



2015 to 2020 Strategic Plan

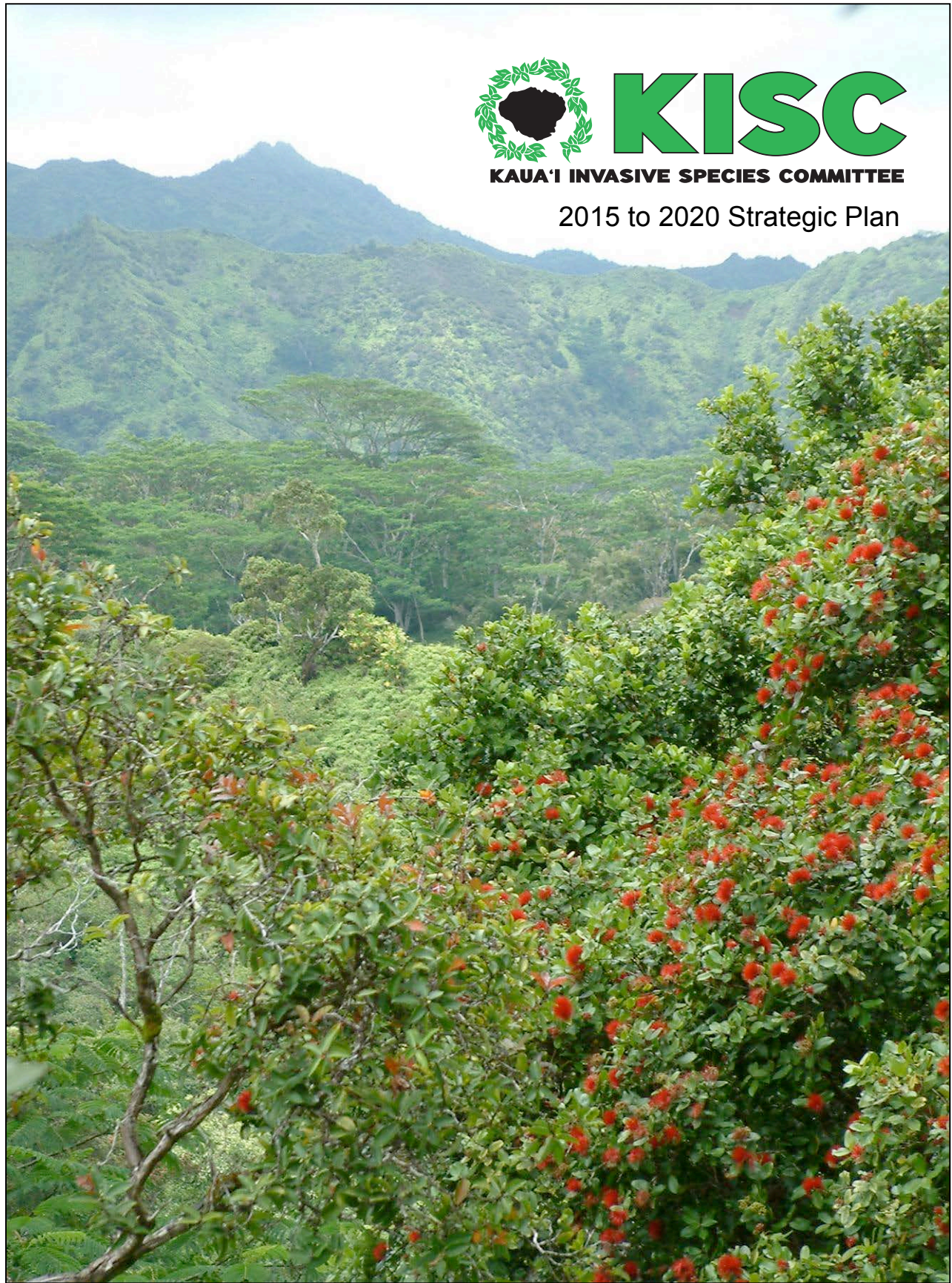


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DRAFT

EXECUTIVE SUMMARY

The introduction of invasive nonnative species to Hawaii is the primary driver behind decreasing agricultural productivity, biodiversity loss, and watershed degradation. Additionally, control costs are an increasing and ongoing economic burden upon public and private landowners as well as the agricultural industry.

The costs associated with invasive species are enormous. The LRB report commissioned by the legislature in 2002 estimated an annual budget of \$50 million dollars is necessary to address the Invasive Species problem. Losses to agriculture alone are estimated at \$300 million a year.

More native species have been eliminated in Hawai'i than anywhere else in the United States. According to the U.S. Fish and Wildlife Service (USFWS), Kaua'i's rate of endemic plants is the highest in the Hawaiian archipelago with threatened and endangered listings for 48 species. Unless prevented and controlled, the impacts of invasive nonnative species on this unique native biota will continue down the path of decreasing biodiversity, ecosystem degradation and extinction. Agricultural impacts include unpalatable species infesting pasture lands, rose-ring parakeets increasing predation on both fruit and seed farmers and barriers to commerce due to export/import restrictions from infested zones. Invasive species also pose threats to Hawai'i's watersheds and water resources due to their trait of forming monotypic stands, shading out understory plant communities which expose bare soil, increasing erosion. The Kaua'i Invasive Species Committee (KISC) uses a science based approach to address the problem basing decisions on research and observations from field crews, partners and the public. It is the opinion of this committee that given enough time, resources and research many of the worst invasions can be prevented or reversed.

