

ROADSIDE SURVEY AND EXPERT INTERVIEWS FOR SELECTED PLANT SPECIES ON MOLOKAI, HAWAII

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ABSTRACT

Hawaii is home to many unique native plants and animals which are threatened by invasion and competition of aggressive non-native organisms. Natural area managers employ numerous strategies to combat invasive non-native species. One strategy in the fight against alien plant invaders is early detection, which seeks to find weeds early, before they become widespread, cause ecological damage, and become more costly and less feasible to remove. The island of Molokai, Hawaii offers many opportunities for prevention and early detection due to its small size, relative isolation, and limited access points.

The Molokai Invasive Species Committee (MoMISC) works to prevent and detect plant species early as part of their overall strategy to combat invasive weeds. To assist in their early detection efforts, we conducted a roadside survey of 126 target incipient weed species on Molokai, in May 2005, using methods derived from a previous roadside survey on Maui. All the main roads on Molokai were driven and target species were mapped using a global positioning system to mark locations. Any unknown or new plants were collected and have been accessioned at Bishop Museum. Experts with botanical knowledge of Molokai were consulted throughout the process.

During road surveys and expert interviews we located 45 out of 126 target species on Molokai. During the road survey, we drove 142 miles of roads and found 986 locations for 41 species. Expert interviews, existing gps data, and literature searches added 291 locations for 10 species, of which 4 were not observed at all during road surveys. We collected 28 plant species, of which, 19 were new island records for Molokai. Most of the target species (81 out of 126) were not found at all. Many of the target species mapped were found in limited distribution, including invasive weeds such as *Bassia hyssopifolia* (Bassia), *Cryptostegia* spp. (rubber vine), *Salsola tragus* (tumble weed), *Sphaeropteris cooperi* (Australian tree fern), and several *Thunbergia* species. Species with limited distribution and high potential threat could be further examined for rapid response.

While it is recognized that road surveys and expert interviews may miss locations, they provide a cost effective way of finding general distribution data for selected species. This survey was useful in showing which of the selected target species were present on Molokai and how widely distributed they were across the island. Targets that were not found or were found in limited numbers can then be prioritized for prevention and early detection efforts, including more focused surveys. Road surveys can be enhanced through a variety of other methods, including expert interviews, literature searches, and further searches on foot, four wheel drive vehicles, or helicopters.

The results of this survey show that roadside surveys are a useful tool in early detection efforts and that there are numerous prevention and early detection opportunities on Molokai. These survey methods could be adapted and used elsewhere by others seeking to use early detection as part of their overall weed strategy.

INTRODUCTION

Early detection methods are currently being tested and refined in Hawaii to address weeds before they become widespread. It is hoped that by finding weeds earlier, costs will be reduced, feasibility of successful removal will be increased, and damage to biological diversity will be minimized.

A roadside survey for approximately 126 incipient non-native plant species was done on May 16-May 19, 2005 by Forest Starr and Kim Starr, United States Geological Survey (USGS). On May 18, 2005, we were accompanied by Lori Buchanan and Mathew Hart, Molokai Invasive Species Committee (MoMISC). We modeled the survey after a roadside survey conducted on Maui in prior years and used similar methods and target species.

The purpose of this survey was to gather baseline distribution data for chosen target species and to collect any other plants that were unknown or new island records. The goal was to find invasive species which were still at an early stage of the invasion process that could be removed before they became more widespread. We also wanted to assess the effectiveness of roadside surveys on other islands and to highlight ways to improve methodology.

The following report summarizes our survey and includes distribution maps and an annotated checklist of target species found on Molokai. Images, maps, and reports produced during this survey will be available on the internet at the following web address: www.hear.org/starr.

METHODOLOGY

Methodology for the survey was derived from a similar survey completed on Maui in 2000 which proved useful in finding new locations of target species as well as finding new invasive species previously not known to be present. We began by deciding on a list of target species to look for and map. We chose the same target species from the Maui survey with additional species that were relevant to Molokai, including MoMISC targets and other species that were of concern to experienced folks on Molokai.

Once the targets were chosen, we gathered information and search images for each species by drawing on prior field experience, literature searches, and information and images on-line. We also reviewed on-line herbarium databases including those of Bishop Museum (BISH) and Smithsonian Institute (USNM) for collections of target species on Molokai.

Once on Molokai, we drove all the publicly accessible paved roads at about 5-10 mph. With two of us in the car, we each scanned our side of the road. When we came across one of our target species, one of us recorded the location on the gps and the other took notes regarding species name, naturalized status, and miscellaneous notes. We used a Garmin eTrex global positioning system (GPS) unit to record locations. When possible,

digital images of target plants were taken. Once the survey work was done, we downloaded the gps data and notes into an ArcView program to create island wide distribution maps for each target. We then printed out the maps and asked those with botanical expertise on Molokai to review them and add any locations that were missed. Additional locations were also added from literature searches and by incorporating existing gps data.

In addition to searching for the target species, we were also on the look out for plants that we did not recognize or were new to Molokai. To prepare, we printed out a list of all species known to be naturalized on Molokai which we used to check if something needed to be collected or not. When found, voucher specimens were collected and stored in plastic bags in the refrigerator until we could return to Maui to process them. When collecting specimens, we also recorded notes on location and other characteristics. Upon return to Maui from Molokai, all plants were scanned, pressed, dried, and accessioned to BISH along with accompanying data.

RESULTS

Overview

We located 45 (36%) out of 126 target species on Molokai. We drove 142 miles of roads in 4 days and recorded 986 locations for 41 species. Expert interviews, existing gps data, and literature searches added 291 locations for 10 species, of which 4 were not observed at all during road surveys. Most of the target species were found in limited distribution, while some were widespread. There were 81 target species which were not observed during our survey. In addition, we collected 28 plant species, of which 19 were new island records.

Target species with widespread distribution

Some of the target species mapped were widespread across the island and well established. Out of 45 target species found, 8 (18%) species had >50 locations recorded for each. Widespread species on Molokai include the following: *Citharexylum spinosum* (fiddlewood), *Ficus benjamina* (weeping fig), *Ficus microcarpa* (Chinese banyan), *Hyparrhenia* spp. (thatching grass), *Pinus* spp. (pines) *Schefflera arboricola* (dwarf umbrella plant), *Schefflera actinophylla* (octopus tree), and *Washingtonia* spp. (California and Mexican fan palm). These widespread species are further along in their invasion stage and may require a different strategy, such as a site-led strategy where they are removed only when in direct threat to native species (such as within a National Park). It is not likely that these widespread species could be completely removed from the entire island, given current resources. Perhaps these species could be removed when found in or near high value sites.

Target species with medium sized distributions

This category represents species that are not fully widespread, but are not limited in distribution either. Out of 45 target species found, 11 (25%) species had >10-50 locations recorded for each. Medium-sized distribution species include the following: *Caesalpinia decapetala* (cat's claw), *Carmona retusa* (carmona), *Clusia rosea* (autograph

tree), *Ficus carica* (edible fig), *Ficus elastica* (rubber tree), *Ficus macrophylla* (Moreton Bay fig), *Ligustrum lucidum* (privet), *Livistona chinensis* (Chinese fan palm), *Ochna* spp. (Mickey mouse plant), *Passiflora laurifolia* (water lemon), and *Phormium tenax* (New Zealand flax). These species are beginning to leave the control priority stage and may be monitored further and evaluated for control based on their threat and proximity to natural areas, size of distribution, and available resources.

Target species with limited distributions

Many, over half, of the target species observed during our survey were found in limited distribution. Out of 45 target species found, 26 (58%) species had ≤ 10 locations recorded. Target species with limited distribution include: *Archontophoenix* spp. (Alexander palm), *Arundo donax* (giant reed), *Bassia hyssopifolia* (bassia), *Cestrum nocturnum* (night blooming jasmine), *Cortaderia* spp. (pampas grass), *Cryptostegia madagascariensis* (rubber vine), *Ficus lyrata* (fiddle leaf fig), *Ficus religiosa* (bo tree), *Ficus pumila* (creeping fig), *Hedychium gardnerianum* (Kahili ginger), *Leptospermum* spp. (tea tree), *Lonicera japonica* (Japanese honey suckle), *Merremia tuberosa* (wood rose), *Olea europaea* subsp. *cuspidata* (African olive), *Olea europaea* subsp. *europaea* (European olive), *Pereskia aculeata* (Barbados gooseberry), *Pimenta dioica* (all spice), *Podranea ricasoliana* (pink trumpet vine), *Salsola tragus* (tumble weed), *Solandra maxima* (cup of gold), *Sphaeropteris cooperi* (Australian tree fern), *Tetragonia tetragonioides* (New Zealand spinach), *Thunbergia alata* (black eye Susan vine), *Thunbergia fragrans* (sweet clock vine), *Thunbergia grandiflora* (trumpet vine), and *Thunbergia laurifolia* (blue trumpet vine). These species are still within the control priority stage of invasion and could possibly be removed from the island, given appropriate resources.

Target species not found

There were 81 out of 126 target species (64%) not observed during our roadside survey. Some of these species include aggressive weeds known to be established on other Hawaiian islands, such as *Coccinia grandis* (ivy gourd), *Macaranga mappia* (bin gabin), *Melastoma* spp. (melastome), *Miconia calvescens* (miconia), *Rhodomyrtus tomentosa* (downy rose myrtle), *Rubus ellipticus* (Himalayan raspberry), *Senecio madagascariensis* (fireweed), and many more. These species are not yet known to be present on Molokai. Prevention and early detection still seem to be viable strategies for these species.

New island records

We made 27 collections of non-native plants on Molokai. Of these, 19 were new island records. There were 7 collections made of plants we did not recognize. We have not yet heard back on their identities. A few of the new island records include ones that could be evaluated for control by MoMISC, including *Salsola tragus* (tumbleweed), a single patch of which was found sparingly naturalized at the dump. This species is naturalized in similar dry areas of Maui, Kahoolawe, and Hawaii, and could potentially become a pest on Molokai if left unchecked.

