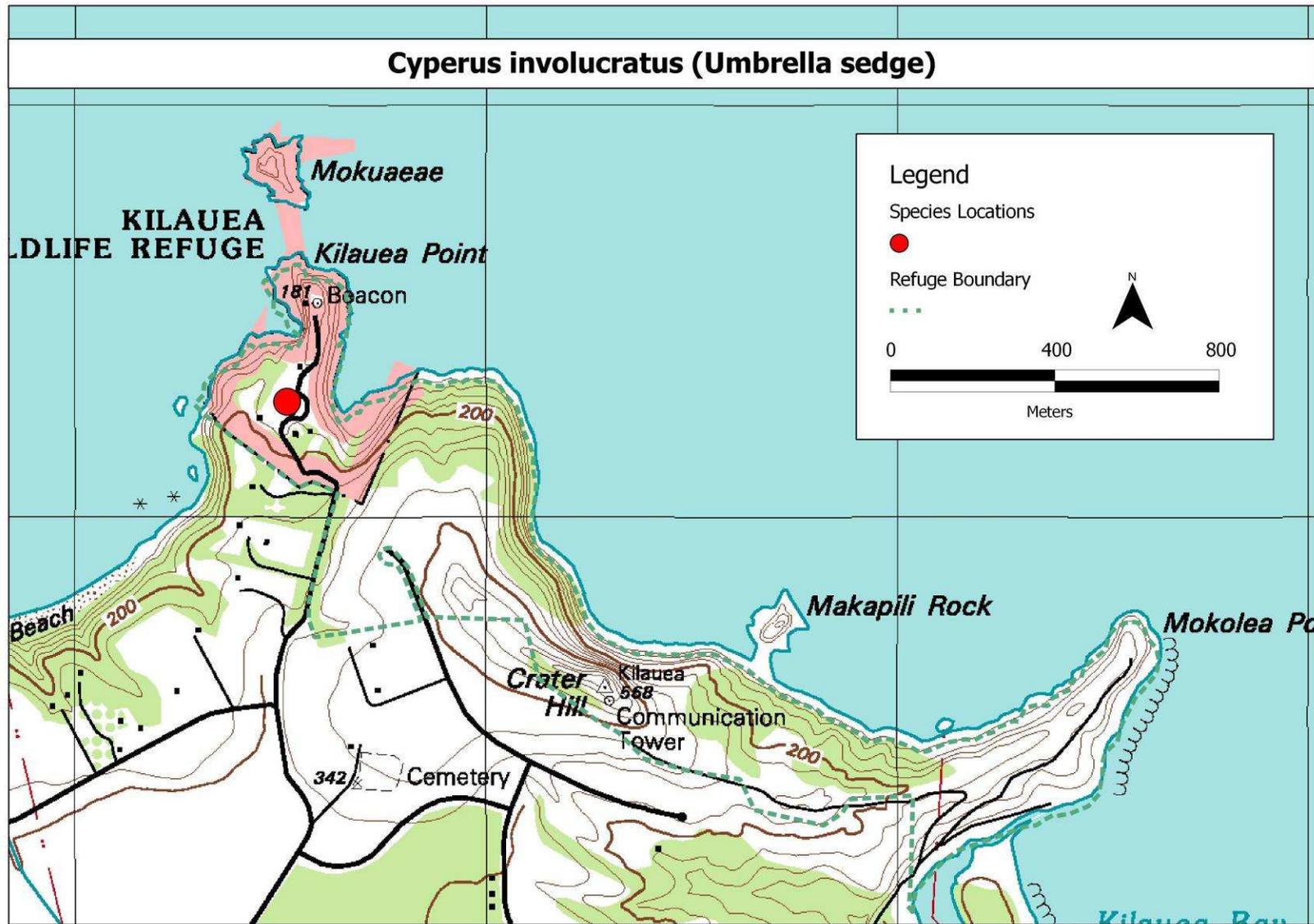


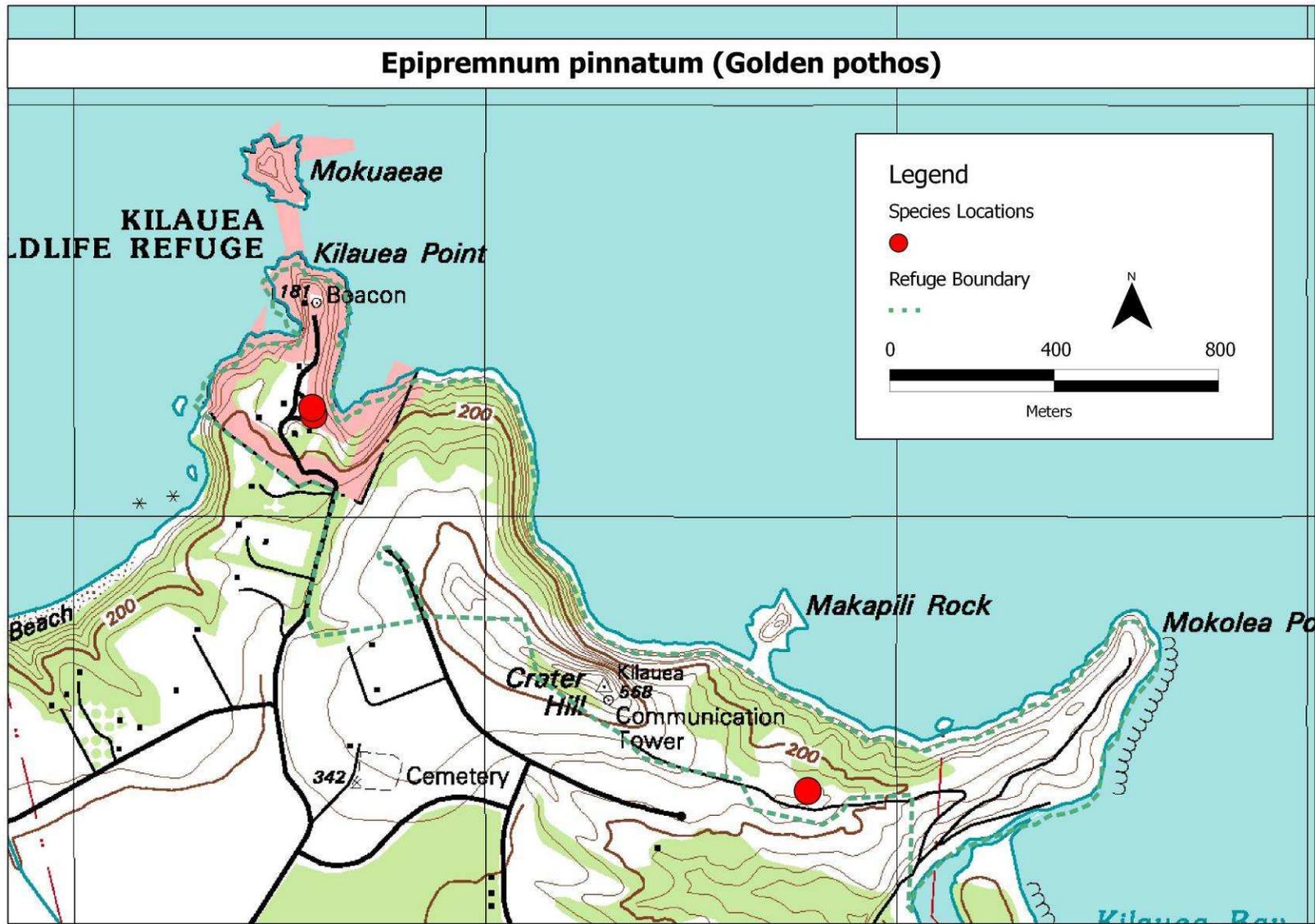
# Cecropia obtusifolia (Trumpet tree)