Kaua'i Invasive Species Committee (KISC) was formed in December 2001, as a voluntary partnership of community members, business owners, private organizations, and government agencies. The formation of KISC, and other island invasive species committees under the Hawaii Invasive Species Committee is meant to fill jurisdictional and response "gaps" that exist between natural resource agencies.¹ KISC is a consensus-based committee that adopted a mission statement, an action plan (2007), and a prioritized list of targeted incipient invasive plants and animals with *Miconia calvescens* being its top priority. In 2015, the committee changed governance at the request of its chair and is now an executive committee that consists of a chair, chair elect and past chair. All meetings are advertised and open to the public.

To understand the role of an invasive committee's responsibility within Hawaii's management regime it is useful to discuss miconia. Miconia response in Kauai is considered a "poster child" of early detection and rapid response due the prompt actions of the conservation community in the mid 1990's. Miconia is of concern due to its persistent ability to act as an exclusion canopy, shading out plants underneath it. This

¹ Dave Duffy's paper

creates monotypic stands of miconia reaching to 50 feet. Because of its large leaves, shallow roots and competition with understory species miconia can destroy watershed function. Large leaves concentrate rainfall into steady streams which hit exposed soil due to lack of an understory which creates surface runoff events followed by erosion, leading to landslides as shallow roots give way in saturated eroded soils. If miconia escapes the Wailua area and becomes established in the rugged terrain of the Halelea Forest Reserve, it will challenge all of Kaua'i's resources to control it. Approximately 158,000² acres of native wet forest, prime habitat for miconia, are at risk. However, ongoing control work has restricted the infestation to 3500 acres and control work is ongoing monthly removing seedlings from known infestation sites and quarterly helicopter surveys to catch seedlings located in new areas before they mature and seed.

KISC also targets specific invasive animals and insects such as the coqui frog (*Eleutherodactylus coqui*), and little fire ant (*Wasmannia auropunctata*). Prevention, early detection and rapid response for species that threaten Hawai'i, such as the small Indian mongoose (*Herpestes auropunctata*) and brown tree snake (*Boiga irregularis*), are also important aspects of KISC's overall program goals. Education and public outreach programs to increase awareness in the community for both children and adults will help to increase KISC's capacity in detecting and preventing introductions of invasive species from other islands.

MISSION STATEMENT

Old: KISC is a voluntary partnership of government, private and non-profit organizations, and concerned individuals working to eliminate or control the most threatening invasive plant and animal species in order to preserve Kaua'i's native bio-diversity and minimize adverse agricultural, ecological, economic and social impacts.

New: To prevent and control introduced invasive pests from becoming established or widespread on Kauai

POLICY STATEMENT

The continued introduction and spread of unwanted pests and invasive organisms harms our economy, water supply, native bio-diversity, health, and the lifestyle and culture unique to this island.

The Kaua'i Invasive Species Committee (KISC) is a voluntary partnership of government, private, non-profit organizations, and individuals working together to:

- Prevent the introduction of potentially damaging pest species to the island,
- Eliminate recently arrived (incipient) pests before they spread beyond control,
- Manage established pests in order to reduce their negative impacts, and

² Miconia model paper

- Educate and involve the public as to the magnitude of the invasive species problem and the need for control programs such as KISC.

KISC is intended to supplement existing programs and aims to assist in the coordination of efforts island-wide.

KISC’s priorities will be those species that are recognized as having the greatest potential to harm human welfare and native biodiversity, and where the use of limited resources are most likely to be successful. KISC field of operations is focused on incipient infestations as described in the following diagram:

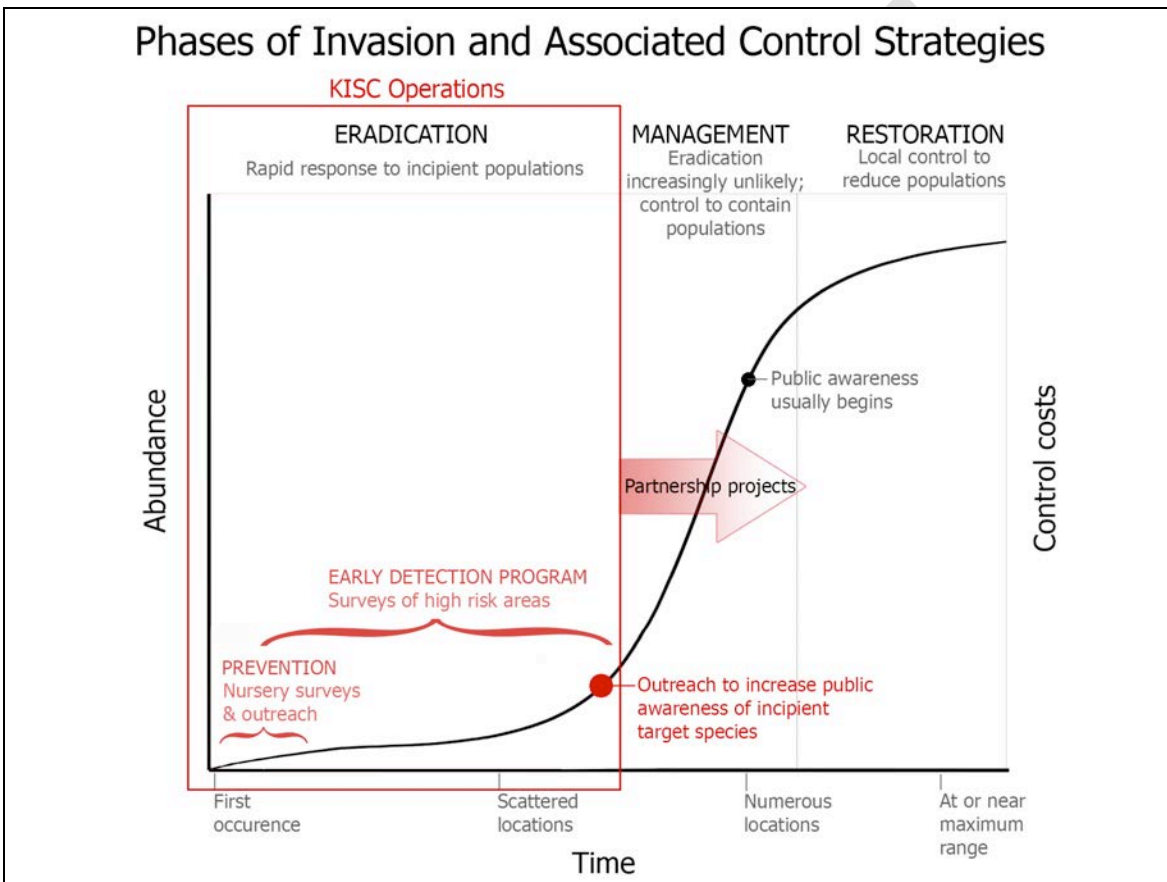


Figure 1: KISC Operations in the Phase of Invasive and Associated Control Strategies

PROJECT NEED

THE IMPORTANCE OF INVASIVE SPECIES CONTROL ON THE ISLAND OF KAUAI

Hawai'i's Alien Species Dilemma

Alien species are increasingly recognized as a threat to biological diversity and human welfare worldwide. An article in the Journal of Science stated: “Many fear that another century or so of frenetic international traffic will lead to an ‘ecological homogenization’ of the world, with a small number of immensely successful species” (Enserink 1999).

Oceanic islands are particularly vulnerable to invasive species, and Hawai'i especially so because of its role as a transportation hub. Because of their evolution in isolation from many forces shaping continental organisms, ecosystems of the Hawaiian Islands are substantially more vulnerable than most ecosystems of the continental United States.

Although habitat destruction has been an important cause of extinction and endangerment, the introduction of alien species has been the predominant cause of biodiversity loss in Hawai'i for a century. The following table combines known costs from invasive species for industry and conservation which will be updated in 2016 through a legislatively funded HISC program in partnership with UH Manoa..

Table of estimated costs by species from 2002 LRB report*

Species	Effect/cost	Affected species/industry
Bacterial blight	40% production drop since 1980	Anthurium Growers
Bacterial wilt	60-70% decline	Ginger Root
Root Aphid	20-90% production losses	cabbage,broccoli,cauliflower
Four species sugar pests	Since 1985 \$9 million loss	Sugar cane
Taro root aphid	90% crop loss	Dryland taro
Fruit fly	\$300 million loss of potential export markets	Restrictions on export of papaya, mango, produce
Papaya ringspot	Potential \$50 million loss	papaya
Mongoose	\$50 million losses in Hawaii and Puerto Rico	Poultry, ground nesting birds, lizards, amphibians
Rodents	\$1.8 to \$3.6 million	Macadamia(other impacts not quantified)
Termites	\$150 million in 1995	Treatment and loss of wood structures
Brown tree snake	Oahu power outage = \$13 million per event	Guam has one power outage every 4 days
Feral pig	\$450,000 per year	Three National Parks
Ants, snakes, etc.	\$18.9 billion in total sales	Tourism
Dengue fever	2001 layoff of 25% hotel employee, 75% loss of bookings	Hotels after 59 cases reported on Maui
Miconia	Losses of \$137 million	Potential reduction in groundwater recharge from Oahu infestation
Coqui Frogs	\$7.6 million loss, \$81,000 loss per year	Hawaii County property values, cut flowers
Avian Malaria	Declining native bird populations	ESA listings
Feral Cats	Predation on ground nesting birds	ESA listings impacting night football, drag racing, construction