Other species of interest

While searching for our target species, we came across a few species that were not on the list, but are known invasive species elsewhere. Two non-native invasive species of interest were observed, *Cupaniopsis anacardioides* (carrot wood) and *Prosopis juliflora* (long thorn kiawe), but not collected because they were on private property. Carrot wood is highly invasive in Florida where it spreads wherever it is planted. A single carrot wood tree was found in a yard in Maunaloa. Long thorn kiawe is a Hawaii state noxious weed and has been targeted for control by the Kauai Invasive Species Committee (KISC) and the Oahu Invasive Species Committee (OISC). A newly planted hedge of long thorn kiawe was found planted along a recently constructed house near Papohaku Beach. Both of these species could likely be removed from Molokai in a day.

Expert interviews and existing data

Limited interviews of botanical experts, literature searches, and incorporating existing MoMISC target species gps points helped reveal a few locations that were not recorded during road surveys. Additional locations were found for the following species: *Arundo donax* (giant reed), *Caesalpinia decapetala* (cat's claw), *Cortaderia* spp. (pampas grass), *Ficus macrophylla* (Moreton Bay fig), *Leptospermum* spp. (New Zealand tea), *Lonicera japonica* (Japanese honey suckle), *Merremia tuberosa* (wood rose), *Pereskia aculeata* (Barbados gooseberry), *Phormium tenax* (New Zealand flax), and *Pinus* spp. (pines).

Road survey methodology refinements

During the survey on Molokai, we found a few things that may help refine the "road survey" methodology in the future. It seemed that driving the roads in both directions helped increase detection of target species. The number of new locations found by driving both directions was generally small, but it became apparent that different angles can hide or expose plants in yards, and sometimes additional locations were found. We also found that detection ability increased when we drove slower, had more people in the vehicle, and searched for only a few targets at a time. There were many areas that were not accessible by passenger car, such as backyards, private properties, four wheel drive roads, and remote inaccessible natural areas. Expert interviews, literature searches, and complimentary surveys employing foot, four wheel drive, helicopter and remote sensing methodology should be used whenever possible to refine maps made from roadside vehicle surveys.

CONCLUSION

Identifying and removing invasive species at an early stage provides a cost effective tool for managing weeds on islands, and roadside surveys are an effective means to gather distribution information on incipient populations in areas where they are likely to get started. On Molokai, we located 45 out of 126 (36%) target species. Many of these, over half, or 27 out of 41 target species, have distributions small enough (<10 locations island wide) that they could possibly be removed from the island. A majority of the target species, 81 out of 126 (64%), were not found at all. In comparison, on Maui, 5 out of the 126 (4%) targets are not yet known to be present. During the survey on Molokai, many new island records were found and a few yet to be identified species were collected,

suggesting that further collections and surveys will help get a more complete list of the current flora on Molokai. That said, it appears many of the aggressive non-native plant species doing considerable damage on other Hawaiian Islands have apparently not yet reached Molokai, or are currently present in limited numbers.

ANNOTATED CHECKLIST OF TARGET SPECIES FOUND

The following checklist provides information for target species found during our survey on Molokai in 2005 and subsequent expert interviews and literature searches. For each entry is a scientific name, common name, family name, and brief description. The description includes information on native range, notes on cultivation and invasiveness, current known distribution in the Hawaiian Islands, and other miscellaneous notes.

***Archontophoenix* spp. -- Alexander palm -- (Arecaceae)**

A single *Archontophoenix* tree was observed cultivated on the east side near Pauwalu. Identification was not made to species level. *A. alexandrae*, native to Queensland, Australia, is a tall palm that is widely cultivated in tropical and subtropical regions of the world. In Hawaii, *A. alexandrae* is escaping from plantings and is naturalized in low elevation mesic to wet valleys on the islands of Hawaii and Maui (Wagner *et al.*, 1999; Starr pers. obs.). A similar species, *A. cunninghamiana* is also occasionally cultivated in Hawaii.

***Arundo donax* -- Giant reed -- (Poaceae)**

Arundo donax was not observed during our roadside survey. Reported from expert interviews. It is known from a single planting in Kaunakakai and occupies about 800 sq. ft. (MoMISC). There has been some control work done by MoMISC. *Arundo donax*, native to the Mediterranean region, has long been cultivated throughout the world for use in making mats, roofing material, erosion control, and as an ornamental (Neal 1965, Wagner *et al.* 1999). *A. donax* has become invasive in several places where it has been planted, such as California and Florida, where it invades riparian areas and over-runs native plants and riverside habitat (Bodle, 1998; Dudley, 1998). In Hawaii, *A. donax* is cultivated and reported as naturalized in coastal areas, often in thickets, on Kaua'i, O'ahu, Maui, and Hawaii (Wagner *et al.*, 1999).

***Bassia hyssopifolia* -- Bassia -- (Chenopodiaceae)**

Bassia hyssopifolia was found as locally abundant in open disturbed areas of Kakahaia National Wildlife Refuge. *B. hyssopifolia* is native to Eurasia and widely naturalized. In Hawaii, it is a weed of low elevation wetland areas on Oahu, Molokai, and Maui (Staples *et al.*, 2002; Starr *et al.*, 2002; Wagner *et al.*, 1999).

***Caesalpinia decapetala* -- Cat's claw - (Fabaceae)**

Cat's claw was not observed during the road survey. Reported from expert interviews. *Caesalpinia decapetala* is a woody vine with sharp thorns and yellow flowers that forms impenetrable thickets (Wagner *et al.*, 1999). This native of tropical Asia can be found on Niihau, Kauai, Oahu, East Maui, Hawaii, and Molokai (Wagner *et al.*, 1999; MoMISC).

***Carmona retusa* -- Carmona -- (Boraginaceae)**

Carmona retusa was observed being cultivated and was naturalized in residential areas of Kualapuu, Kaunakakai, and Kawela. A collection (#050516-05) was made during this survey representing a new island record for Molokai. *C. retusa* is native from India to

Malay Peninsula and the Philippines. In Hawaii, *C. retusa* is spreading from plantings on Kauai and Maui (Lorence *et al.*, 1995; Starr *et al.*, 2003).

***Cestrum nocturnum* -- Night blooming jasmine -- (Solanaceae)**

Cestrum nocturnum was observed in cultivation at two locations, Kaluakoi and Maunaloa. *C. nocturnum*, native to the Antilles and Central America, is commonly cultivated in Hawaii for its fragrant flowers which bloom at night. *C. nocturnum* is spread by fruit eating birds and is naturalized on at least Kauai, Oahu, Maui, and Hawaii (Wagner *et al.*, 1999; Oppenheimer and Bartlett, 2000; Starr *et al.*, 2003).

***Citharexylum spinosum* -- Fiddle wood -- (Verbenaceae)**

Citharexylum spinosum is very popular and was widely cultivated and naturalized in Kaluakoi, Papohaku, Maunaloa, Mahana, Kualapuu, and Kakahaia. A collection (#050516-01) was made during this survey representing a new island record for Molokai. *Citharexylum spinosum*, native to the Caribbean, is cultivated in tropical areas for its attractive orange foliage, fragrant white flowers, and orange fruits. In Hawaii, this species is planted as an ornamental tree as well as a forestry tree. It is known to spread from plantings on the islands of Oahu and East Maui (Herbarium Pacificum Staff, 1998; Starr *et al.*, 2002).

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

Clusia rosea was fairly common in cultivation in the following areas: Kaluakoi, Papohaku, Maunaloa, Mahana, Kualapuu, Hoolehua, Kalamaula, Kaunakakai, and Pukoo. It was not observed as spreading yet. A native to tropical America, *C. rosea* is widely grown as an ornamental in tropical regions of the world. In Hawaii, *C. rosea* is commonly planted as a street, parking lot, or specimen tree. Plants readily spread from initial plantings, dispersed by fruit eating birds, to surrounding areas. Plants thrive in a variety of environments from dry barren lava landscapes to steep cliffs in wet areas. *C. rosea*, like strangler figs, can germinate in the crotch of other trees and grow as epiphytes. They send down aerial roots and will eventually smother the host tree. *C. rosea* is known to be naturalized on Kauai, Oahu, Maui, and Hawaii (Wagner *et al.*, 1999; Oppenheimer and Bartlett, 2000).

***Cortaderia* spp. -- Pampas grass -- (Poaceae)**

Pampas grass was not observed during road surveys. Location reported during expert interviews. On Molokai, *C. jubata* is reported from 3 plantings in Maunaloa, including several naturalized plants, which were removed in 2002 (MoMISC). Pampas grass, native to the Andes mountains, are commonly cultivated large tussock forming grasses that readily spread from plantings and have become serious weeds in many parts of the world, such as California, New Zealand, and Australia. *C. jubata* is now documented as naturalized on Maui (Loope and Medeiros, 1992; Meidell *et al.*, 1997; Wagner *et al.*, 1999).

***Cryptostegia* sp. -- Rubber vine -- (Asclepiadaceae)**

Cryptostegia spp. were occasionally observed in yards and climbing in roadside scrub from Kaunakakai east to Kupeke. A multi-acre infestation was observed in the coastal

lowland at Kamalo where scattered vines of different size classes were growing in the understory and climbing into the canopy of *Prosopis pallida* (kiawe) trees. Previously collected on Molokai by L. Buchanan. Collected again during this survey (#050517-04, (#050519-01). These collections represent a new island record for Molokai.

Cryptostegia species, *C. grandiflora* and *C. madagascariensis*, are widely cultivated and have become pests in places where they are introduced, including Australia, where *C. grandiflora* is a weed of national significance. *Cryptostegia* spp. are cultivated in Hawaii and are naturalized on at least Oahu, Molokai, Maui, and Hawaii, though proper publication of its status is lacking. On Maui, *Cryptostegia* spp. is a MISC target, and on Molokai it is being investigated as a potential target by MoMISC.