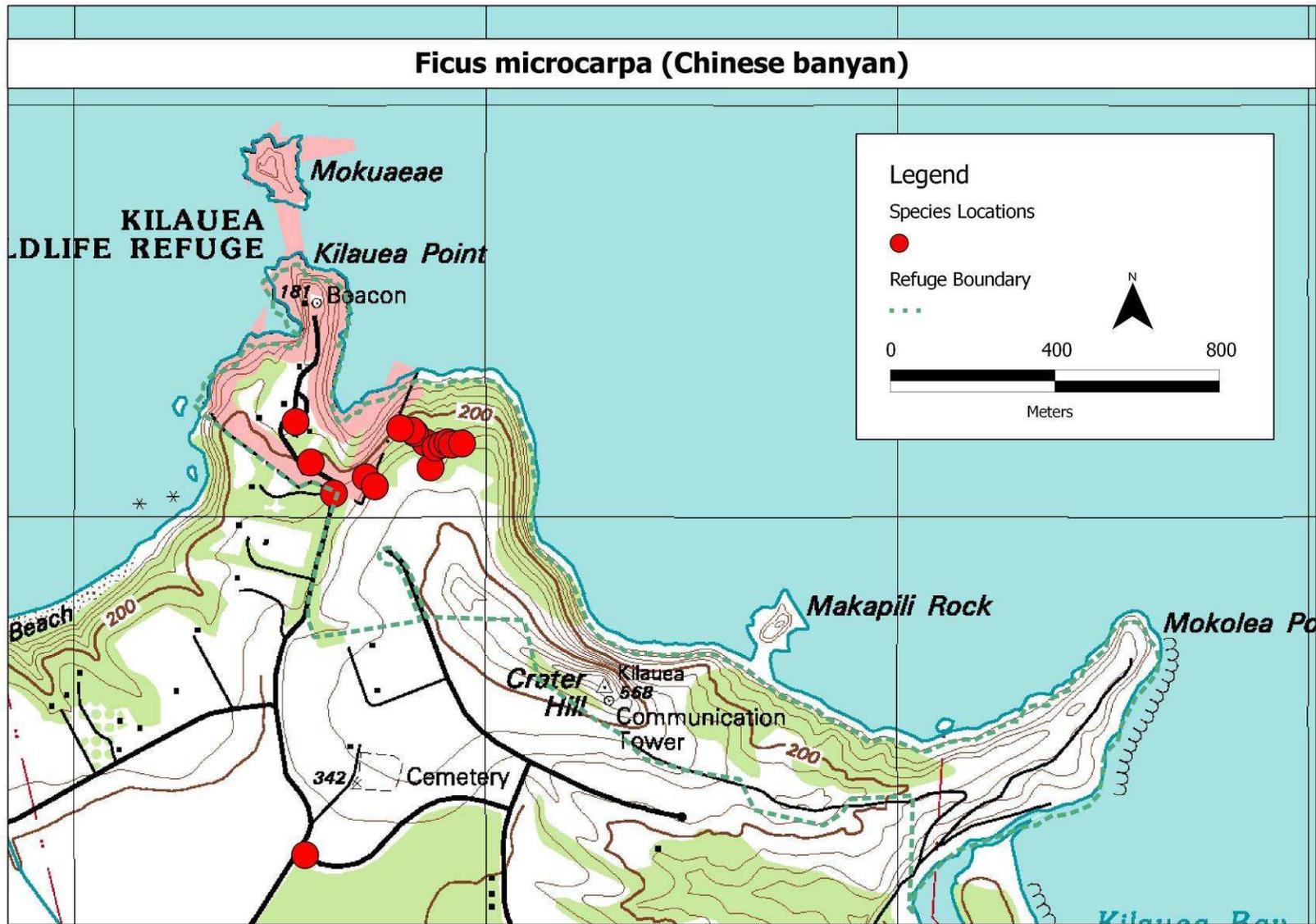


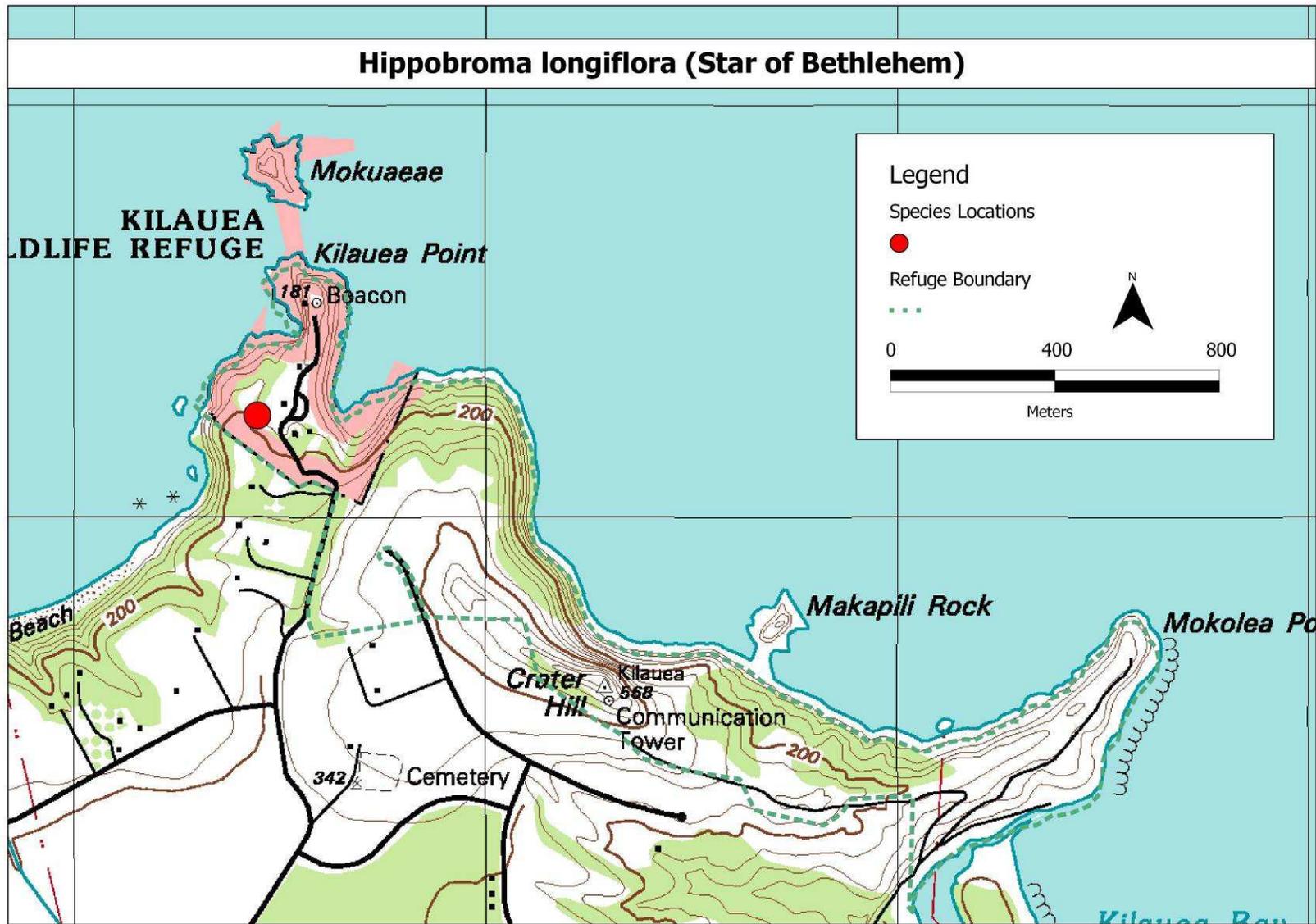




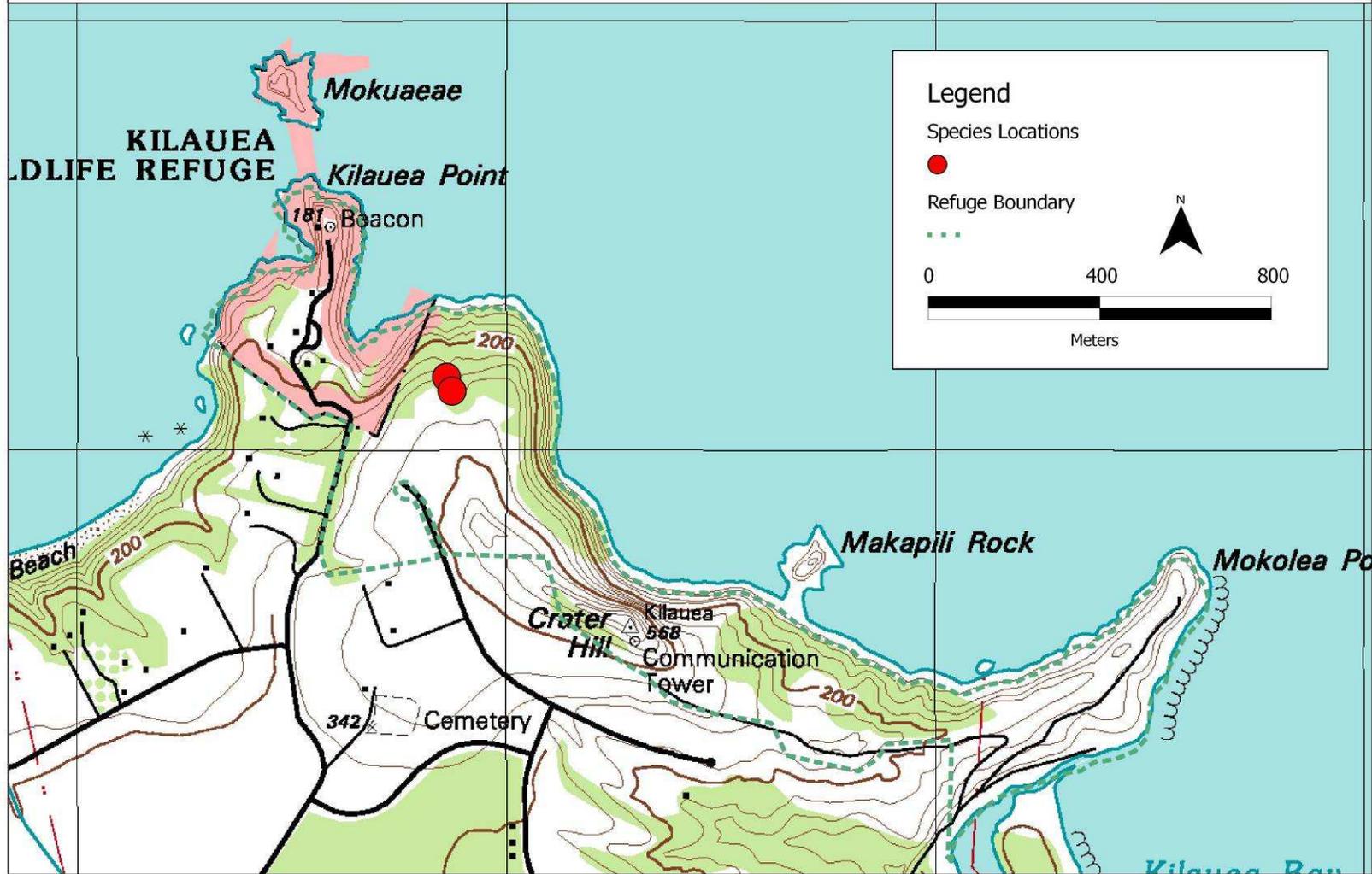