Albizia	\$3.5 million for one highway clearing project on Kauai	HDOT
Australian tree fern	\$100K's of helicopter treatment	Native forest bird habitat
Little Fire Ant	\$400K in treatments from 2014 to 2015 in Hawaii county parks	Loss of agricultural lands, negative tourist impacts

*The 2002 Legislative Reference Bureau Report

The Formation of KISC

The Kaua'i Invasive Species Committee formed as a voluntary partnership of community members, private organizations, and government agencies. The first meeting was held in December of 2001. KISC has developed a consensus-based committee that has adopted a mission statement, an action plan (2007), and a prioritized list of targeted incipient invasive plants and animals with *miconia calvescens* being the top priority. KISC members realize that a unified effort is needed to effectively tackle this problem. KISC members include concerned community members and groups, ranchers, farmers, nurserymen, visitor industry members, private land owners, the Department of Land and Natural Resources (DLNR) Division of Forestry and Wildlife (DOFAW) and State Parks, Koke'e Resource Conservation Program (KRCP), Hui 'o Laka / Koke'e Museum, Kaua'i Forest Bird Recovery Project (KFBRP), Kaua'i Endangered Seabird Recovery Project (KESRP), Kamehameha Schools, Hawai'i Department of Agriculture (HDOA), Hawai'i Ant Lab (HAL), National Tropical Botanical Garden (NTBG), The Nature Conservancy (TNC), the Kaua'i Group Sierra Club, United States (US) Fish and Wildlife Service, US Department of Agriculture Animal & Plant Health Inspection Service (USDA-APHIS) Wildlife Services and Forest Service, Kaua'i Department of Water, Kaua'i Community College, Grove Farm LLC, Kaua'i Farm Bureau, A&B Properties, USDA Natural Resource Conservation Service (NRCS), Garden Island Resource Conservation & Development, Inc. (GIRC&D), Pacific Missile Range Facility (PMRF), University of Hawai'i College of Tropical Agriculture and Human Resources (UH-CTAHR), UH Sea Grant, and the County of Kaua'i. KISC is also receiving support from the Hawai'i Invasive Species Council (HISC) as well as coordinated efforts between all island Invasive Species Committees (ISCs) and the Coordinating Group on Alien Pest Species (CGAPS). KISC is also a founding member of the Kaua'i Conservation Alliance (KCA).

KISC is focused on island-wide invasive species issues concerning, but not limited to, the threat to Kaua'i's: watershed areas, native forests and diverse native species, pasture lands, agricultural crops, recreational resources and the visitor industry. As stated in our Mission and Policy Statements, KISC's priorities are eradicating incipient invasive species, controlling the spread of established invasive populations, preventing the entry of new invasive species, and early detection and rapid response to newly discovered invasive threats. Under present conditions, Kaua'i faces the unchecked threat of pest introductions due to the lack of adequate quarantined transportation of people, goods, and plant materials to Kaua'i. Because of this, it is vital that early detection protocols and surveys be fully functional and implemented at all times.

The need for KISC here on Kaua'i is significant and with the support of the community at large, the State of Hawai'i, and partner's funding sources, KISC will make a significant impact on both the preservation of our irreplaceable resources and the prevention of possible negative effects on the local economy.

The Need for Continued Funding for Invasive Pest Eradication

Economically, invasive species have the potential to negatively impact down the State's primary private industry -- tourism. Pests such as biting sand flies, the lethal yellowing disease, red fire ants, the Caribbean coqui frog and a host of other harmful pests can wreak havoc on tourists and an industry dependent on a tranquil and peaceful environment. Other industries, such as agriculture suffer losses of an estimated \$300 million annually from the destruction caused by alien pests. Environmentally, Hawaii's scenic beauty and pristine environment are inextricably interrelated with the tourism industry. Thus, protecting the environment from invasive species means protecting the State's primary economic engine as demonstrated by recent efforts to control and eradicate the miconia plant that has overrun parts of the State cost \$1 million in Maui County alone. Invasive species also affect the health and safety of island residents and visitors. From rodents and brown tree snakes to dengue fever carrying mosquitoes and the stinging nettle caterpillar, the very nature of our Hawaiian lifestyle is jeopardized by the danger and disease caused by invading pests

Resource managers, ranchers, farmers, and other concerned community members recognize that although active on-site vigilance and management are essential for protecting native ecosystems, pastures, and crops, long-term protection of these areas may depend more than anything else on the success of keeping new alien plant and animal species from becoming established and spreading island-wide. Preventing establishment and spread of new introductions is not only cost-effective, but also practical. Likewise, resource managers recognize the need to work together on invasive species problems and solutions.

KISC is a grass-roots organization that has the capacity to survey, map, and control incipient invasive pests, act as an early-detection rapid-response team, as well as conduct long-term invasive species management. The majority of KISC's funding is sourced from Federal, State, and County level agencies such as; the US Forest Service, US Fish and Wildlife Service, Hawai'i Invasive Species Council, the State of Hawai'i, and the County of Kaua'i. Invasive Species Committees (ISCs) have now become established on all of the main Hawaiian Islands: Maui County was the first to form a committee (MISC) in 1997 (MISC conducts work throughout all of Maui Nui including on Molokai that has its own subcommittee called MoMISC); Big Island (Hawai'i) established a Melastome Action Committee (BIMAC) in 1995 that focused on miconia and expanded its focus to become an Invasive Species Committee (BIISC) in 1999; O'ahu formed an Invasive Species Committee (OISC) in the fall of 2000.