***Ficus benjamina* -- Weeping fig -- (Moraceae)**

Ficus benjamina was commonly planted in most residential areas and no signs of spread were noted. The weeping fig is widely cultivated in Hawaii and has not had its associated wasp introduced and therefore has not yet spread from initial plantings.

***Ficus carica* -- Edible fig -- (Moraceae)**

Ficus carica was observed in cultivation in Hoolehua, Kualapuu, Maalehu, Kaunakakai, Kawela, Kaluaaha, Pukoo, and Waialua. *F. carica* has been cultivated for a long time in various places worldwide for its edible fruit. Though *F. carica* can spread vegetatively, is generally not considered invasive in Hawaii today due to the unsuccessful introduction of its associated pollinator wasp (*Blastophaga psenses*) (Wagner *et al.*, 1999). However *F. carica* is considered invasive in Australia and California (Randall, 1998; CalEPPC, 1999). Should the associated wasp become established in Hawaii, there would be the potential for *F. carica* to begin spreading by seed.

***Ficus elastica* -- Rubber tree -- (Moraceae)**

Ficus elastica was occasionally planted in residential areas and no signs of spread were noted. The rubber tree is widely cultivated in Hawaii and has not had its associated wasp introduced and therefore has not yet spread from initial plantings.

***Ficus lyrata* -- Fiddle leaf fig -- (Moraceae)**

Ficus lyrata was sparingly cultivated in Maalehu and Kamalo and no signs of spread were noted. The fiddle leaf fig is occasionally cultivated in Hawaii and has not had its associated wasp introduced and therefore has not yet spread from initial plantings.

***Ficus macrophylla* -- Moreton bay fig -- (Moraceae)**

Ficus macrophylla was observed being cultivated in Maunaloa, Hoolehua, Kualapuu, Kalae, Kaunakakai, and Halawa. Some cultivated trees, especially at Maunaloa, were exceptionally large specimens. Naturalized plants were observed at Halawa and Kalae, germinating in other trees and on fence-posts. It is possible that there are other forestry areas where this species occurs that were missed during roadside surveys. Expert interviews revealed several naturalized trees located at Puu Keuwa. *F. macrophylla* is native to tropical Queensland and northern New South Wales in Australia (Riffle, 1998). In Hawaii, *F. macrophylla* has been widely planted in forestry plantations and is sometimes cultivated in botanical gardens and yards. The associated pollinator wasp,

Pleistodontes frogatti, was introduced to help facilitate forestry plantings. As a result, *F. macrophylla* is capable of reproducing and is now spreading from initial plantings to adjacent areas. Numerous fruits are born on mature trees, attracting fruit eating birds that disperse the small seeds. Seeds often germinate in host trees, such as *Acacia koa* (koa) and *Metrosideros polymorpha* (ohia) and grow as epiphytes, eventually replacing them. *F. macrophylla* has been documented as naturalized on the islands of Molokai, Maui and Hawaii (Oppenheimer, in press; Oppenheimer and Bartlett, 2000; Starr *et al.*, 2002).

***Ficus microcarpa* -- Chinese banyan -- (Moraceae)**

Ficus microcarpa was widely cultivated and naturalized in most areas surveyed, spreading from initial plantings. *F. microcarpa* is a popular ornamental tree grown widely in many tropical regions of the world. The pollinator wasp, *Parapristina verticillata*, has been introduced to a number of places where the tree is cultivated, including Hawaii, where it was purposefully introduced in 1938, allowing this species to spread beyond initial plantings. *F. microcarpa* is a notorious invader in Hawaii, Florida, Bermuda, and from Central to South America. In Hawaii, *F. microcarpa* is naturalized on the islands of Midway Atoll, Kauai, Molokai, Oahu, Maui, and Hawaii (Hughes, 1995; Lorence *et al.*, 1995; Wagner *et al.*, 1999; Starr *et al.*, 2002).

***Ficus pumila* -- Creeping fig -- (Moraceae)**

F. pumila was sparingly cultivated in Maunaloa and Kualapuu. No signs of spread were noted. Creeping fig is occasionally cultivated in Hawaii and has not had its associated wasp introduced and therefore has not yet spread from initial plantings, except in a few cases where old plantings are adjacent to wild lands.

***Ficus religiosa* -- Bo tree -- (Moraceae)**

Two large *Ficus religiosa* trees were observed cultivated on the grounds at the USDA/NRCS property. No signs of spread were noted. *F. religiosa* is a sacred tree native to India where it grows up to elevations of 5,000 ft (Neal, 1965). It is said to be the tree that Buddha was born under and also where he sat for six years of meditation and enlightenment. Elsewhere in the world and in Hawaii, trees are occasionally cultivated and are most often seen planted near temples. Though *F. religiosa* is not invasive in Hawaii today because its associated pollinator wasp, *Blastophaga psenses*, is not present, it is considered invasive in Israel and Florida where the wasp is present. Should the associated wasp be introduced to Hawaii in the future, there would be the potential for *F. religiosa* to begin to spread on its own.

***Hedychium gardnerianum* -- Ginger -- (Zingiberaceae)**

A few cultivated and questionably naturalized plants were observed in Kipu and Maalehu. According to Molokai folks, *Hedychium coronarium* (white ginger) is widespread, but *Hedychium gardnerianum* (Kahili ginger) is known from house plantings only. *Hedychium gardnerianum* (Kahili ginger), native to the Himalayas, is naturalized in wet forests of Kauai, Maui, and Hawaii where this species is considered a pest (Wagner *et al.*, 1999).

***Hyparrhenia* spp. -- Thatching grass -- (Poaceae)**

Hyparrhenia spp. is locally abundant along roadsides in Maunaloa, west of Manalo gulch, Kipu, and from Puu o Hoku Ranch to Halawa. We did not distinguish between the two species during our survey. *Hyparrhenia* spp. (*H. hirta* and *H. rufa*) are native to tropical Africa, and commonly spread in places where they are planted. These fire adapted grasses are widely planted throughout the tropics as pasture grasses, produce numerous seeds, and are widely established. *H. hirta* is adventive on Molokai and Lanai and *H. rufa* is naturalized on Kauai, Oahu, Molokai, Maui, and Hawaii (Wagner *et al.*, 1999).

***Leptospermum scoparium* -- New Zealand tea tree -- (Myrtaceae)**

A few *Leptospermum scoparium* plants were observed in cultivation in Hoolehua and Kalae. According to F. Duvall, there are naturalized plants in Kaunakakai Gulch. *L. scoparium*, native to New Zealand, is cultivated as an ornamental and as a forestry tree in Hawaii. Several other species are cultivated and naturalized as well. *L. scoparium* is spreading from plantings into disturbed mesic to wet forests on the islands of Kauai, Oahu, and Lanai (Wagner *et al.*, 1999).

***Ligustrum lucidum* -- Glossy privet -- (Oleaceae)**

Ligustrum lucidum was observed as cultivated in several areas including Kaluakoi resort area, Maunaloa, Hoolehua, Kalamaula, Kaunakakai, Kalae Loa, and Pukoo. No signs of spread were noted. *L. lucidum*, native to temperate Asia, is planted as an ornamental and is considered a pest in some areas, such as Florida and New Zealand, where it is spreading beyond initial plantings. In Hawaii, several *Ligustrum* species are cultivated including *L. lucidum* and *L. sinense*, which is naturalized on Kauai and Hawaii (Wagner *et al.*, 1999).

***Livistona chinensis* -- Chinese fan palm -- (Arecaceae)**

Livistona chinensis was observed as cultivated in Hoolehua and Kualapuu. Cultivated and naturalized plants were observed on the east end from Ualapue to Puu o Hoku Ranch. *L. chinensis* is a fan palm native to Japan and China that is cultivated worldwide in tropical and temperate climates. It has escaped from cultivation and is sparingly naturalized in moist areas in at least Florida and Hawaii (FLEPPC, 2001; Wagner *et al.*, 1999). In Hawaii, *L. chinensis* is known from the islands of Oahu and Maui (Wagner *et al.*, 1999; Oppenheimer, 2003).

***Lonicera japonica* -- Japanese honeysuckle -- (Arecaceae)**

Lonicera japonica was observed at a few cultivated locations in Maunaloa, Kualapuu, and Kaunakakai. No spread was noted. According to R. Hobdy and F. Duvall, there are plants located at the Waikolu Valley lookout. *L. japonica*, native to Asia, is an ornamental groundcover that is commonly planted in many areas of the world for its sprawling habit, numerous sweetly fragrant white flowers, ability to quickly cover bare or steep ground, and attractive evergreen foliage. *L. japonica* has escaped from cultivation in several places, becoming a major nuisance, and is restricted in parts of North America and New Zealand (Auckland Regional Council, 1997; Nuzzo, 1997; GRIN, 2002). In

Hawaii, the first naturalized collection of *Lonicera japonica* was made in 1951 (Wagner *et al.*, 1999), and it is now widely cultivated. It is escaping cultivation in cool, upland, mesic to wet areas in Kokee State Park, Kauai, on Oahu, East Maui, and near Volcano and slopes of Hualalai, Hawaii (Wagner *et al.*, 1999; Starr *et al.*, 2002).

***Merremia tuberosa* -- Wood rose -- (Convolvulaceae)**

Merremia tuberosa was observed as sparingly naturalized in Hoolehua, Kaunakakai, and Kalae Loa. It was collected during this survey (#050517-02) representing a new island record for Molokai. According to L. Buchanan, there are naturalized plants located at the boy scout camp. *M. tuberosa* is a widely cultivated vine with showy yellow flowers and an aggressive habit. In Hawaii, it is sparingly naturalized in disturbed areas of Kauai, Oahu, Maui, and Hawaii (Wagner *et al.*, 1999).