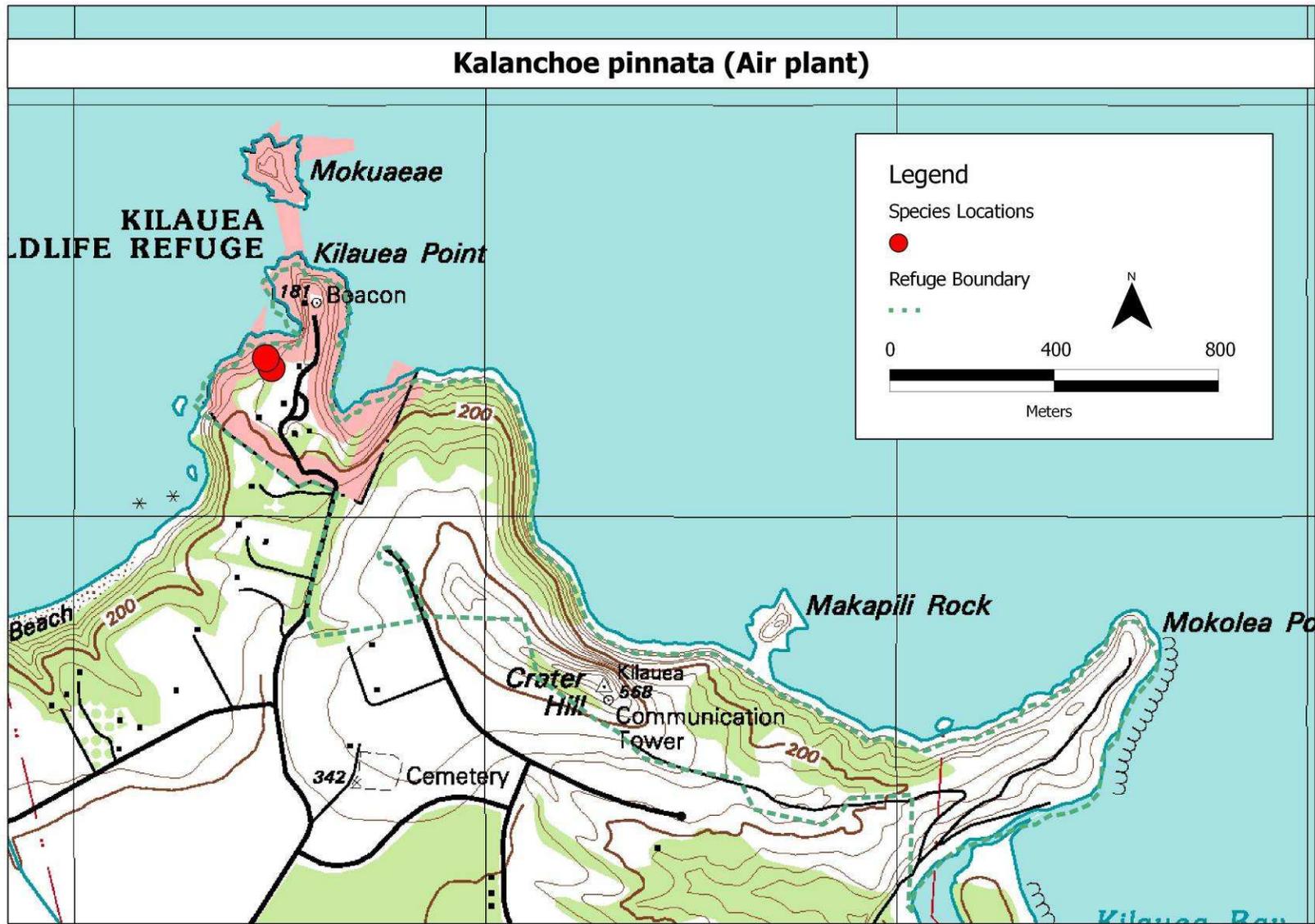


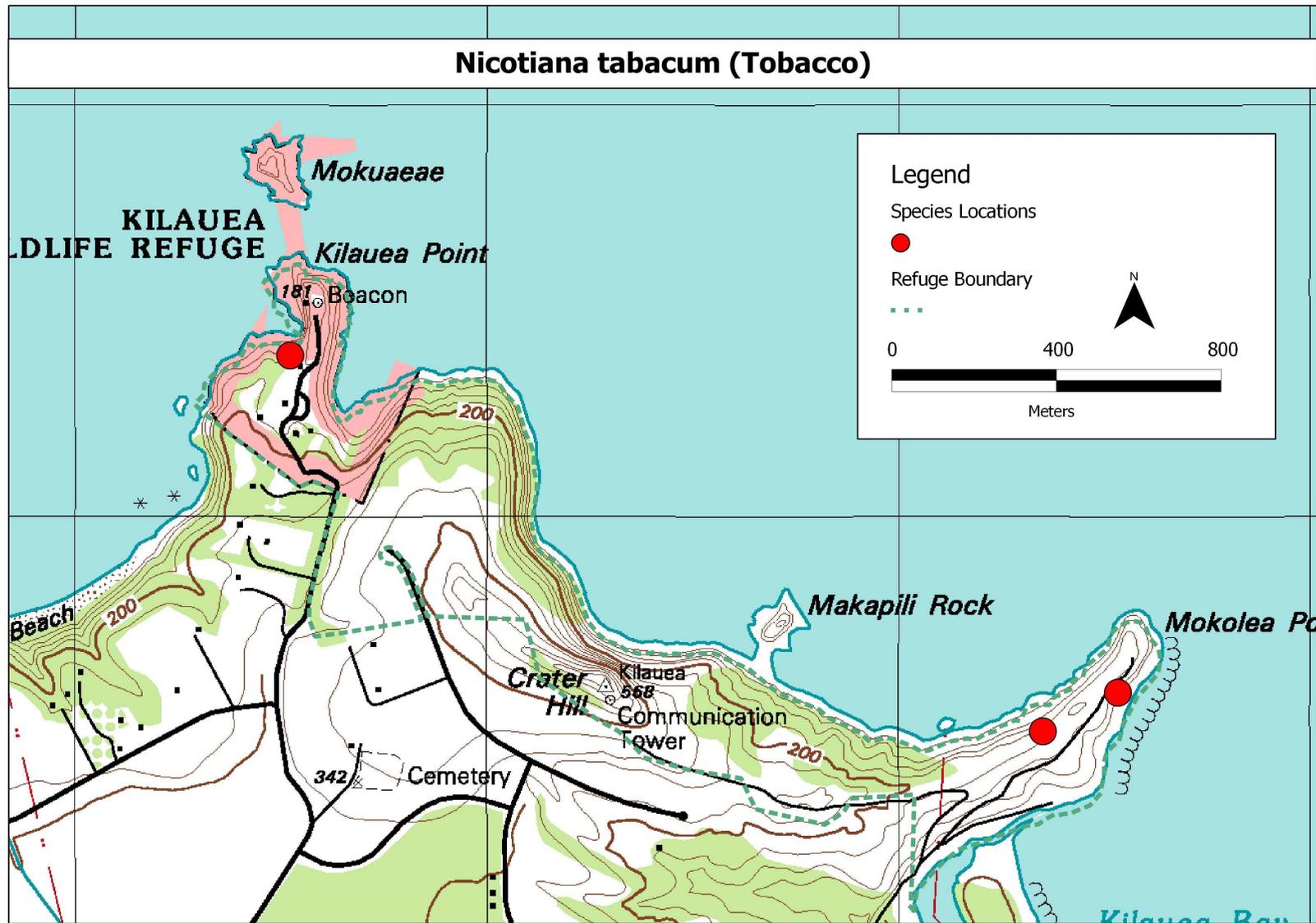




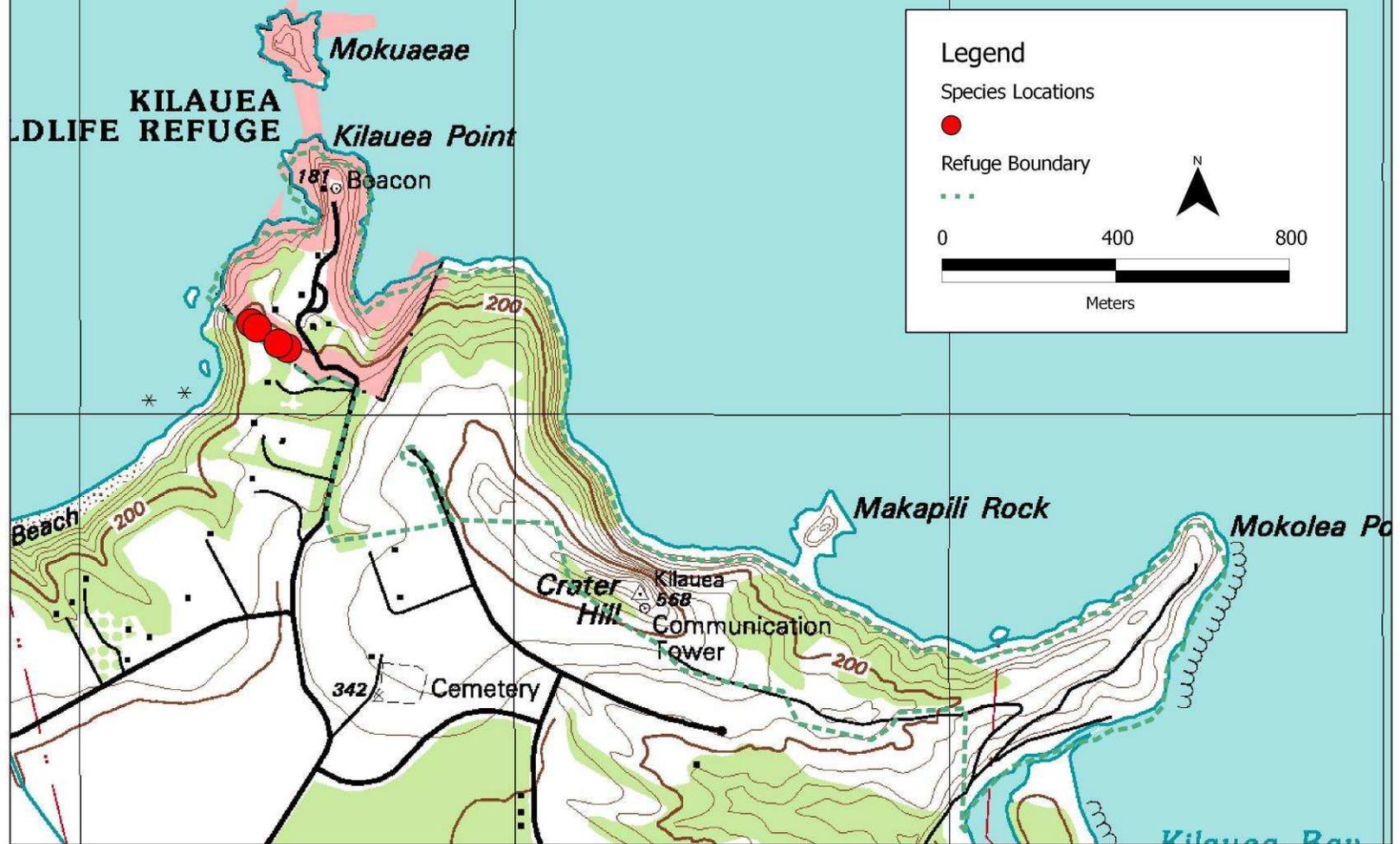
# Justicia betonica (White shrimp plant)