Each island has a different mix of agencies, stakeholders, and interest groups, with each contributing uniquely toward effective grassroots action against invasive species. Maui's successes and failures, in particular, guide efforts statewide. In addition, the

Invasive Species Committees have the potential for contributing to national and world models for such efforts. The ISCs work on several levels: building partnerships on each island to combat the worst invasive pests facing that island; with each other on common goals to prevent the spread of species from island to island; and with the statewide Coordinating Group on Alien Pest Species (CGAPS) in an effort to prevent new pests from entering the state by changing or enacting more effective policies, procedures, and legislation.

The management challenges for species such as miconia and other aggressive alien invaders provide examples of why committed, long-term funding is crucial to the effective control strategy for Kaua'i's worst pests. Populations of targeted invasive species remain, established seed banks persist, landowner access is pending in some areas, new areas need to be surveyed, and there is a steady stream of new introductions that have the potential to highly impact the State of Hawai'i's and Kaua'i's economy, environment, and quality of life. KISC is committed to early detection, a quick response with long-term sustainable efforts to eradicate and control these unwanted invaders.

Public education and outreach on Kaua'i is developing and expanding regarding invasive species issues. KISC targets school curriculum, develops educational materials, acts as liaison to the landscaping and horticultural trade, and interacts with the public at various venues across the island. The public's support will be a critical factor in the successfulness of KISC's objectives.

With continued funding KISC has been able to establish an office/base-yard that serves as their hub of operations. This facility is located at the College of Tropical Agriculture and Human Resources Experimental Farm above Kapa'a.

Staffing

In FY 2015, sufficient funds were released by the legislature to allow KISC to fill all positions. These included, filling two vacant crew positions, a full-time outreach specialist and the addition of an early detection botanist (see Fig 2). The chair elect also suggested the formation of an executive committee to consist of a committee chair, a chair elect and a past chair. This streamlined governance was adopted during the KISC annual meeting in October 2014 and a new chair and chair elect were selected by the attendees³.

In the early days of KISC's formation the committee was larger and meetings held more frequently. As the nature of the problem revealed itself to be long term repetitive management actions (e.g. repeated monthly sweeps for miconia until the seed bank is exhausted in as much as sixteen years) there was less for the committee to decide and less for KISC management to report. However, eight years passed since the last action

³ Meeting minutes October 2014

plan and it was determined in 2014 that old strategies and actions need to be updated and the early detection and priority target lists revisited.