***Ochna* spp. -- Mickey mouse plant -- (Ochnaceae)**

Ochna spp. were observed both cultivated and spreading from plantings in Hoolehua, Kualapuu, Kaunakakai, and Pauwalu. It still needs to be collected on Molokai. *Ochna* species are ornamental shrubs and trees native to tropical woodlands of Africa and Asia. Several species, including *Ochna serrulata* and *Ochna thomasi*, are cultivated in Hawaii for their colorful flowers and unusual fruits. *Ochna* spp. are known to spread from plantings on the islands of Oahu, Maui, and Hawaii (Herbarium Pacificum Staff, 1998; Wagner *et al.*, 1999; Imada *et al.*, 2000; Oppenheimer, 2003; Oppenheimer, 2004). It has also recently been collected as naturalized on Lanai (S. Anderson, pers. obs.; Starr *et al.*, in press).

***Olea europaea* subsp. *cuspidata* -- African olive -- (Oleaceae)**

Only cultivated *Olea europaea* subsp. *cuspidata* plants were observed occasionally planted as a hedge in Hoolehua, Kualapuu, Kalae, and Kaunakakai. No signs of spread were noted. *Olea europaea* subsp. *cuspidata*, native to the Mediterranean region, is widely cultivated throughout the world. In Hawaii, this species is naturalized on the islands of Kauai, Maui, and Hawaii (Lorence *et al.*, 1995; Starr *et al.*, 1999; Wagner *et al.*, 1999). On Maui, this species is widely planted, produces numerous bird dispersed fruits, and often carpets of seedlings are observed nearby plantings with naturalized plants seen along roads, in disturbed areas, woodlands, and pastures from sea level up to at least 5,000 ft on East Maui in both moist and dry conditions.

***Olea europaea* subsp. *europaea* -- European olive -- (Oleaceae)**

A single *Olea europaea* subsp. *europaea* tree was observed being cultivated in Maunaloa. *Olea europaea* subsp. *europaea*, native to the Mediterranean region, has long been cultivated as a source of olive oil. In Hawai'i, *Olea europaea* subsp. *europaea* is occasionally cultivated as an ornamental tree and is naturalized on the islands of Hawaii and Maui (Wagner *et al.*, 1999; Starr *et al.*, 1999).

***Passiflora laurifolia* -- Water lemon -- (Passifloraceae)**

Passiflora laurifolia was observed as naturalized in moist areas along roads and sprawling in vegetation in Kipu, Maalehu, Kalae, Kaluaaha, and Halawa. *P. laurifolia* is native to the West Indies, Guianas, and South America. In Hawaii, *P. laurifolia* is

naturalized in mesic to wet lowland areas on the islands of Kauai, Oahu, Molokai, Maui, and Hawaii (Meidell *et al.*, 1998; Starr *et al.*, 1999; Wagner *et al.*, 1999).

***Pereskia aculeata* -- Barbados gooseberry -- (Cactaceae)**

Not observed during road survey. Other locations noted from expert interviews and existing gps data. *Pereskia aculeata* is a current MoMISC target and is known from Halawa Valley where this thorny vine sprawls over vegetation.

***Phormium tenax* -- New Zealand flax -- (Agavaceae)**

Observed at one location during road survey. Other locations noted from expert interviews and existing gps data. New Zealand flax is a current MoMISC target. A native to New Zealand, *P. tenax* has long been cultivated in Hawaii and is known to become established, spreading by rhizomes and seeds, on at least Kauai and Molokai (Wagner *et al.*, 1999).

***Pimenta dioica* -- Allspice -- (Myrtaceae)**

A few cultivated *Pimenta dioica* trees were observed in Maunaloa, Hoolehua, and Kawela. No signs of spread were noted. *P. dioica*, native to the West Indies, southern Mexico, and Central America, is widely cultivated in warm regions of the world (Riffle, 1998). *Pimenta dioica* is spread by fruit eating birds and has escaped from cultivation in some areas, including Tonga and Hawaii (PIER, 2003). In Hawaii, *Pimenta dioica* has long been cultivated both as an ornamental and as a forestry tree. It is currently documented from moist lowland disturbed scrub and secondary forests, where it forms a sub-canopy tree on the islands of Kauai, Oahu, and Maui (C. Chimera pers. comm.; Lorence *et al.*, 1995; Wagner *et al.*, 1999; Starr *et al.*, 2003).

***Pinus* spp. -- Pines -- (Myrtaceae)**

A few cultivated *Pinus* spp. were observed in Hoolehua, Kalae, and Kaunakakai. According to R. Hobdy, there are many trees located in forest reserves. Numerous *Pinus* species, mostly native to North America, have been planted in mass in forestry areas of Hawaii. According to Skolmen (1960), some of the more popular pine species used on Molokai in forestry plantings include the following species (# planted 1910-1960): *Pinus caribea* (26,000), *Pinus echinata* (10,000), *Pinus elliotii* (52,377), *Pinus pinaster* (79,798), and *Pinus radiata* (36,911). Several of these species are invasive on Maui, including *Pinus caribea*, *Pinus elliotii*, *Pinus pinaster*, and *Pinus radiata*. It is likely that *Pinus caribea* and *Pinus elliotii*, both of which thrive at lower elevations (2000-4000 ft) compared to the other pine species which prefer elevation >4000 ft, are either currently spreading on Molokai or will do so in the future.

***Podranea ricasoliana* -- Pink trumpet vine -- (Bignoniaceae)**

Podranea ricasoliana was observed at Maunaloa, planted in a yard and spreading into nearby adjacent areas. *P. ricasoliana*, native to South Africa, is a vine with purple flowers that is occasionally cultivated for ornamental purposes. In Hawaii, *Podranea ricasoliana* has been cultivated for some time now and is often observed sprawling and climbing on nearby vegetation and structures. This aggressive vine spreads mostly by vegetative means and through underground tuberous roots. Only rarely have seed pods

been observed. The vine is nearly impossible to kill due to underground roots which re-sprout. This species has not yet invaded natural areas, though does display invasive characteristics and is being monitored. It was recently documented as sparingly naturalized on Maui in the areas of Haiku, Makawao, Olinda, and Kula (Starr *et al.*, 2004).

***Salsola tragus* -- Tumbleweed -- (Chenopodiaceae)**

A small infestation (less than a dozen plants) of *Salsola tragus* was observed at the dump. The site was shown to Lori Buchanan (MoMISC) who plans to spray the plants and keep an eye out for other sites. A collection (#050516-03) was made during this survey representing a new island record for Molokai. *S. tragus*, native to Eurasia, is a weedy and thorny shrub that is naturalized in various places of the world. It occurs along roadsides and dry disturbed areas. Once mature, the plant dries up, breaks off at the base, and tumbles across the landscape, spreading numerous seeds as it goes, clogging fencelines, and invading pastures and agriculture areas. In Hawaii, *S. tragus* was previously known from Waimea, Hawaii (Wagner *et al.*, 1990). *S. tragus* has now also been reported from Maui and Kahoolawe (Herbst and Wagner, 1999; Oppenheimer and Bartlett, 2002).

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

Schefflera actinophylla was observed being cultivated in most urban areas from Kaluakoi on the west side to Waialua on the east side. Naturalized plants were readily observed. It is likely too widespread to eradicate, though it could be removed in sensitive areas. *S. actinophylla*, native to Australia and New Guinea, is widely cultivated throughout the world. *S. actinophylla* is bird dispersed, can grow as an epiphyte, and is an aggressive invader. On most Hawaiian islands, this species is extremely popular in landscaping and is readily invading nearby areas. In Hawaii, *S. actinophylla* is widely planted and documented as naturalized from Kauai, Oahu, Molokai, Maui, and Hawaii (Wagner *et al.*, 1999; Staples *et al.*, 2002).

***Schefflera arboricola* -- Dwarf octopus tree -- (Araliaceae)**

Mostly cultivated *Schefflera arboricola* plants were observed in gardens in urban areas from Kaluakoi on the west side to Waialua on the east side. A few sparingly naturalized plants were observed growing on other plants or structures in Maunaloa, Hoolehua, and Waialua. *S. arboricola*, native to Taiwan, is similar in appearance and behavior to the related species, *S. actinophylla*, but is more compact. *S. arboricola* produces numerous bird dispersed fruits and occasionally spreads in moist lowland areas where it comes up in nooks of tree branches and on fence posts. This species is a popular ornamental in Hawaii and was recently documented as naturalized on Maui (Starr *et al.*, 2003).

***Solandra maxima* -- Cup of gold -- (Solanaceae)**

Solandra maxima is occasionally cultivated in the following areas: Papohaku, Hoolehua, Kalae, and Halawa. At Halawa, some questionably naturalized plants were observed spreading into nearby vegetation. *S. maxima*, native to Mexico, is occasionally cultivated for its large ornamental flowers. This species is grown in Hawaii and has been observed to show aggressive growth through vegetative means. It can be a nuisance when grown near natural areas.

***Sphaeropteris cooperi* -- Australian tree fern -- (Cyathaceae)**

Sphaeropteris cooperi was observed cultivated in yards of Maunaloa, Hoolehua, Kualapuu, Kipu, Kalae, and Kaunakakai. It is currently a MoMISC target for eradication. A few plants have already been killed. *S. cooperi*, native to Australia, is commonly cultivated as an ornamental plant. In Hawaii, *S. cooperi* was reported as escaping from cultivation as early as 1950 on Oahu. Today, it is naturalized on Kauai, Oahu, Maui, and Hawaii and is considered one of the worst weeds in Kipahulu Valley of Haleakala National Park, Maui (Palmer, 2003).

***Tetragonia tetragonioides* -- New Zealand spinach -- (Aizoaceae)**

Naturalized *Tetragonia tetragonioides* plants were observed on the beach at Halawa Valley. A collection (#050517-13) was made during this survey representing a new island record for Molokai. *T. tetragonioides*, native to New Zealand, is cultivated in tropical areas as a source of leafy greens and is also a volunteer along beaches in many countries (Neal 1965). *T. tetragonioides* is considered one of the worst weeds on the Farallon Islands, California (P. Pyle pers. comm.). *T. tetragonioides* is recently reported as naturalized in Hawaii from the islands of Midway Atoll and both West and East Maui (Oppenheimer *et al.*, 1999; Starr and Martz, 2000; Starr *et al.*, 2003).