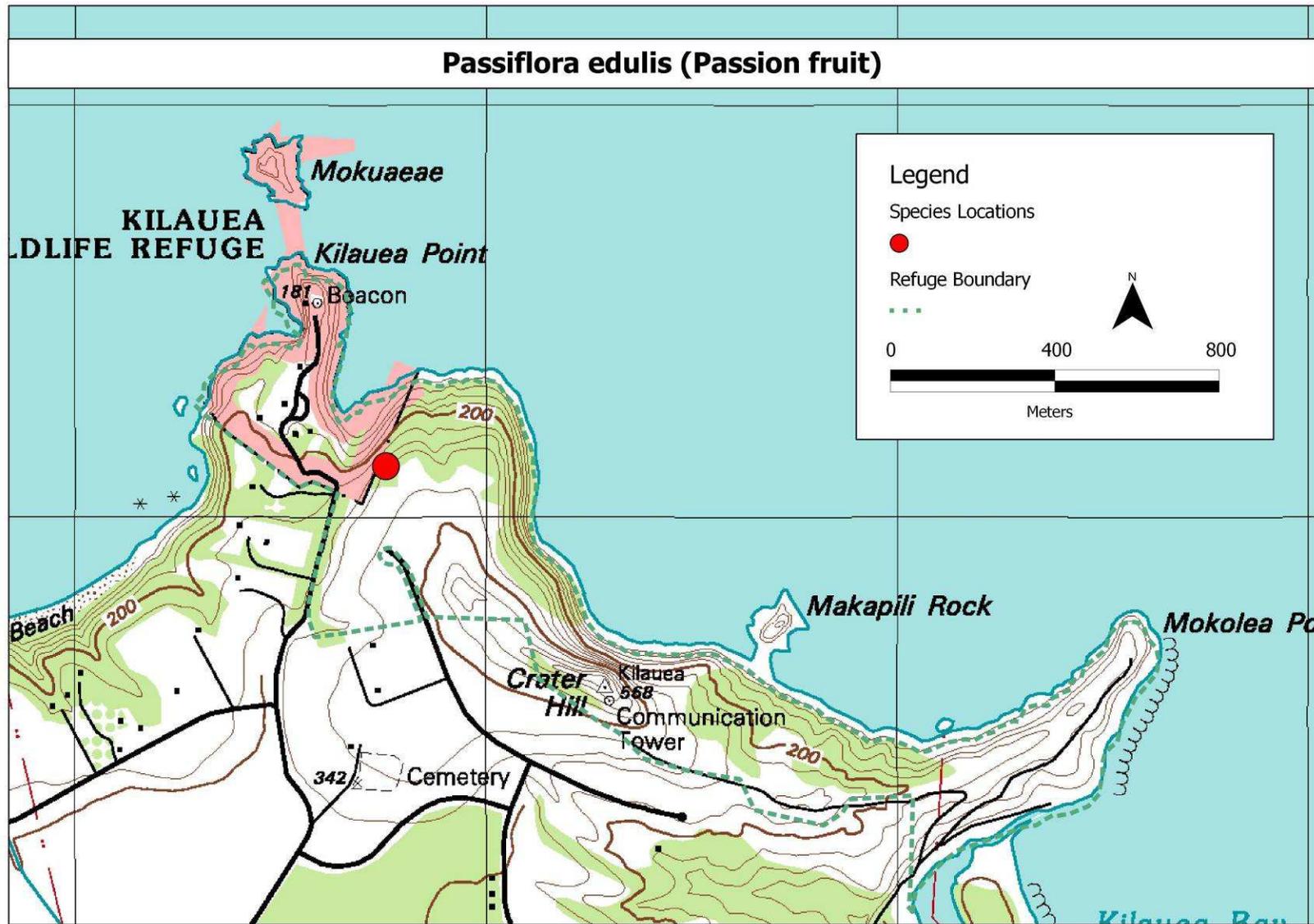


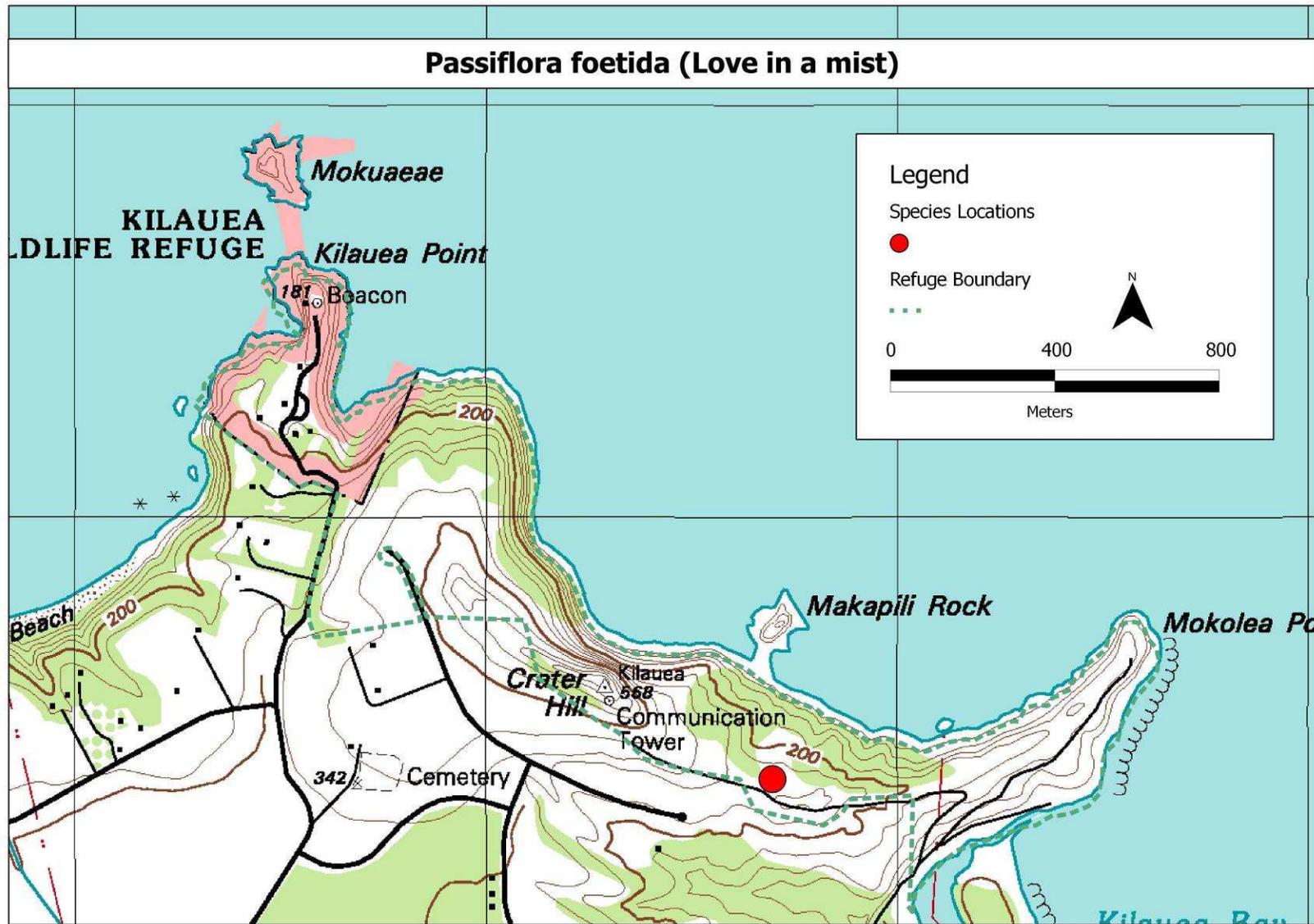


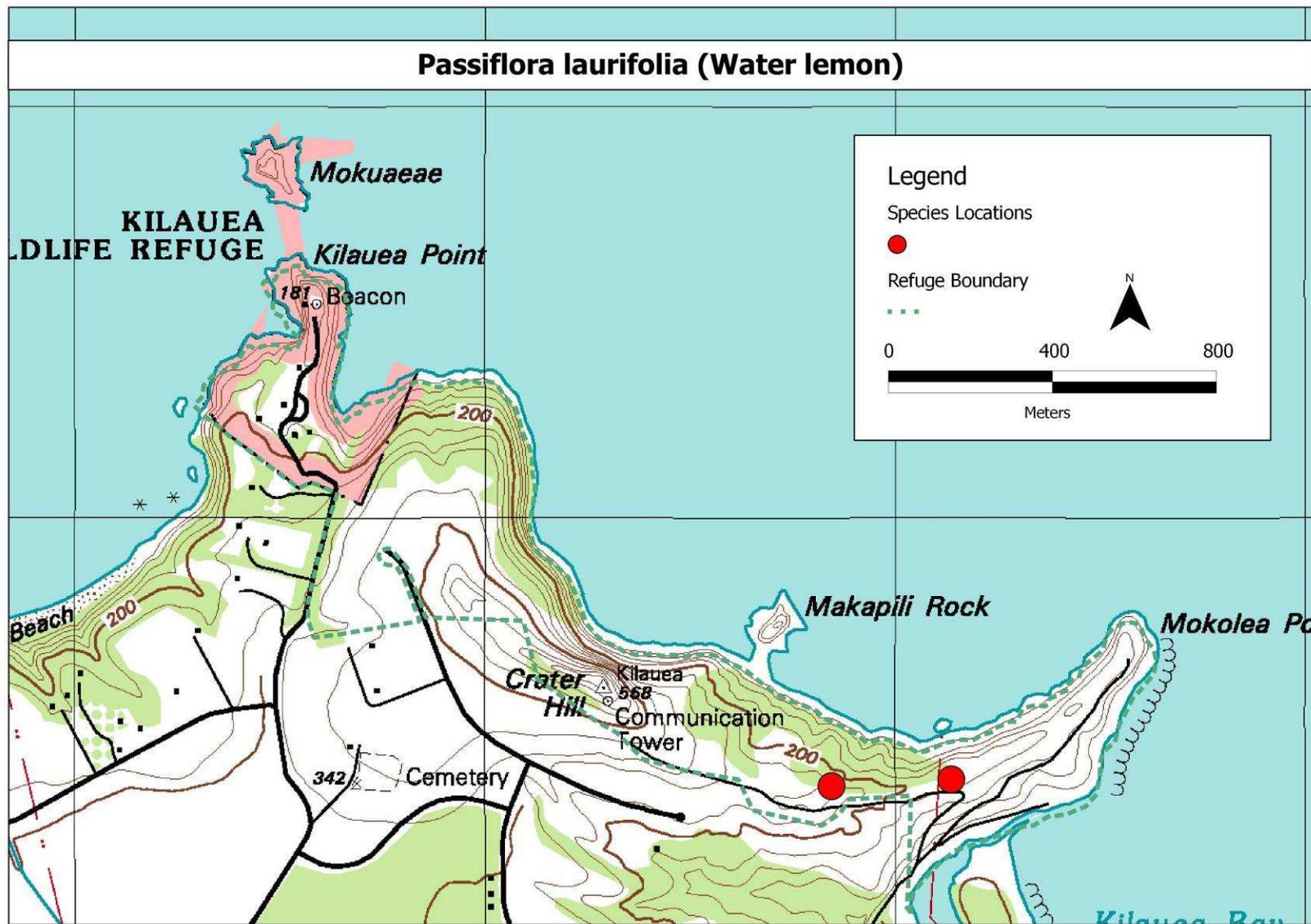


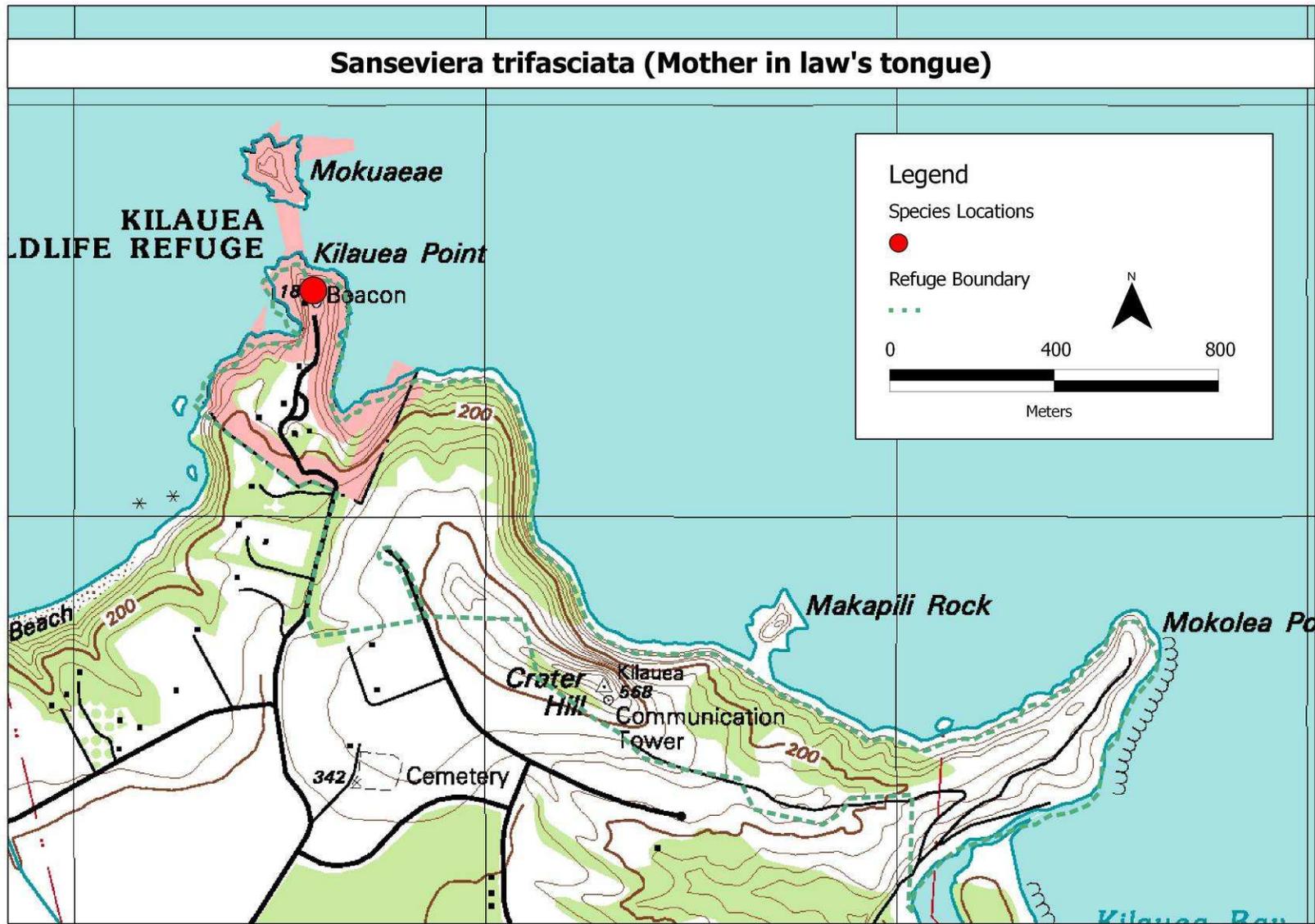
# Noronhia emarginata (Madagascar olive)