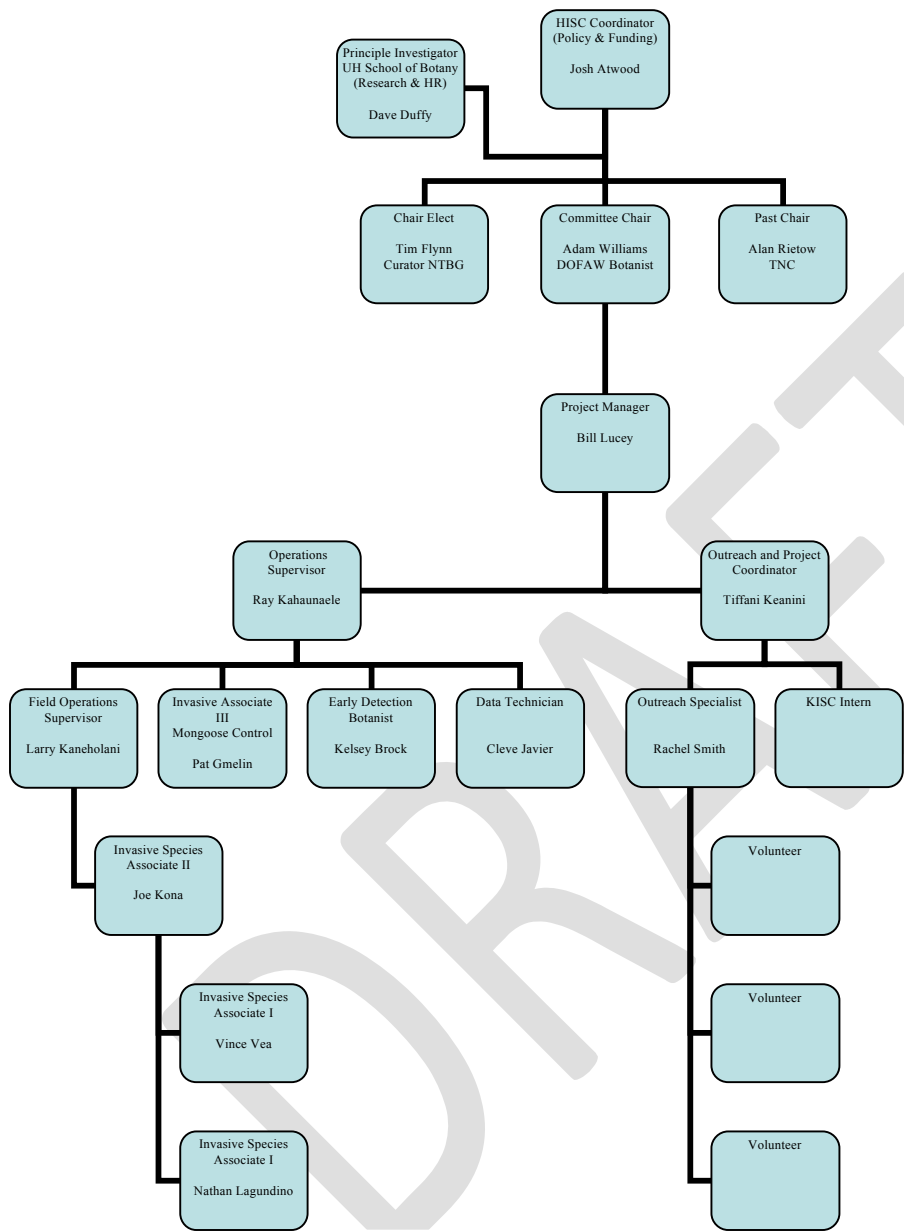


Figure 2: KISC Employee flowchart

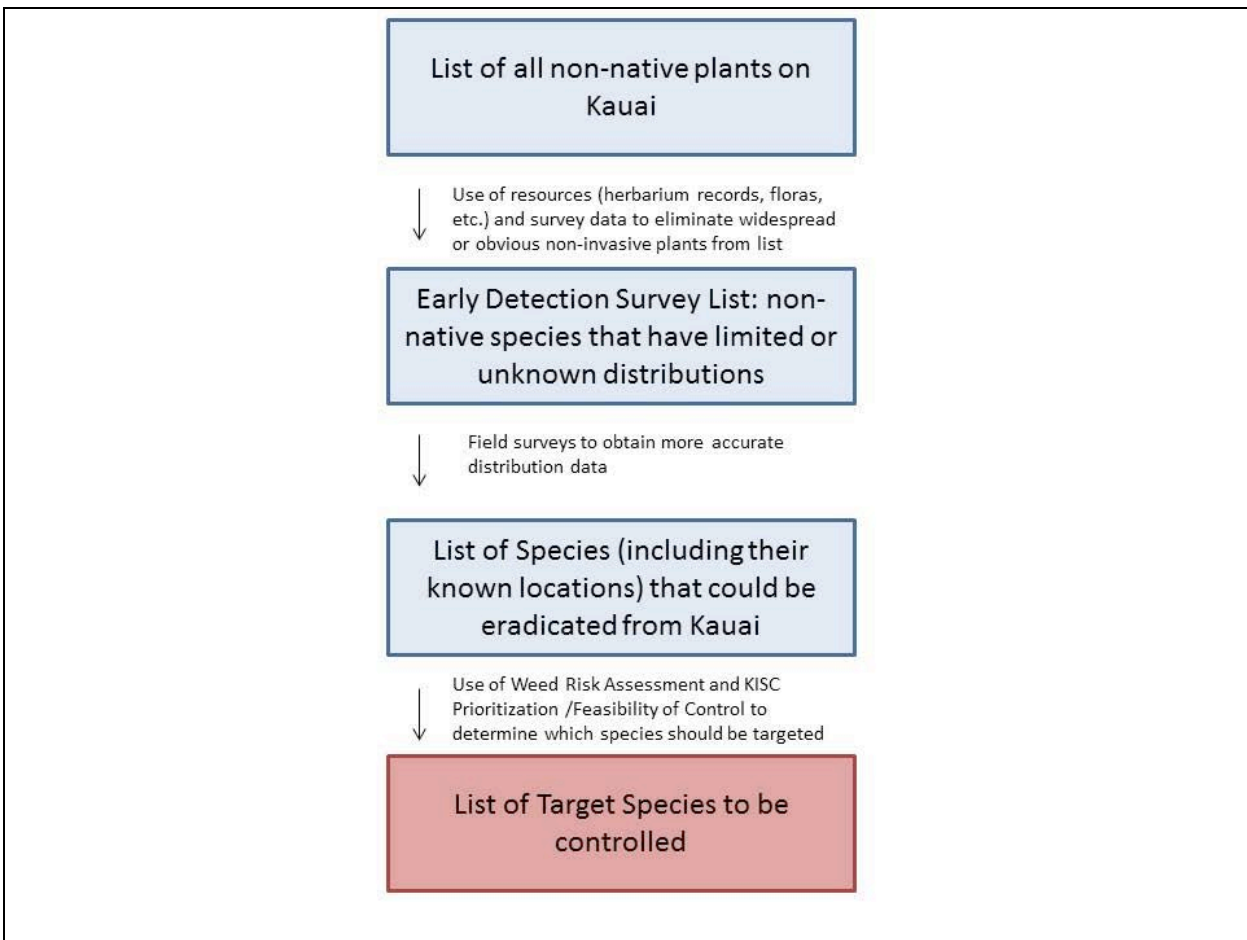
TERRESTRIAL PLANTS

EARLY DETECTION PROGRAM



An Early Detection strategy to identify and control incipient invasive plants yields obvious environmental and economic benefits as control during late invasion phases requires exponentially more resources. Past projects associated with KISC's Early Detection Program have included: 1) Compilation of a map showing all publicly available roads on Kauai, 2) Island wide roadside surveys 3) Production of a "plant prevention field guide"; a book of additional invasive pests (taken out daily with our ground crew) containing information on plants with a high potential of arriving on Kaua'i from neighboring islands and 4) developing an Early Detection Workshop through our outreach education program.

Future objectives will include adapting Oahu's Early Detection program for Kauai to better inform decisions about which non-native plant species should be prioritized for control. This will be completed primarily by the Early Detection Botanist (hired in April 2015), who will generate reliable distribution information and ongoing accurate plant identifications through field surveys while utilizing and depositing collections within the National Tropical Botanic Garden (NTBG). Distribution data is a critical component considered during KISC's Prioritization and Feasibility of Control (see Appendix A) process used to generate KISC's list of species targeted for control. Thus, this position will allow better recognition of which species can be eradicated by KISC alone vs which species may be managed by partnership projects or require out-of-scope funding. An overview of how the Early Detection Program influences the KISC Target Species list is represented below:



Furthermore, the comprehensive non-native plant species composition and distribution survey list and dataset created by this program will be useful to many other Kauai conservation groups for decisions regarding early detection, feasibility of control and restoration.

EARLY DETECTION SURVEY LIST

A database for consolidating invasion and distribution information for non-native species has been developed by Oahu's Early Detection program and will be utilized during this project. This database will be used to eventually derive a distribution score that will be assigned to each non-native species, revealing whether its distribution is known as limited, widespread or unknown. This information will be used to create an ever-evolving list of survey species, which is a critical first step for the plant Early Detection Program. This list will include species of interest that are of minimal or unknown distribution on Kauai, as well as invasive species that are likely to arrive from neighboring islands. Additionally, data and survey lists from past roadside surveys as well as inputs of island botanists as well as industry and conservation groups will be considered. On Oahu, this process was used to assess 1700 non-native plants to compile a survey list of 130 species.