***Thunbergia alata* -- Black eye Susan vine -- (Acanthaceae)**

Thunbergia alata was observed sparingly cultivated at one site in Maunaloa. No sign of spread was noted. *T. alata*, native to tropical eastern Africa, is a sprawling vine that is often cultivated for its attractive flowers. It is widely cultivated and naturalized in other tropical regions of the world. In Hawaii, *T. alata* was first reported from Oahu in 1864-1865 and is now known from at least Kaua'i, Moloka'i, East Maui, and in Hilo and Volcano Village, Hawaii (Wagner *et al.*, 1999). On Maui, *T. alata* is commonly cultivated and naturalized on East Maui from about 300-4,000 ft (91-1,219 m) elevation, mostly in and adjacent to urban and residential areas. Large patches of *T. alata* are commonly observed in Piiholo and Kula where *T. alata* climbs up and over steep walls and fences and sprawls into forested gulches and open pastures and fields.

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

A few naturalized locations of *Thunbergia alata* were observed in Kualapuu and Kalae. A collection (#050518-03) was made during this survey representing a new island record for Molokai. *T. fragrans*, native from India to Southeast Asia, is occasionally cultivated in warm regions of the world for its attractive white flowers. In Hawaii, *T. fragrans* was first collected on Kauai in 1916, and is now naturalized in moist lowland disturbed areas of Kauai, Oahu, Maui, and Hawaii (Wagner *et al.*, 1999).

***Thunbergia grandiflora* -- Trumpet vine -- (Acanthaceae)**

Thunbergia grandiflora was sparingly cultivated in one location at Maunaloa. No sign of spread was noted. *T. grandiflora*, native to India, is widely cultivated throughout the world as an ornamental climbing vine. *T. grandiflora* is sparingly naturalized in a few areas where it is cultivated including Florida, Hawaii, Australia, and Singapore (Wagner *et al.*, 1999; APIRS, 2003; PIER, 2003). In Australia, *T. grandiflora* is a declared

noxious weed (Weeds Australia, 2003) and is a major threat to wet forest and coastal river habitat where it climbs and blankets native vegetation, kills mature trees, and impedes regeneration of seedlings (Land Protection, 2001). In addition, it is difficult to control once established due to large underground tuberous roots. In Hawaii, it is naturalized on the islands of Kauai, Oahu, Maui and Hawaii (Wagner *et al.*, 1999; Starr *et al.*, 2002).

***Thunbergia laurifolia* -- Blue trumpet vine -- (Acanthaceae)**

Thunbergia laurifolia is sparingly cultivated at one location in Ualapue. *T. laurifolia*, native to India, is an aggressive vine that is commonly cultivated and sometimes escaped. In Hawaii, *T. laurifolia* was cultivated on Oahu as early as the late 1800's and is now naturalized on Kauai, Oahu, and Maui (Starr *et al.*, 1999; Wagner *et al.*, 1999). On Maui, naturalized populations have been observed in Wailua, Honomanu, and Kokomo. In these areas, *T. laurifolia* appeared to be spreading vegetatively from plantings climbing and blanketing nearby disturbed lowland moist scrub.

***Washingtonia* spp. -- California and Mexican fan palms -- (Arecaceae)**

Washingtonia spp. are some of the most popular ornamental trees in landscaping and can be found cultivated and naturalized in most urban areas around the island. *Washingtonia* species, including *W. filifera* (California palm) and *W. robusta* (Mexican fan palm), are large fan palms native to the west coast of the United States and Mexico that are commonly cultivated as ornamental street and landscape trees. Hybrids between the two species are common (Dehgan, 1998). In Hawaii, these palms were recently reported as naturalized on the island of Maui (Oppenheimer and Bartlett, 2002). On Maui, *Washingtonia* spp. favor hot, lowland, urban areas near water sources, such as wetlands, areas close to the water table, irrigation ditches, and ponds. In these areas, numerous seedlings and saplings are observed germinating wherever possible. Seedlings have even been observed to come up through cracks in concrete sidewalks and streets. Plants spread rapidly from cultivation, invade wetland areas, and crowd out native species.

LIST OF TARGET SPECIES

This list includes scientific and common names for 126 target species which were searched for during roadside surveys on Molokai (2005). For each species it is noted whether it was found or not (Found?), whether it was observed as naturalized or not (Nat?), and the number of locations that were found (# Loc).

Scientific Name	Common Name	Found?	Nat?	# Loc
<i>Acacia auriculiformis</i>	Earpod wattle	No	--	--
<i>Acacia mangium</i>	Mangium wattle	No	--	--
<i>Acacia podalyrii</i>	Queensland silver wattle	No	--	--
<i>Acacia retinodes</i>	Water wattle	No	--	--
<i>Anredera cordifolia</i>	Madeira vine	No	--	--
<i>Antirrhinum orontium</i>	Lesser snapdragon	No	--	--
<i>Archontophoenix</i> spp.	Alexander palm	Yes	No	1
<i>Ardisia elliptica</i>	Shoebutt on ardisia	No	--	--
<i>Argemone mexicana</i>	Mexican poppy	No	--	--
<i>Aristolochia littoralis</i>	Calico flower	No	--	--
<i>Arundo donax</i>	Giant reed	Yes	Yes	1
<i>Bassia hyssopifolia</i>	Bassia	Yes	Yes	8
<i>Bocconia frutescens</i>	Tree poppy	No	--	--
<i>Brexia madagascariensis</i>	Brexia	No	--	--
<i>Buddleia davidii</i>	Butterfly bush	No	--	--
<i>Buddleia madagascariensis</i>	Smoke bush	No	--	--
<i>Caesalpinia decapetala</i>	Cat's claw	Yes	Yes	12
<i>Carmona retusa</i>	Carmona	Yes	Yes	16
<i>Centranthus ruber</i>	Valerian	No	--	--
<i>Cestrum diurnum</i>	Day blooming jasmine	No	--	--
<i>Cestrum nocturnum</i>	Night blooming jasmine	Yes	No	2
<i>Chrysobalanus icaco</i>	Chrysobalanus	No	--	--
<i>Cinchona calisaya</i>	Ledger quinine	No	--	--
<i>Cinchona officianalis</i>	Loja quinine	No	--	--
<i>Cinchona pubescens</i>	Quinine tree	No	--	--
<i>Cinnamomum burmanii</i>	Padang cassia	No	--	--
<i>Cinnamomum camphora</i>	Camphor tree	No	--	--
<i>Cinnamomum verum</i>	Cinnamon	No	--	--
<i>Citharexylum caudatum</i>	Juniperberry	No	--	--
<i>Citharexylum spinosum</i>	Fiddlewood	Yes	Yes	65
<i>Clerodendrum inerme</i>	Seaside clerodendrum	No	--	--
<i>Clerodendrum macrostegium</i>	Velvetleaf glorybower	No	--	--
<i>Clidemia hirta</i>	Coster's curse	No	--	--
<i>Clusia rosea</i>	Autograph tree	Yes	No	17
<i>Coccinia grandis</i>	Ivy gourd	No	--	--
<i>Cortaderia</i> spp.	Pampas grass	Yes	?	1
<i>Cotoneaster pannosus</i>	Cotoneaster	No	--	--
<i>Cryptostegia</i> spp.	Rubber vine	Yes	Yes	10
<i>Delairea odorata</i>	Cape ivy	No	--	--
<i>Derris elliptica</i>	Poison vine	No	--	--
<i>Enchylaena tomentosa</i>	Enchylaena	No	--	--
<i>Erigeron karvinskianus</i>	Daisy fleabane	No	--	--
<i>Falcataria moluccana</i>	Molucca albizia	No	--	--

Scientific Name	Common Name	Found?	Nat?	# Loc
<i>Ficus benghalensis</i>	Indian banyan tree	No	--	--
<i>Ficus benjamina</i>	Weeping fig	Yes	No	57
<i>Ficus carica</i>	Edible fig	Yes	No	15
<i>Ficus cf. platypoda</i>	Port Jackson fig	No	--	--
<i>Ficus deltoidea</i>	Mistletoe fig	No	--	--
<i>Ficus elastica</i>	Rubber tree	Yes	No	14
<i>Ficus lyrata</i>	Fiddle leaf fig	Yes	No	2
<i>Ficus macrophylla</i>	Moreton bay fig	Yes	Yes	17
<i>Ficus microcarpa</i>	Chinese banyan	Yes	Yes	174
<i>Ficus nota</i>	Ficus	No	--	--
<i>Ficus pseudopalma</i>	Philippine fig	No	--	--
<i>Ficus pumila</i>	Creeping fig	Yes	No	3
<i>Ficus religiosa</i>	Bo tree	Yes	No	2
<i>Hedychium gardnerianum</i>	Kahili ginger	Yes	?	2
<i>Hiptage benghalensis</i>	Hiptage	No	--	--
<i>Hyparrhenia spp.</i>	Thatching grass	Yes	Yes	55
<i>Hypericum canariense</i>	Canary Islands St. John's Wort	No	--	--
<i>Hypericum perforatum</i>	St. John's wort	No	--	--
<i>Leptospermum spp.</i>	Tea tree	Yes	No	3
<i>Ligustrum chinense</i>	Privet	No	--	--
<i>Ligustrum lucidum</i>	Glossy privet	Yes	No	13
<i>Livistona chinensis</i>	Chinese fan palm	Yes	Yes	11
<i>Lonicera japonica</i>	Japanese honeysuckle	Yes	No	5
<i>Macaranga mappia</i>	Bingabing	No	--	--
<i>Macaranga tanarius</i>	Parasol leaf tree	No	--	--
<i>Melastoma spp.</i>	Asian melastome	No	--	--
<i>Melochia umbellata</i>	Melochia	No	--	--
<i>Merremia tuberosa</i>	Wood rose	Yes	Yes	4
<i>Miconia calvescens</i>	Miconia	No	--	--
<i>Morella [Myrica] cerifera</i>	Wax myrtle	No	--	--
<i>Morella [Myrica] faya</i>	Fire tree	No	--	--
<i>Ochna spp.</i>	Mickey mouse plant	Yes	Yes	18
<i>Olea europaea cuspidata</i>	European olive	Yes	No	10
<i>Olea europaea europaea</i>	African olive	Yes	No	1
<i>Omolanthus populifolius</i>	Omolanthus	No	--	--
<i>Oxyspora paniculata</i>	Oxyspora	No	--	--
<i>Paederia foetida</i>	Maile pilau	No	--	--
<i>Paraserianthes lophantha</i> subsp. <i>montana</i>	Mountain Albizia	No	--	--
<i>Parkinsonia aculeata</i>	Jerusalem thorn	No	--	--
<i>Passiflora laurifolia</i>	Water lemon	Yes	Yes	12
<i>Passiflora ligularis</i>	Sweet granadilla	No	--	--
<i>Passiflora mollissima</i>	Banana poka	No	--	--
<i>Pennisetum setaceum</i>	Fountain grass	No	--	--
<i>Pereskia aculeata</i>	Barbados gooseberry	Yes	Yes	1