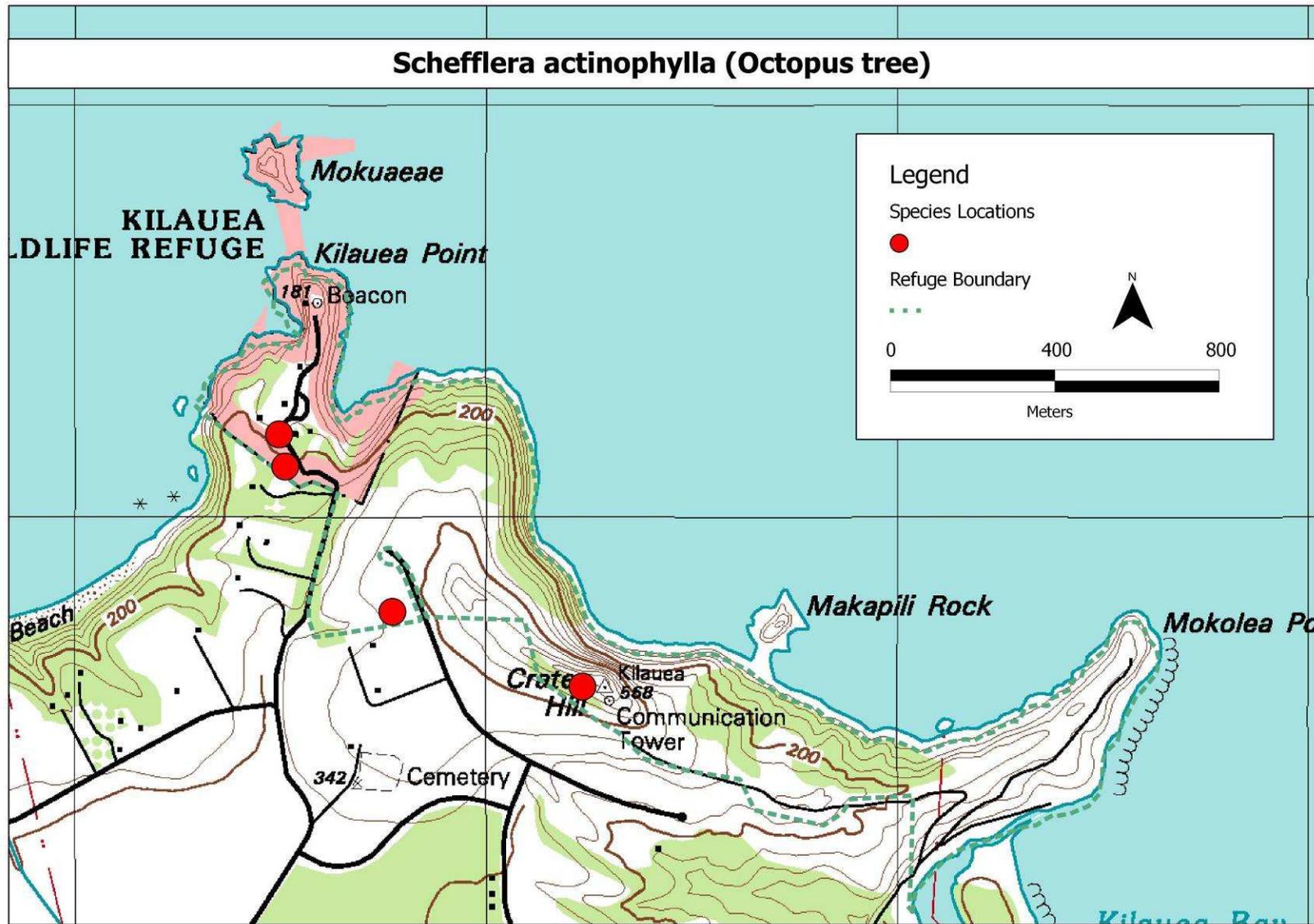


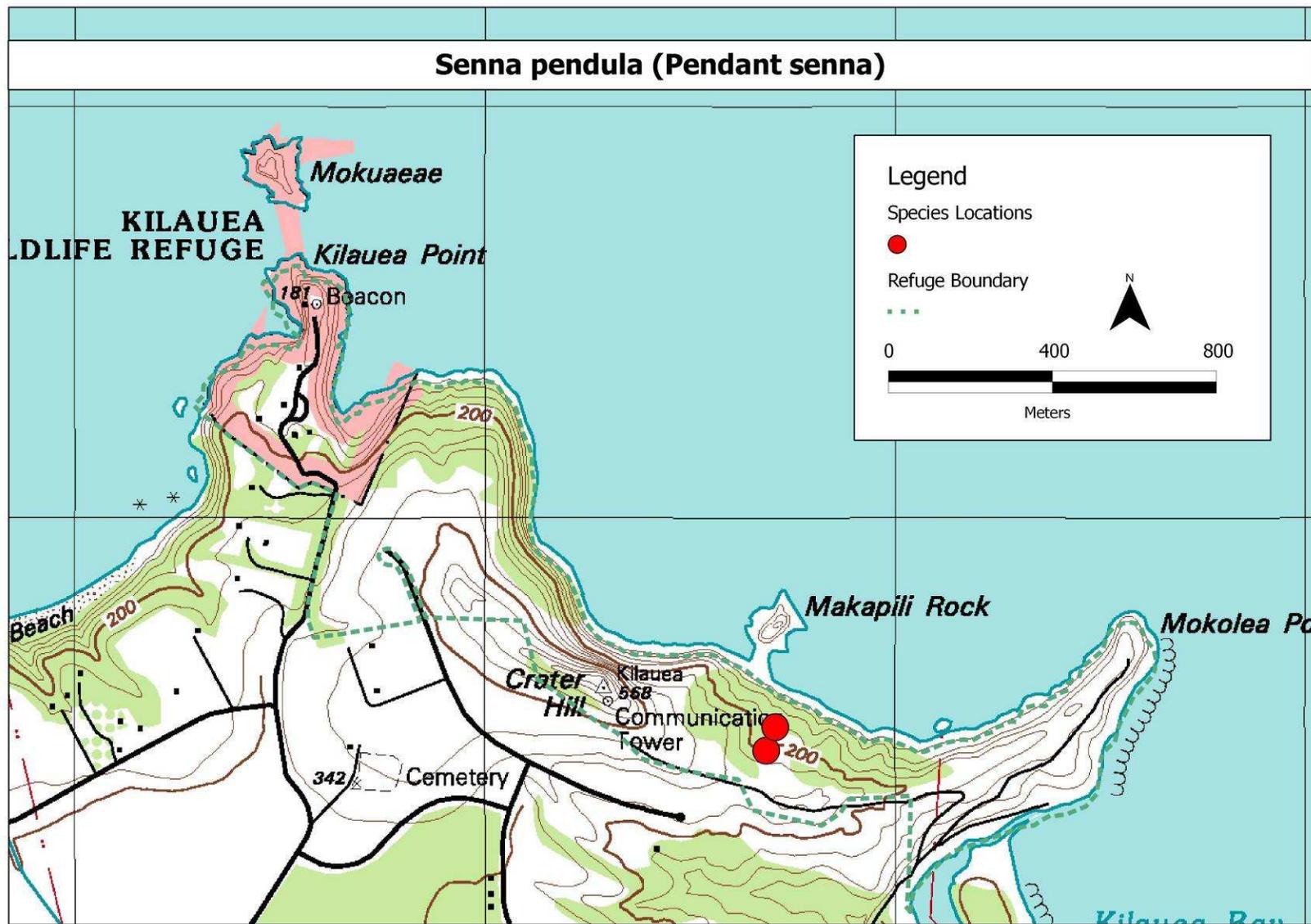


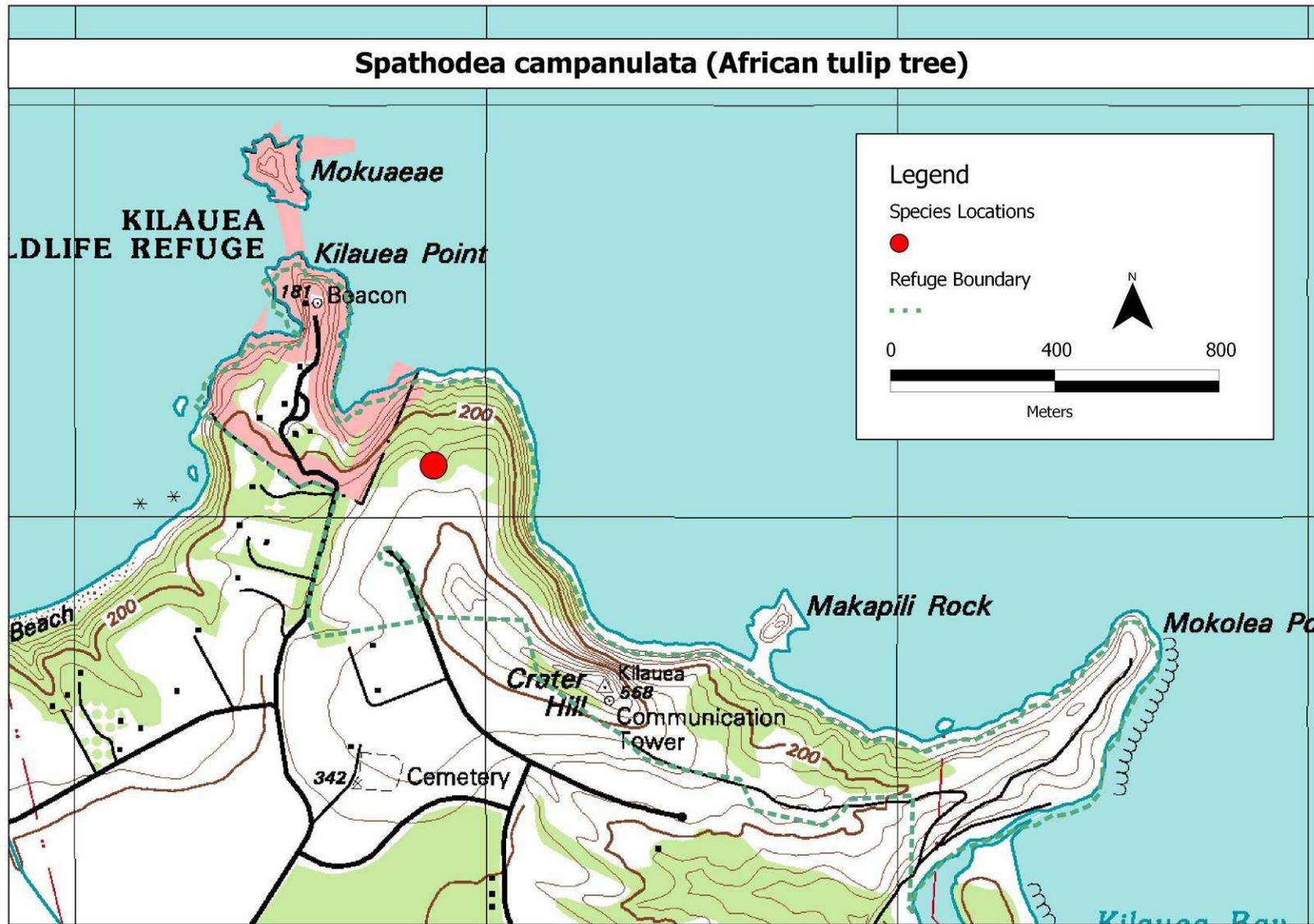


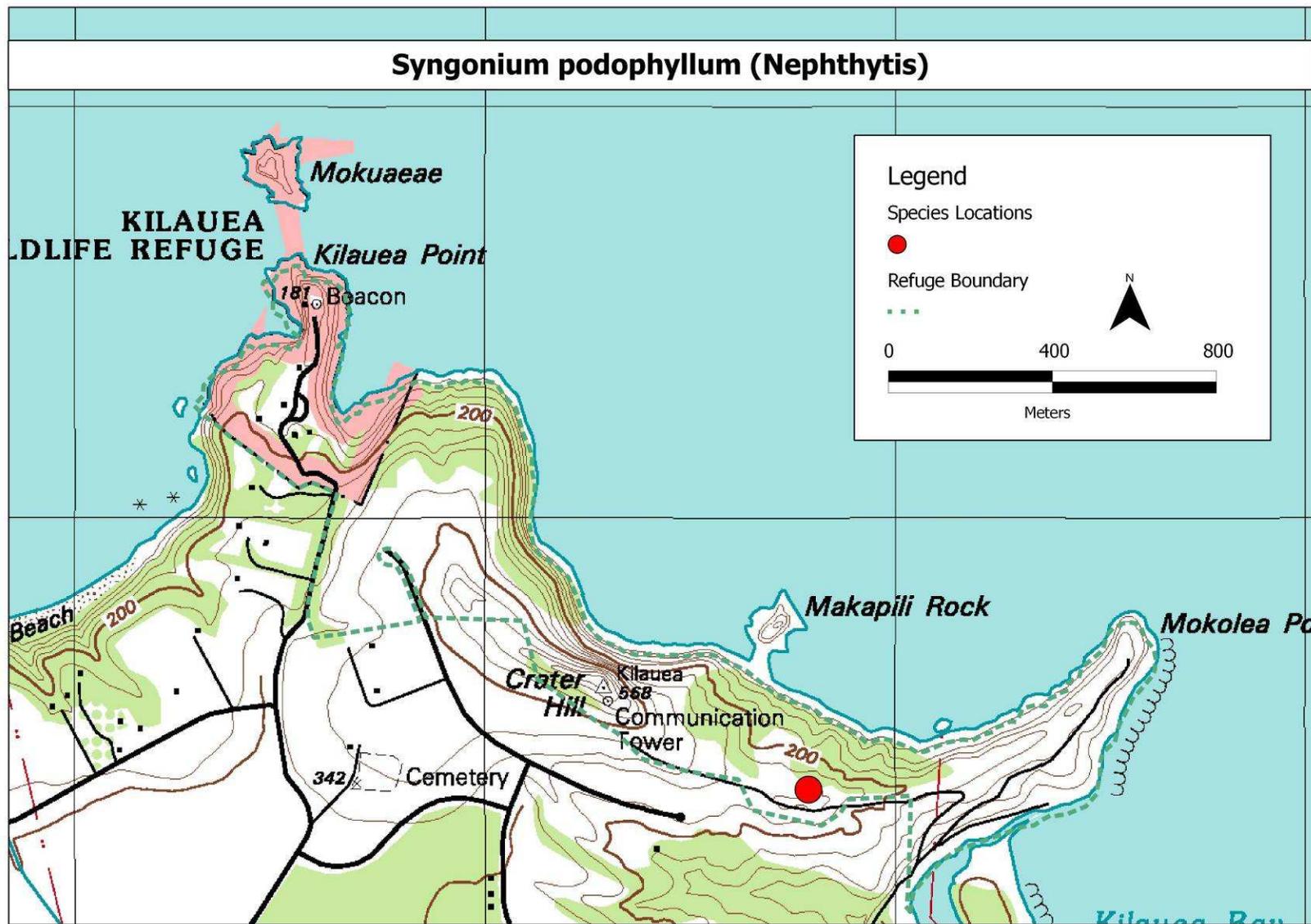


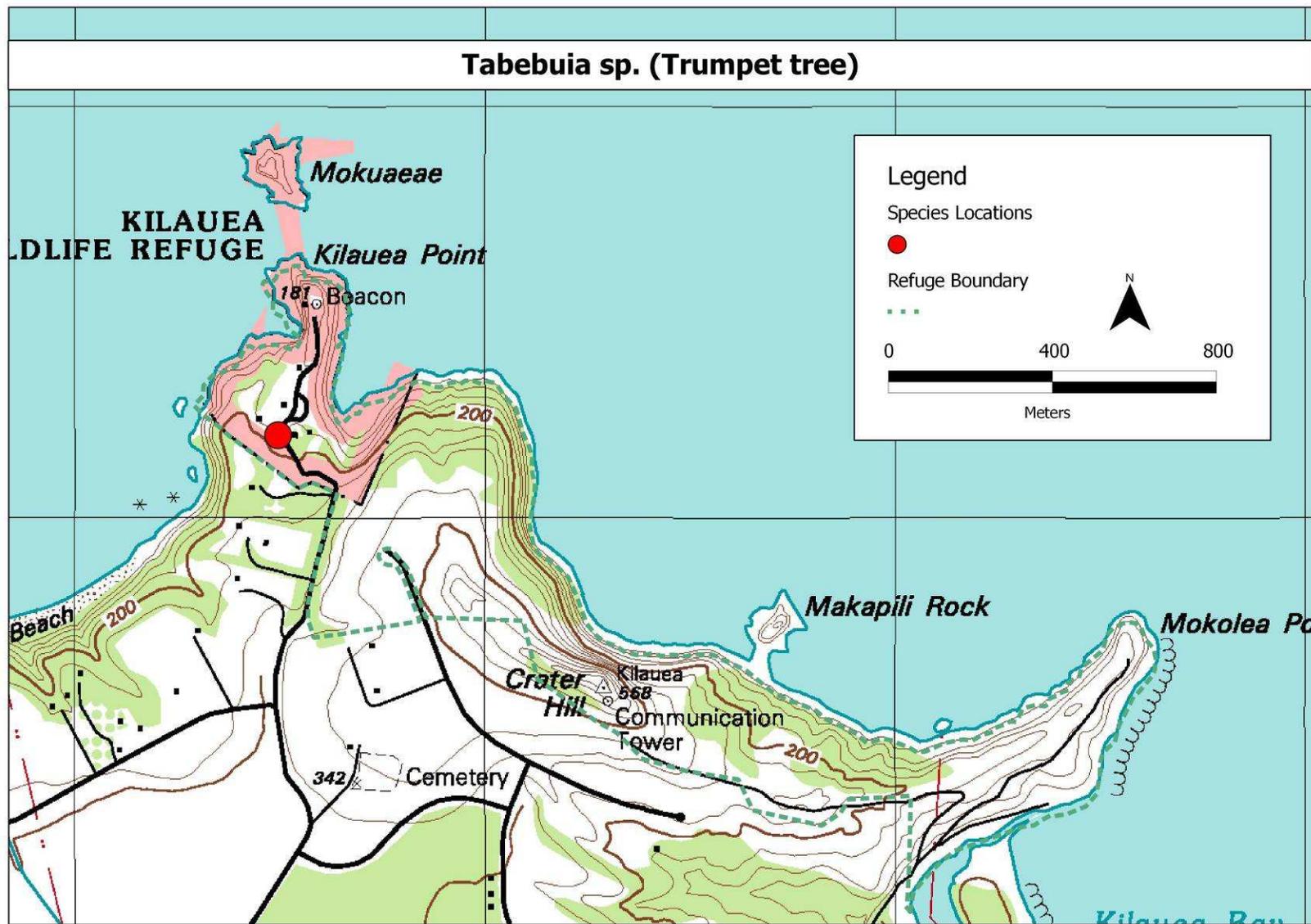