INTRODUCTION-LEVEL DETECTION

As the majority of invasive plant introductions on Kauai have been intentional, KISC is working with Plant Pono to develop a Pono Endorsement program that encourages nurseries and landscapers to avoid distributing invasive plants. In order to receive Pono endorsement, nurseries will be encouraged the discontinued sale of targeted invasive species on endorsement program plant lists. These lists will largely reflect particular species that are deemed “high risk” by assessments conducted by the Hawaii Pacific Weed Risk Assessment (HPWRA), which will be promoted as a tool for nurseries to screen their stock for invasiveness. Additionally, Pono Endorsed companies must allow the KISC botanist to conduct thorough scheduled surveys of their inventory for targeted species, which also allows for detection of other species of interest. The species lists as well as other stipulations of the Pono Endorsement program are currently being developed.

EARLY DETECTION SURVEYS

Past Early Detection surveys have included roadside surveys in 2007 (conducted by National Tropical Botanic Garden staff; major roads), 2010 (conducted by Oahu Early Detection Botanists; all accessible roads) and 2014 (conducted by Oahu Early Detection Botanists; state roads only). In the future, surveys of all areas considered likely sites for incipient plant species invasions will be conducted, including:

- All accessible roads on Kauai
- Nurseries
- Public Gardens and Arboretums
- Ports of Entry
- Uncultivated areas adjacent to nurseries, gardens and other areas of plant cultivation.
- The first mile of every popular hiking trail

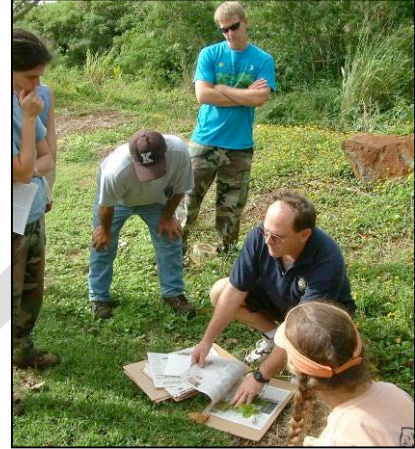
Location, as well as size and structure of the population will be recorded for species on the Early Detection Species List as well as for species not known to the surveyor (as they may be a new island introduction). This data will be entered into the KISC database and collections of specimens will be deposited in the NTBG herbarium with duplicates to be sent to the Bishop Museum. An annual report that will be distributed to the KISC committee, collaborators and interested parties will include the following:

- A map of areas surveyed
- A list of all species encountered and their assigned distribution rank
- Distribution maps for species on the Early Detection Survey List
- A list of species recommended for Early Eradication (ie. to be assessed for prioritization/feasibility of control)

EARLY DETECTION FIELD GUIDE AND WORKSHOPS

Background:

KISC's early detection workshops program was developed for both public outreach and professional continued education. In order to make the most of our limited resources in our fight against newly arriving invasive species we realize that, through education, we can have many more observers available to do some of our early detection work for us. The workshops are intended to train various factions of the interested public and allied work force employees what potentially invasive species to be aware of when they are out in the field.