Scientific Name	Common Name	Found?	Nat?	# Loc
<i>Philadelphus karvinskianus</i>	Philadelphus	No	--	--
<i>Phormium tenax</i>	New Zealand flax	Yes	No	30
<i>Pimenta dioica</i>	Allspice	Yes	No	5
<i>Pimenta racemosa</i>	Bay Rum Tree	No	--	--
<i>Pinus</i> spp.	Pine tree	Yes	No	245
<i>Pittosporum undulatum</i>	Victorian box	No	--	--
<i>Pittosporum viridiflorum</i>	Cape pittosporum	No	--	--
<i>Podranea ricasoliana</i>	Podranea	Yes	?	3
<i>Pueraria montana</i> var. <i>lobata</i>	Kudzu	No	--	--
<i>Pyracantha</i> spp.	Fire thorn	No	--	--
<i>Rhodomyrtus tomentosa</i>	Downy rose myrtle	No	--	--
<i>Rubus discolor</i>	Blackberry	No	--	--
<i>Rubus ellipticus</i>	Yellow Himalayan raspberry	No	--	--
<i>Rubus glaucus</i>	Raspberry	No	--	--
<i>Rubus niveus</i> f. <i>a</i>	Hill raspberry - white stem	No	--	--
<i>Rubus niveus</i> f. <i>b</i>	Hill raspberry - red stem	No	--	--
<i>Salsola tragus</i>	Tumble weed	Yes	Yes	1
<i>Schefflera actinophylla</i>	Umbrella plant	Yes	Yes	171
<i>Schefflera arboricola</i>	Dwarf schefflera	Yes	?	71
<i>Schizachyrium condensatum</i>	Beard grass	No	--	--
<i>Senecio confusus</i>	Flame vine	No	--	--
<i>Senecio madagascariensis</i>	Fireweed	No	--	--
<i>Sideroxylon persimile</i>	Bully tree	No	--	--
<i>Solanandra maxima</i>	Cup of gold	Yes	?	8
<i>Solanum robustum</i>	Prickly Solanum	No	--	--
<i>Solanum torvum</i>	Turkey berry	No	--	--
<i>Sphaeropteris cooperi</i>	Australian tree fern	Yes	?	9
<i>Tetragonia tetragonioides</i>	New Zealand spinach	Yes	Yes	1
<i>Tetragium pubinerve</i>	Tetragium	No	--	--
<i>Thunbergia alata</i>	Black-eyed Susan vine	Yes	No	1
<i>Thunbergia fragrans</i>	Sweet clock vine	Yes	Yes	3
<i>Thunbergia grandiflora</i>	Trumpet vine	Yes	No	1
<i>Thunbergia laurifolia</i>	Trumpet vine	Yes	No	1
<i>Tibouchina herbacea</i>	Cane tibouchina	No	--	--
<i>Tibouchina urvilleana</i>	Glory bush	No	--	--
<i>Ulex europaeus</i>	Gorse	No	--	--
<i>Urena lobata</i>	Aramia	No	--	--
<i>Verbascum thapsus</i>	Common mullein	No	--	--
<i>Washingtonia</i> spp.	California and Mexican fan palm	Yes	Yes	168

LIST OF TARGET SPECIES FOUND

This list includes 45 target species which were located during roadside surveys on Molokai (2005). Information on naturalized status and number of locations is given. The list is sorted by number of locations with the least at the top and the most at the bottom.

# Loc	Scientific Name	Nat?
1	<i>Archontophoenix</i> spp.	No
1	<i>Arundo donax</i>	Yes
1	<i>Cortaderia</i> spp.	?
1	<i>Olea europaea europaea</i>	No
1	<i>Pereskia aculeata</i>	Yes
1	<i>Salsola tragus</i>	Yes
1	<i>Tetragonia tetragonioides</i>	Yes
1	<i>Thunbergia alata</i>	No
1	<i>Thunbergia grandiflora</i>	No
1	<i>Thunbergia laurifolia</i>	No
2	<i>Cestrum nocturnum</i>	No
2	<i>Ficus lyrata</i>	No
2	<i>Ficus religiosa</i>	No
2	<i>Hedychium gardnerianum</i>	?
3	<i>Ficus pumila</i>	No
3	<i>Leptospermum</i> spp.	No
3	<i>Podranea ricasoliana</i>	?
3	<i>Thunbergia fragrans</i>	Yes
4	<i>Merremia tuberosa</i>	Yes
5	<i>Lonicera japonica</i>	No
5	<i>Pimenta dioica</i>	No
8	<i>Bassia hyssopifolia</i>	Yes
8	<i>Solantra maxima</i>	?
9	<i>Sphaeropteris cooperi</i>	?
10	<i>Cryptostegia</i> spp.	Yes
10	<i>Olea europaea cuspidata</i>	No
11	<i>Livistona chinensis</i>	Yes
12	<i>Caesalpinia decapetala</i>	Yes
12	<i>Passiflora laurifolia</i>	Yes
13	<i>Ligustrum lucidum</i>	No
14	<i>Ficus elastica</i>	No
15	<i>Ficus carica</i>	No
16	<i>Carmona retusa</i>	Yes
17	<i>Clusia rosea</i>	No
17	<i>Ficus macrophylla</i>	Yes
18	<i>Ochna</i> spp.	Yes
30	<i>Phormium tenax</i>	No
55	<i>Hyparrhenia</i> spp.	Yes
57	<i>Ficus benjamina</i>	No
65	<i>Citharexylum spinosum</i>	Yes
71	<i>Schefflera arboricola</i>	?
168	<i>Washingtonia</i> spp.	Yes
171	<i>Schefflera actinophylla</i>	Yes
174	<i>Ficus microcarpa</i>	Yes
245	<i>Pinus</i> spp.	No

LIST AND MAP OF VOUCHER SPECIMENS

This list and map includes new island records and plant specimens collected during roadside surveys on Molokai (2005). All specimens accessioned at BISH.

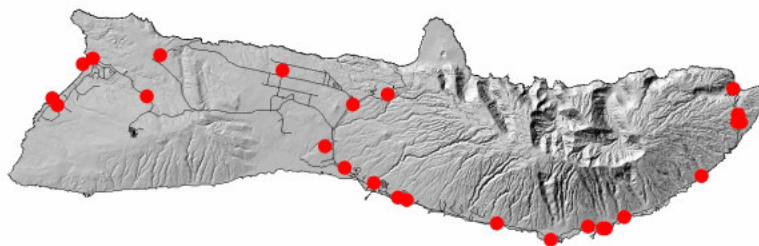
Voucher #	Scientific name	Location	Significance
050516-01	<i>Citharexylum spinosum</i>	Kaluakoi	NIR
050516-02	<i>Calotropis gigantea</i>	Papohaku Beach	NIR
050516-03	<i>Salsola tragus</i>	By dump	NIR
050516-05	<i>Carmona retusa</i>	Molokai Shores	NIR
050516-06	<i>Hyptis pectinacea</i>	Kaluakoi Rd.	NIR
050516-07	<i>Coccoloba uvifera</i>	Pohakuloa Rd.	NIR
050517-01	<i>Antigonon leptopus</i>	Kakahaia	NIR
050517-02	<i>Merremia tuberosa</i>	Kalae Loa	NIR
050517-03	<i>Asparagus plumosus</i>	Near Wavecrest	NIR
050517-04	<i>Cryptostegia</i>	Wavecrest	NNR
050517-05	<i>Barleria cristata</i>	Kaluaaha	NIR
050517-06	<i>Sporobolus pyramidatus</i>	Waialua	NIR
050517-07	Unknown sedge	Kukumamalu gulch	ID
050517-08	<i>Centratherum punctatum</i>	Kukumamalu gulch	NIR
050517-09	Unknown bur like plant	Kukumamalu gulch	ID
050517-10	Unknown uhaloa like plant	Puu o Hoku Ranch	ID
050517-11	Unknown wispy grass	Puu o Hoku Ranch	ID
050517-12	Unknown euphob like plant	Puu o Hoku Ranch	ID
050517-13	<i>Tetragonia tetragonioides</i>	Halawa Valley	NIR
050517-14	<i>Dyssodia tenuiloba</i>	Kaunakakai	NIR
050518-01	Unknown yellow fragrant	Kaunakakai	ID
050518-02	<i>Ipomoea triloba</i>	Kaunakakai	NIR
050518-03	<i>Thunbergia fragrans</i>	Kualapu	NIR
050518-04	<i>Araucaria sp.</i>	Hahaeule	NIR?
050518-05	<i>Crotolaria assamica</i>	Hoolehua	NIR
050519-01	<i>Cryptostegia</i>	Kamalo	NIR
050519-02	Unknown moomomi plant	Moomomi	ID