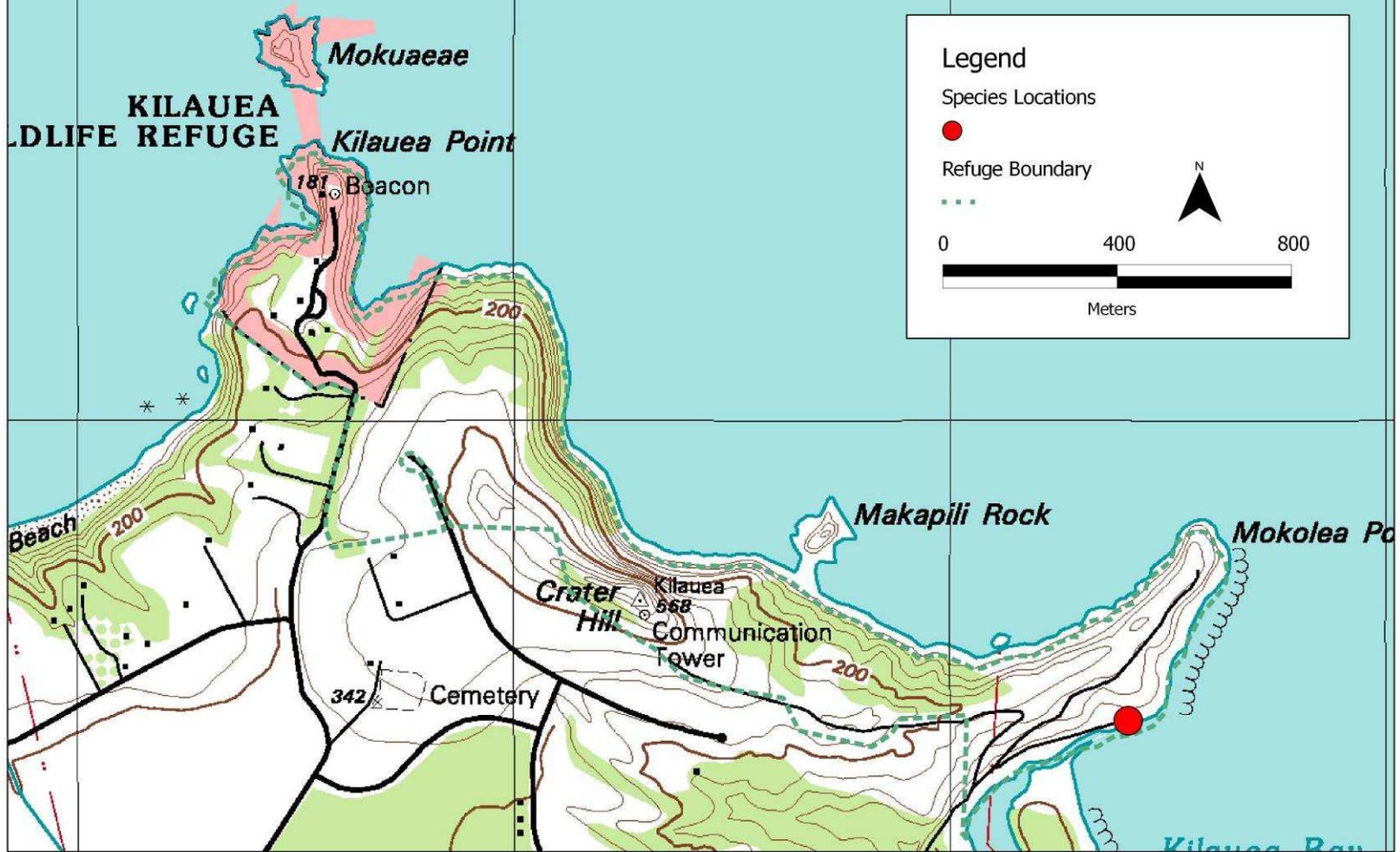




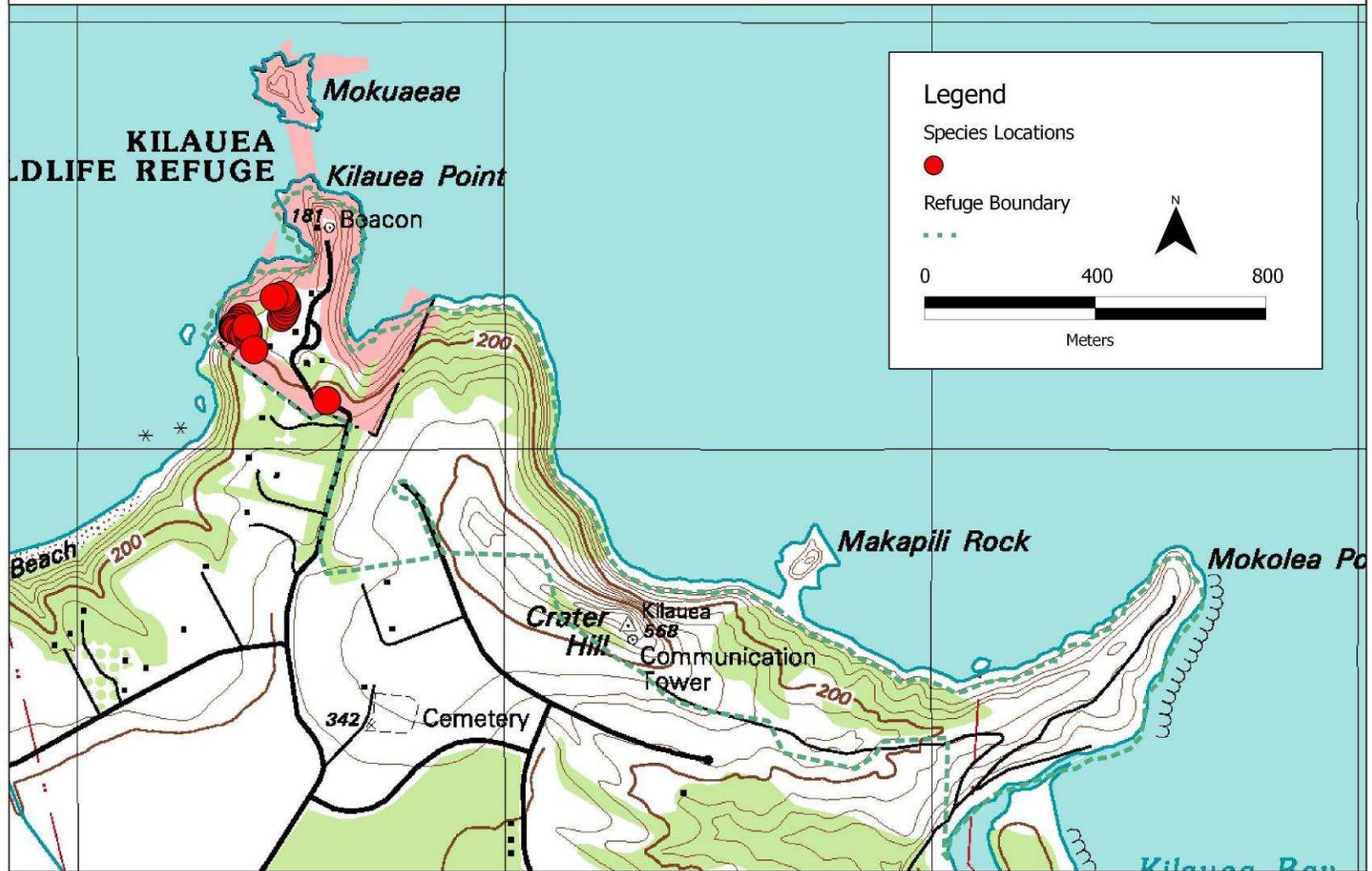




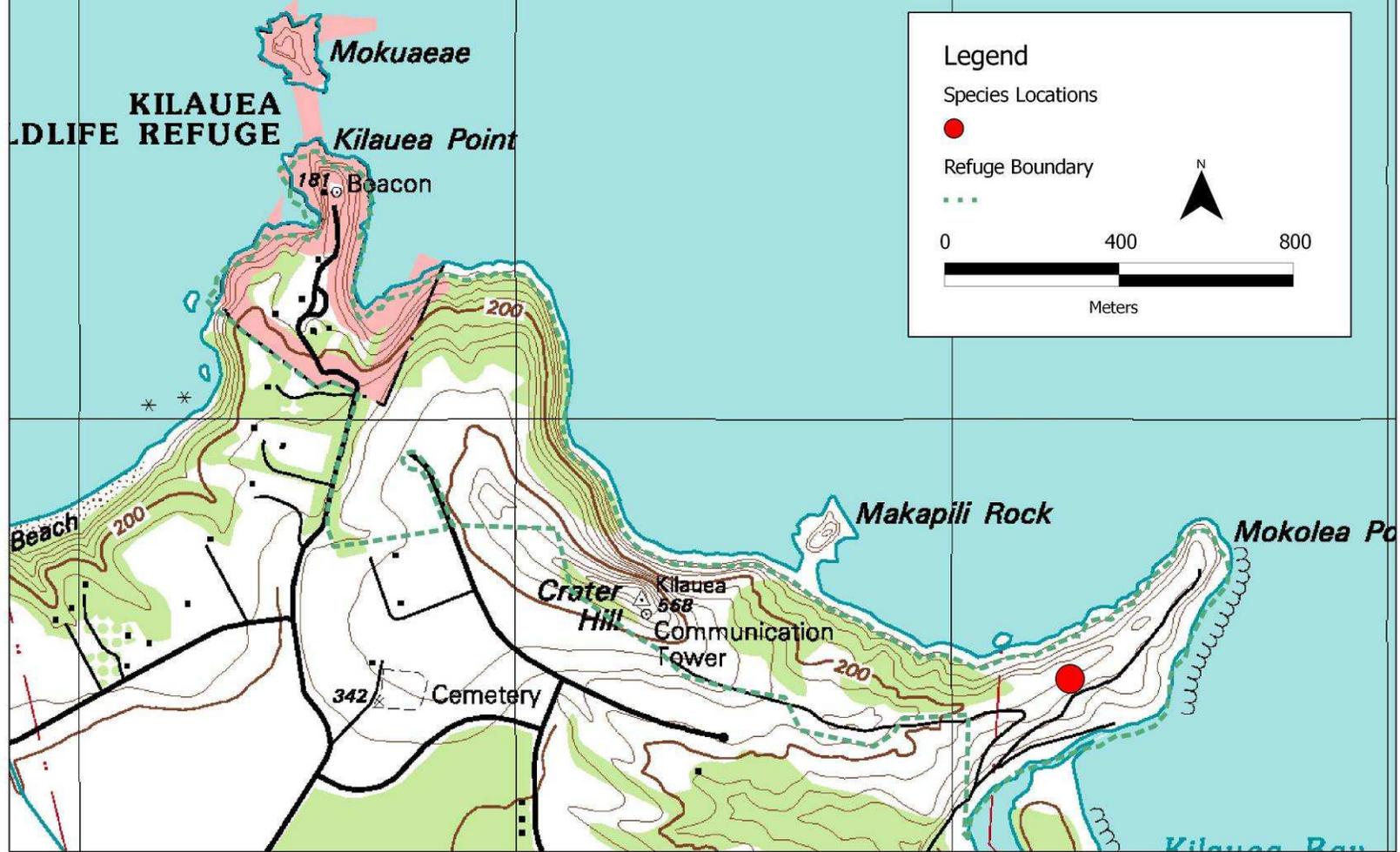
## Tetragonia tetragonioides (New Zealand spinach)