NNR = New naturalized record

NIR = New island record

ID = Identification needed

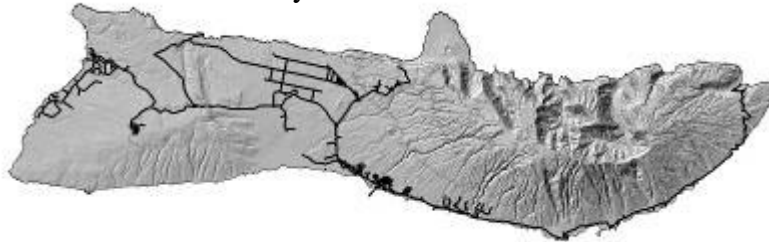
Collections made during Molokai road survey



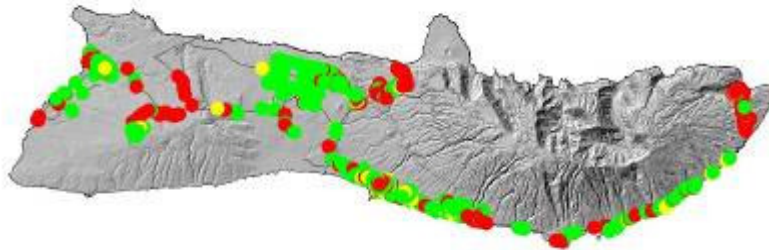
SUMMARY OF EXPERT INTERVIEWS AND LOCATIONS GATHERED

During this project, we surveyed 142 miles of roads; recorded 986 locations for 41 species; and interviewed three expert field botanists, acquired GPS data, and reviewed literature, adding 291 plant locations for 10 species.

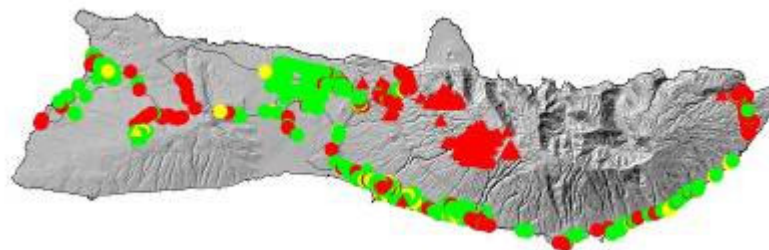
Surveyed 142 miles of roads



Recorded 986 locations for 41 species during survey

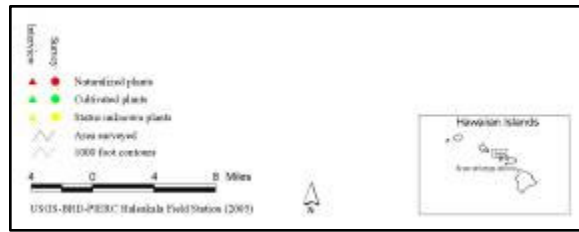


Added 291 locations for 10 species through expert interviews



DISTRIBUTION MAPS

Below are maps of known distribution of select species on the island of Molokai.



Archontophoenix spp.



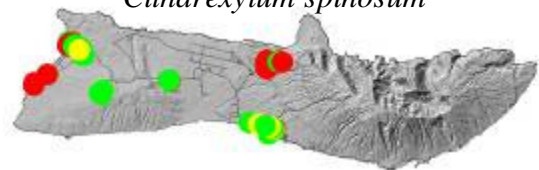
Cestrum nocturnum



Arundo donax



Citharexylum spinosum



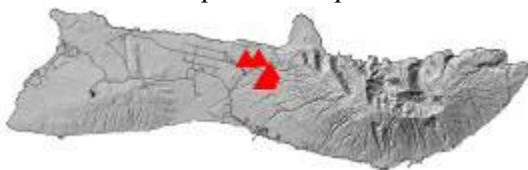
Bassia hyssopifolia



Clusia rosea



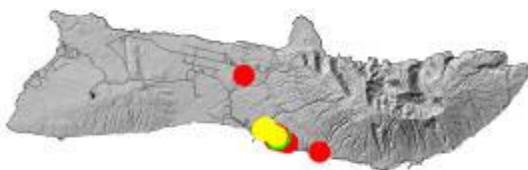
Caesalpinia decapetala



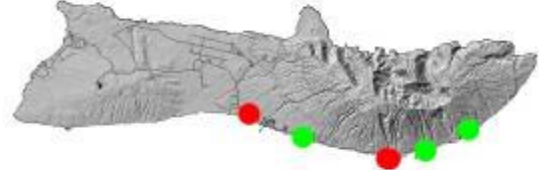
Cortaderia spp.



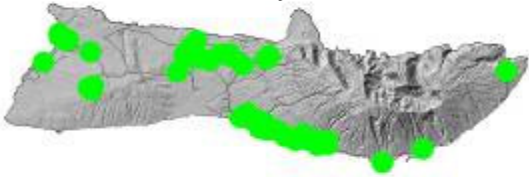
Carmona retusa



Cryptostegia spp.



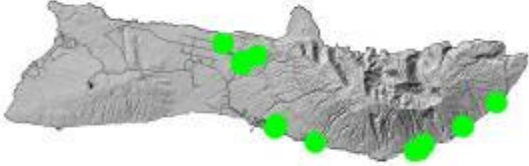
Ficus benjamina



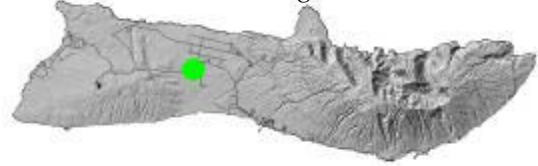
Ficus pumila



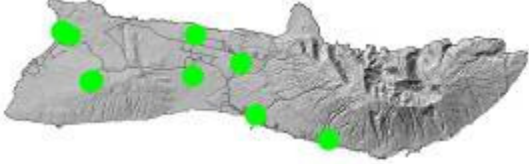
Ficus carica



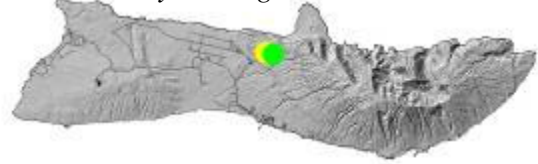
Ficus religiosa



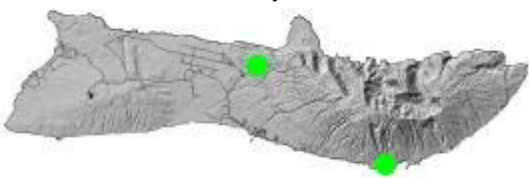
Ficus elastica



Hedychium gardnerianum



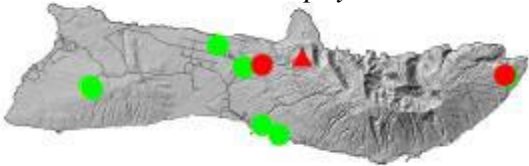
Ficus lyrata



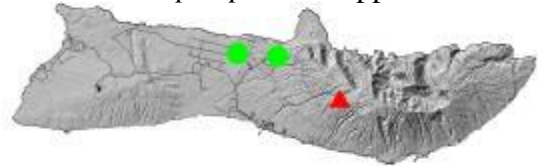
Hyparrhenia spp.



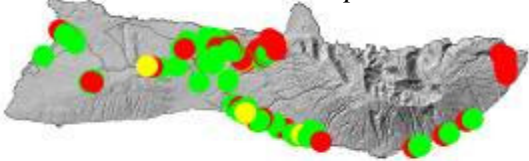
Ficus macrophylla



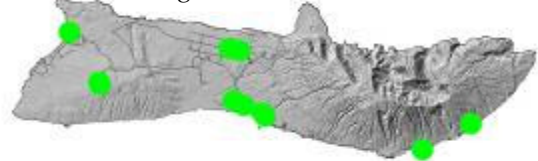
Leptospermum spp.



Ficus microcarpa



Ligustrum lucidum



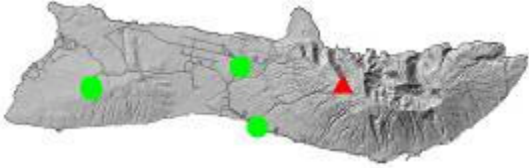
Livistona chinensis



Passiflora laurifolia



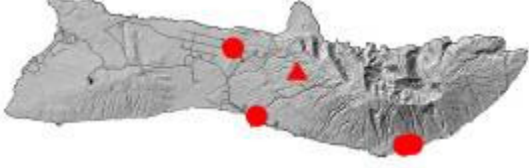
Lonicera japonica



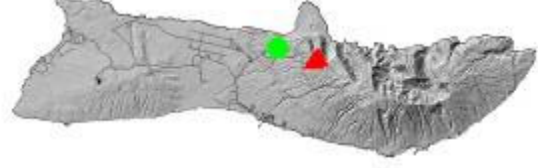
Pereskia aculeata



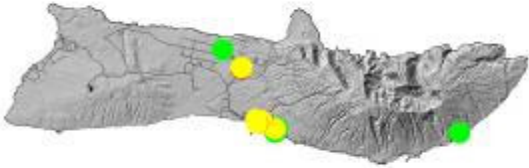
Merremia tuberosa



Phormium tenax



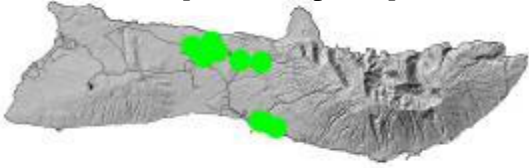
Ochna spp.