### Thevetia peruviana (Be-still tree, yellow oleander)

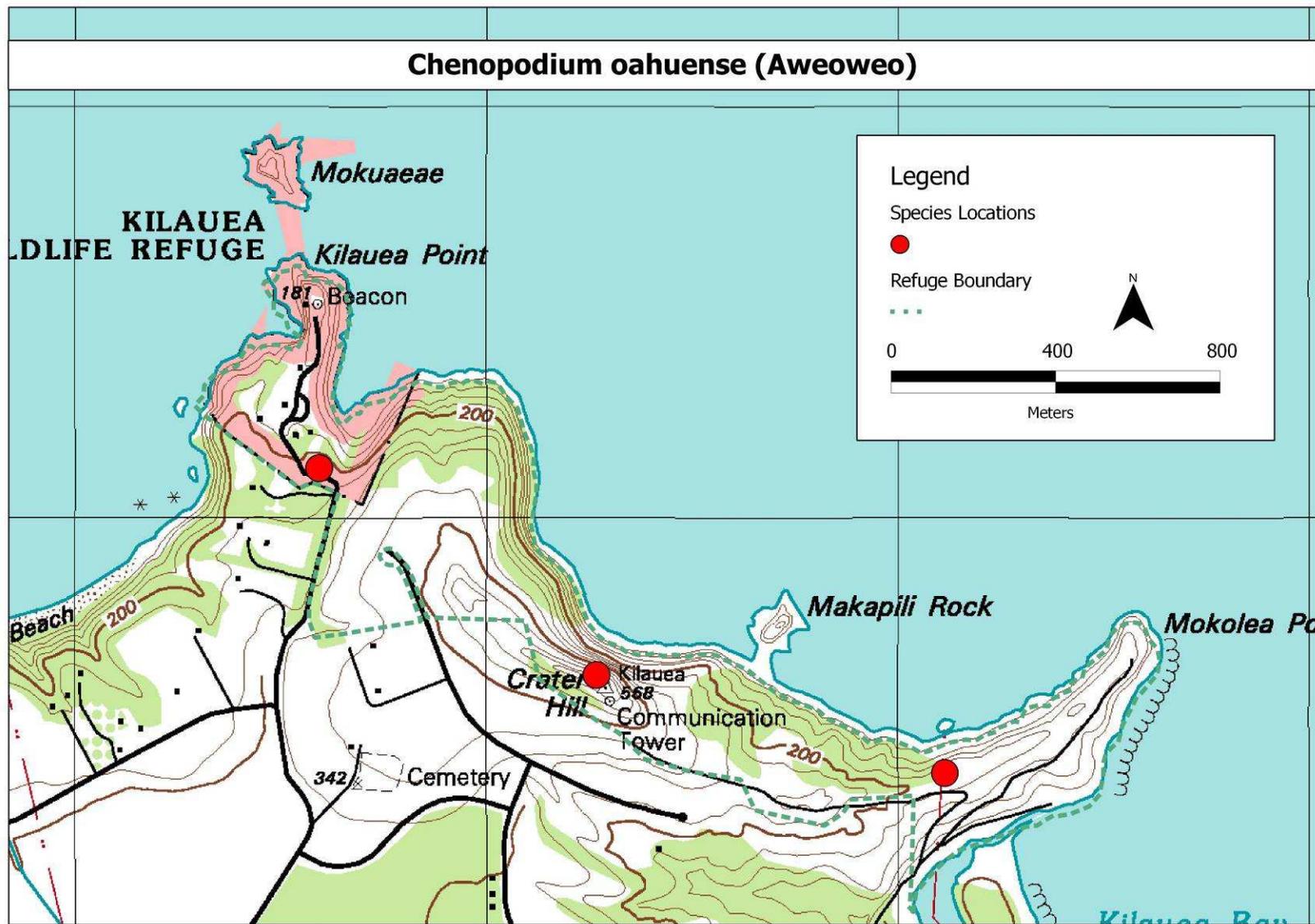


# Xanthium strumarium (Cocklebur)

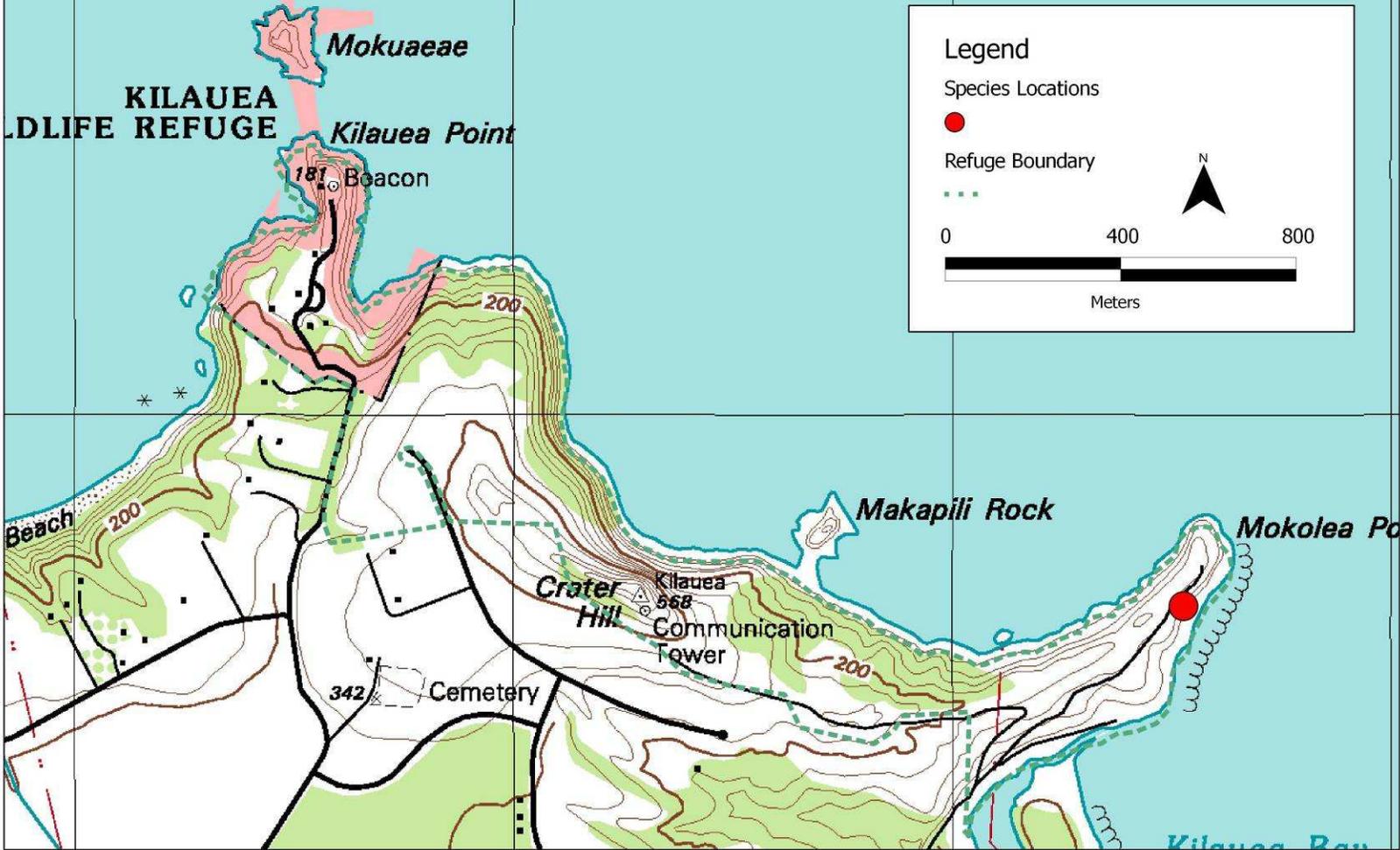


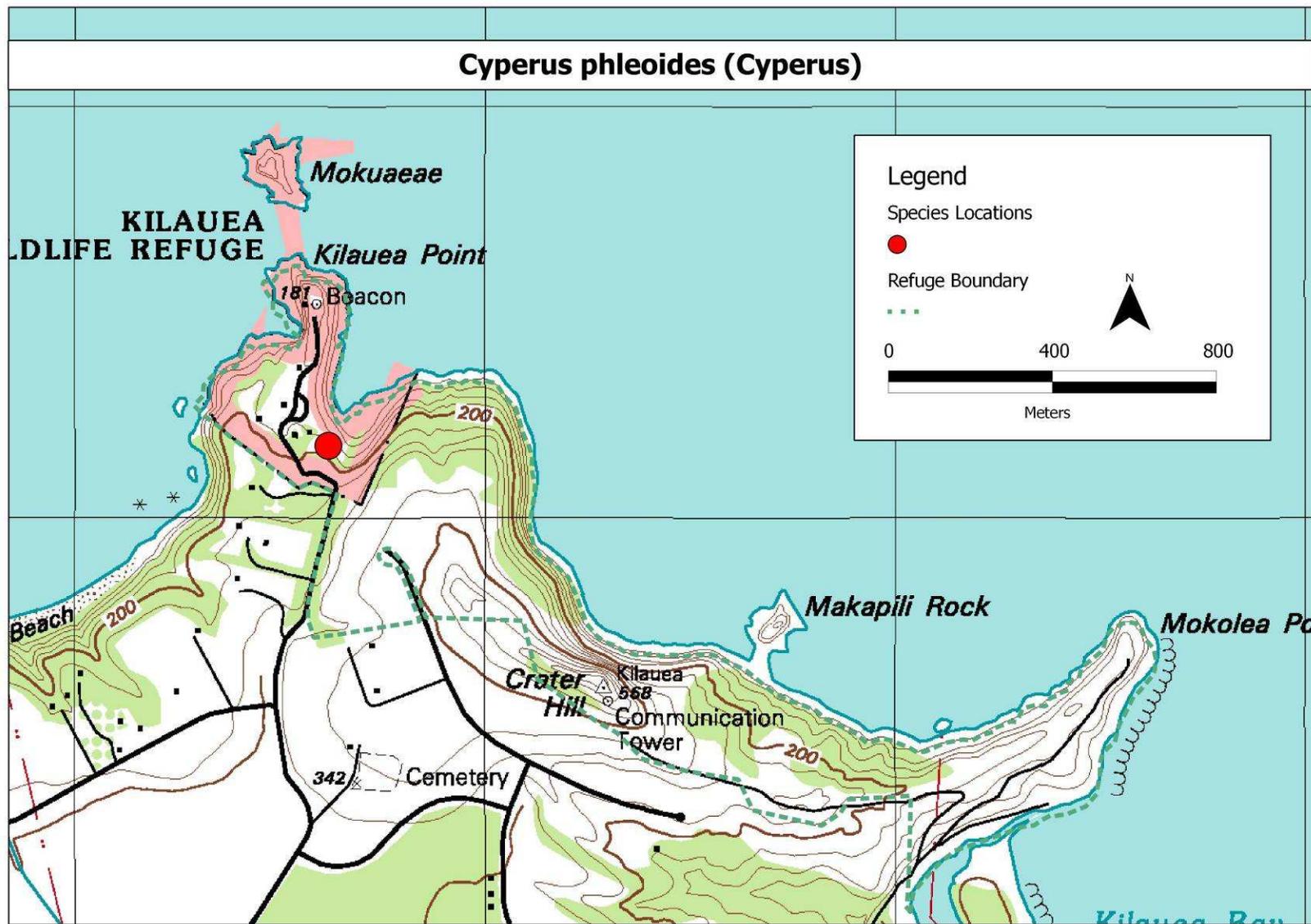
## NATIVES

- *Chenopodium oahuense* (Aweoweo)
- *Cyperus javanicus* (Ahuawa)
- *Cyperus phleoides* (Cyperus)
- *Fimbristylis cymosa* (Mauu Akiaki)