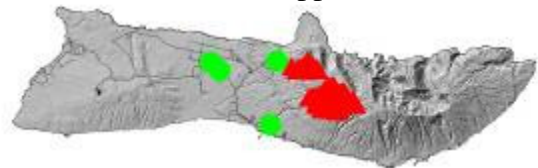
Pimenta dioica



Olea europaea subsp. *cuspidata*



Pinus spp.



Olea europaea subsp. *europaea*



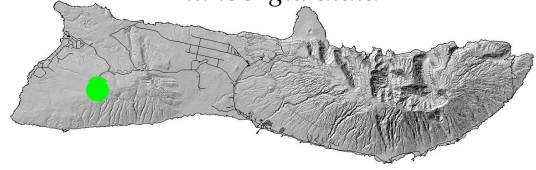
Podranea ricasoliana



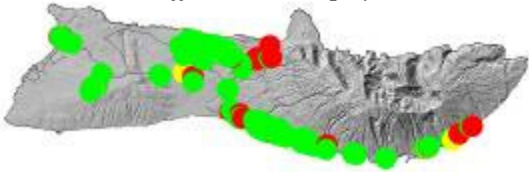
Salsola tragus



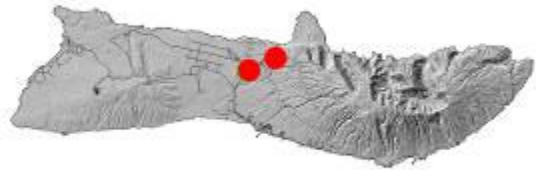
Thunbergia alata



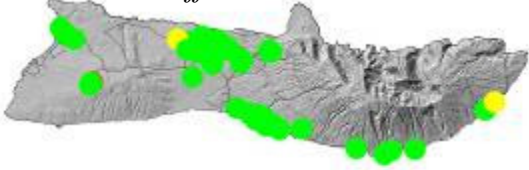
Schefflera actinophylla



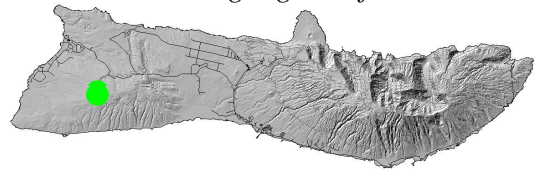
Thunbergia fragrans



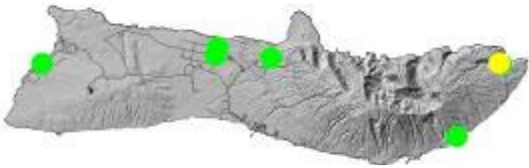
Schefflera arboricola



Thunbergia grandiflora



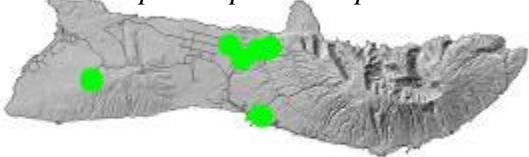
Solandra maxima



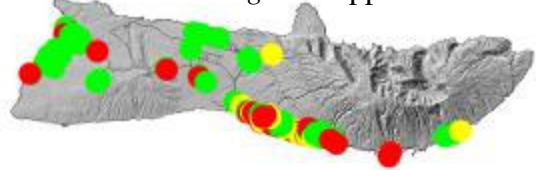
Thunbergia laurifolia



Sphaeropteris cooperi



Washingtonia spp.



Tetragonia tetragonoides



REFERENCES

- APIRS (Aquatic, Wetland and Invasive Plant Retrieval System). 2003. Aquatic, Wetland and Invasive Plant Particulars and Photographs. University of Florida, Center for Aquatic and Invasive Plants, Gainesville, FL. Available: <http://plants.ifas.ufl.edu/> (Accessed: March 31, 2003).
- Auckland Regional Council. 1997. Pest Facts #43, Japanese honeysuckle, *Lonicera japonica*. Auckland, NZ.
- Bodle, M. 1998. *Arundo* the world in (at least) eighty ways. *Wildland Weeds* Vol. 1, Number 3.
- Brickell, C. and J.D. Zuk. 1997. *The American Horticultural Society A-Z Encyclopedia of Garden Plants*. DK Publishing, Inc., NY.
- CalEPPC (California Exotic Pest Plant Council). 1999. Exotic Pest Plant List. California Exotic Pest Plant Council. Available: <http://www.caleppc.org> (Accessed: September 19, 2001).
- Dehgan, B. 1998. *Landscape Plants for Subtropical Climates*. University Press of Florida, Gainesville, FL.
- Dudley, T. L. 1998. Noxious Wildland Weeds of California: *Arundo donax*. In: *Noxious Wildland Weeds of California*. C. Bossard, J. Randall, and M. Hoshovsky, eds. Available: <http://www.ceres.ca.gov/tadn/arundoWW.html> (Accessed: May 12, 1998).
- FLEPPC (Florida Exotic Pest Plant Council). 2001. List of Invasive Species. Florida Exotic Pest Plant Council, Florida EPPC Newsletter, Volume 11, Number 1, pp. 3-4. Available: <http://www.fleppc.org> (Accessed: January 3, 2003).
- GRIN (Germplasm Resources Information Network). 2002. Online Database. United States Department of Agriculture, Agricultural Research Service, National Germplasm Resources Laboratory, Beltsville, MD. Available: <http://www.ars-grin.gov/> (Accessed: January 1, 2002).
- Herbarium Pacificum Staff. 1998. New Hawaiian plant records for 1997. *Bishop Mus. Occas. Pap.* 56(2): 8-15.
- Hughes, G.D. 1995. New Hawaiian plant records. II. *Bishop Mus. Occas. Pap.* 42(2): 1-10.
- Imada, C.T., G.W. Staples, and D.R. Herbst. 2000. New Hawaiian plant records for 1999. *Bishop Mus. Occas. Pap.* 63(1): 9-16.

- Land Protection. 2001. NRM Facts: Pest Series. Queensland Government, Natural Resources and Mines, Australia. Available: <http://www.nrm.qld.gov.au> (Accessed: April 11, 2003).
- Lorence, D.H., T.W. Flynn, and W.L. Wagner. Contributions to the flora of Hawaii. III. *Bishop Mus. Occas. Pap.* 41(1): 19-58.
- Lorence, D. and T. Flynn. 1999. New naturalized plant records for the Hawaiian Islands. *Bishop Mus. Occas. Pap.* 59(2): 3-6.
- Meidell, J.S., H.L. Oppenheimer, and R.T. Bartlett. 1998. New plant records from Puu Kukui Watershed and adjacent areas, Maui. *Bishop Mus. Occas. Pap.* 49(2): 17-19.
- Neal, M.C. 1965. *In Gardens of Hawaii*. Bernice P. Bishop Museum Special Publication 40, Bishop Museum Press, Honolulu, HI.
- Nuzzo, V. 1997. Element Stewardship Abstract for *Lonicera japonica* (Japanese honeysuckle). The Nature Conservancy, Arlington, VA.
- Oppenheimer, H.L. In press. New plant records for 2004. *Bishop Mus. Occas. Pap.*
- Oppenheimer, H.L. 2004. New plant records for 2003. *Bishop Mus. Occas. Pap.* 79(2): 8-20.
- Oppenheimer, H.L. 2003. New plant records from Maui and Hawaii Counties. *Bishop Mus. Occas. Pap.* 73(1): 3-30.
- Oppenheimer, H.L. and R.T. Bartlett. 2000. New plant records from Maui, Oahu, and Hawaii Islands. *Bishop Mus. Occas. Pap.* 64(2): 1-10.
- Palmer, D.D. 2003. *Hawaii's Ferns and Fern Allies*. University of Hawaii Press, Honolulu, HI.
- PIER (Pacific Islands Ecosystems at Risk). 2003. Invasive Plant Species: *Buddleia madagascariensis*. Available: <http://www.hear.org/pier> (Accessed: June 1, 2003).
- Randall, R. 1998. Western Weeds. Plant Protection Society of Western Australia. Available: http://members.iinet.net.au/~weeds/western_weeds/mol_mor_myf.htm (Accessed: February 7, 2002).
- Riffle, R.L. 1998. *The Tropical Look*. Timber Press, Portland, OR.
- Skolmen, R.G. 1960. *Plantings on the Forest Reserves of Hawaii: 1910-1960*. Institute of Pacific Islands Forestry, Pacific Southwest Forest and Range Experiment Station, United States Forest Service, Honolulu, HI.

- Staples, G.W., Imada, C.T., and D.R. Herbst. 2002. *Bishop Mus. Occ. Pap.* 68(1): 3-18.
- Starr, F., K. Starr, and L.L. Loope. In press. New plant records for the Hawaiian Archipelago.
- Starr, F., K. Starr, and L.L. Loope. 2004. New plant records for the Hawaiian Archipelago. *Bishop Mus. Occ. Pap.* 79(2): 20-30.
- Starr, F., K. Starr, and L.L. Loope. 2003. New plant records for the Hawaiian Archipelago. *Bishop Mus. Occ. Pap.* 74(2): 23-34.
- Starr, F., K. Martz, and L.L. Loope. 2002. New plant records for the Hawaiian Archipelago. *Bishop Mus. Occ. Pap.* 69(2): 16-27.
- Starr, F. and K. Martz. 2000. New plant records for Midway Atoll. *Bishop Mus. Occ. Pap.* 64(2): 10-12.
- Starr, F., K. Martz, and L.L. Loope. 1999. New plant records from East Maui for 1998. *Bishop Mus. Occ. Pap.* 59(2):11-15.
- Wagner, W.L., D.R. Herbst, and S.H. Sohmer. 1999. *Manual of the Flowering Plants of Hawaii*. 2 vols. Bishop Museum Special Publication 83, University of Hawaii and Bishop Museum Press, Honolulu, HI.
- Weeds Australia. 2003. National Weeds Strategy, Australia. Available: <http://www.weeds.org.au/> (Accessed: March 31, 2003).