- *Jacquemontia sandwicensis* (Pau o Hiiaka)
- *Lipochaeta succulenta* (Nehe)
- *Lycium sandwicense* (Ohelo kai)
- *Panicum torridum* (Konakona grass)
- *Plectranthus parviflorus* (Alaalawainui wahine)

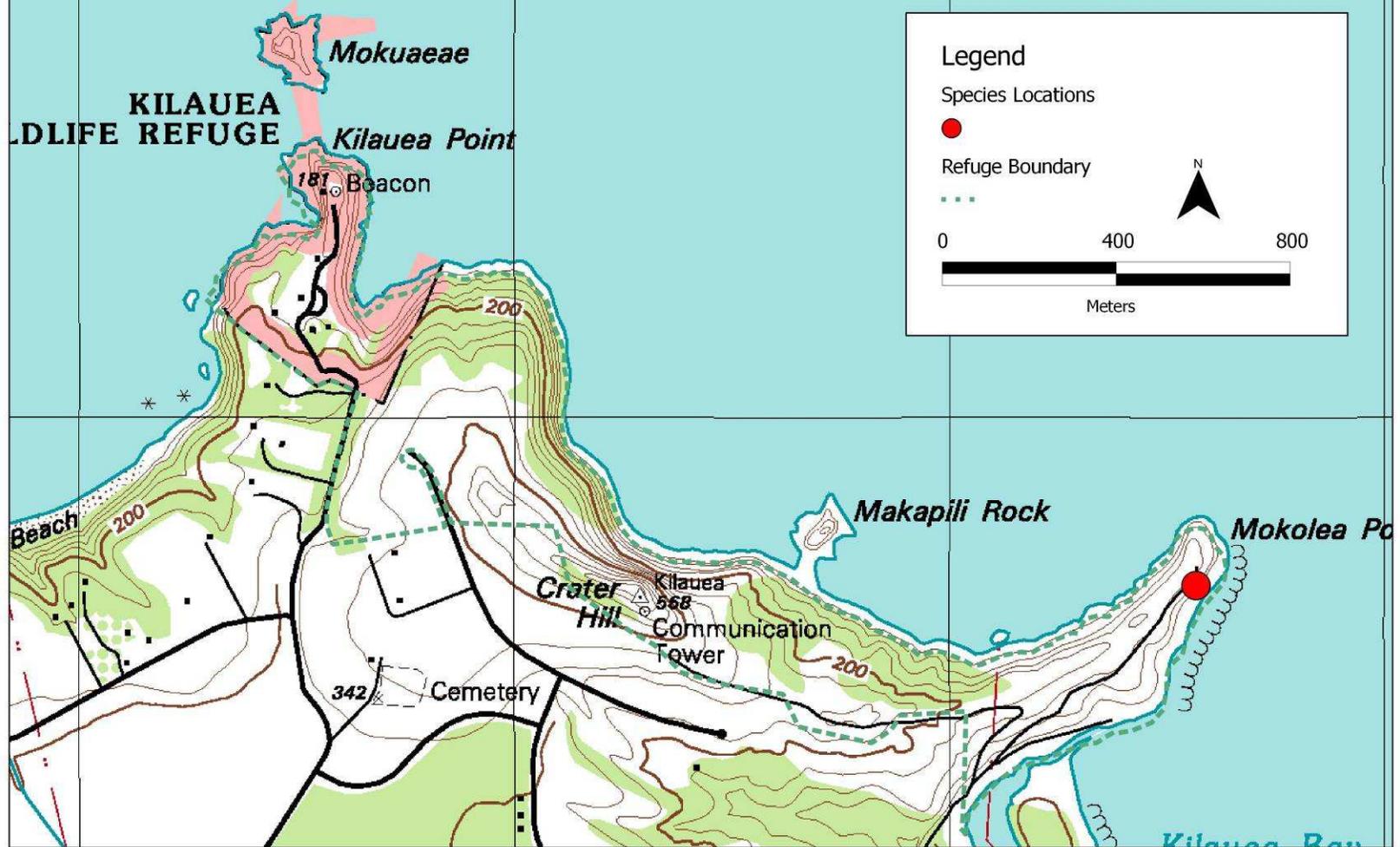


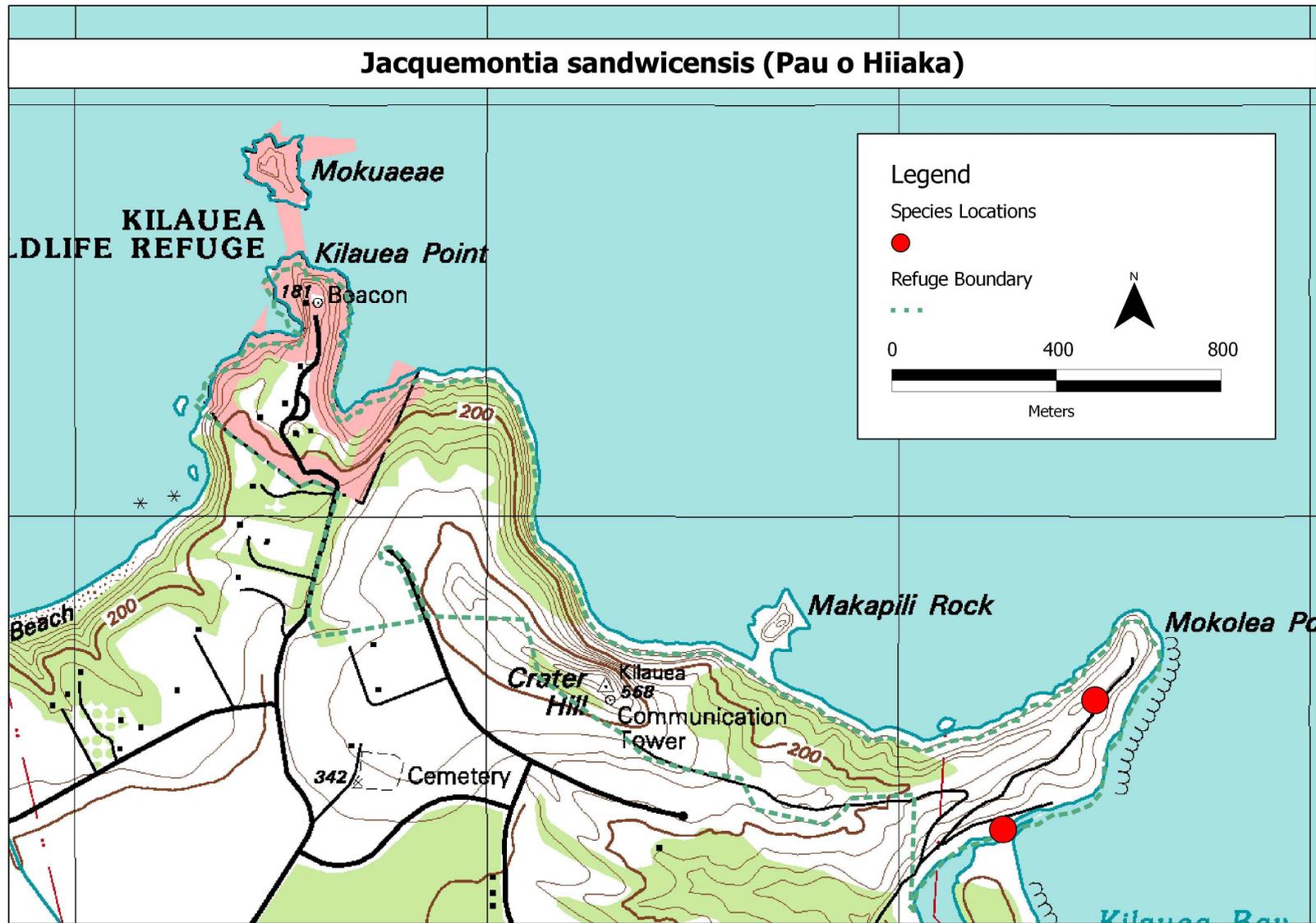
**Cyperus javanicus (Ahuawa)**





# Fimbristylis cymosa (Mauu akiaki)





# Lipochaeta succulenta (Nehe)