These workshops have proven successful since the program began in 2010. KISC will continue the collaboration with conservation workers in the field, the interested public and local, State and Federal employees who commonly monitor areas such as ports of entry, roadsides and State Lands. These workshops will continue to broaden our scope of observation by utilizing the existing labor and skills already available on the island.

KISC's Early Detection Field Guide (provided at workshops) and Plant Prevention Guide (provided to staff and targeted partners) will both be updated following completion of the annual Early Detection Report.

RAPID RESPONSE

KISC maintains awareness about current invasive species that may arrive from neighbor islands through communication with other ISCs and conservation groups throughout the state. Information regarding species that pose significant environmental or economic threat is dispersed through KISC outreach events and information pamphlets to increase the likelihood of detection by the public. In the event that one of these species is detected, KISC will rapidly attempt to eradicate the species before it spreads. As part of this commitment, KISC maintains and adapts its resources to ensure it can rapidly delineate and organize control of incipient invasive species populations, which includes maintenance of: current detailed map data, appropriate field equipment, and useful information regarding access to property across the island.

TARGET SPECIES

KISC currently targets 19 plant and species for control with the intent of eventual eradication of these species from Kauai. These species were prioritized for control using a system based on a successful model developed by the New Zealand Department of Conservation. This tool identifies species that are perceived as highly invasive, are detrimental to environmental/agricultural ecosystems, have limited distributions, and are feasible to eradicate (e.g. are accessible and responsive to control efforts). The prioritization of control process is presented in Appendix A.

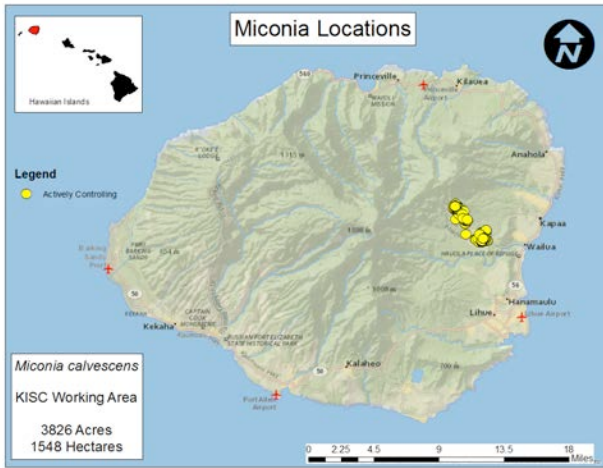
In addition to utilizing past roadside survey data and reports from the public to identify target plant species locations, KISC is in the process of aggregating data from Bishop and NTBG herbaria and other conservation groups on the island to ensure that former locations are surveyed. So far, this process has revealed fifteen additional locations that will be surveyed in 2015. Populations of target species are delineated by conducting searches within a 200m buffer of the known target location and in ideal habitat (if known) within an 800m buffer. Search methods vary depending on terrain, property access and degree of landscaping for each site. Sites where the target species re-establishes after control is applied are designated as “active sites” that will be revisited until the target is eradicated from the site. Sites where the target fails to re-establish after a suitable time has elapsed are placed on a 5 year monitoring schedule or are completely decommissioned for low risk sites (eg. site was paved). The time interval allowed to expire between both active site revisits and demotion of active sites to 5 year monitoring is determined on a site specific basis that reflects species biology and site conditions. The following table summarizes the control history for each of the KISC target plants species.

Common Name	Scientific Name	First date of KISC control	# total delineated sites	# active sites	# 5 year/ decommissioned sites
Barbados Gooseberry	<i>Pereskia aculeata</i>	2011	3	1	2
Bingabing	<i>Macaranga mappa</i>	2011	3	2	1
Calliandra	<i>Calliandra calothyrsus</i>	2014	1	1	0
Cattail	<i>Typha latifolia</i>	2002	32	32	0
Dillenia	<i>Dillenia suffruticosa</i>	2012	1	0	1
False Kava	<i>Piper auritum</i>	2002	20	14	6
Fireweed	<i>Senecio madagascariensis</i>	2002	4	0	4
Fountain Grass	<i>Pennisetum setaceum</i>	2004	4	2	2
Giant Reed	<i>Arundo donax</i>	2002	28	16	12
Grape Ivy	<i>Cissus nodosa</i>	2012	2	2	0
Ivy Gourd	<i>Coccinia grandis</i>	2002	27	16	11

Long Thorn Kiawe	<i>Prosopis juliflora</i>	2002	19	15	4
Miconia	<i>Miconia calvenscens</i>	2001	5	5	0
Molucca Raspberry	<i>Rubus sieboldii</i>	2013	1	1	0
Mules Foot Fern	<i>Angiopteris evecta</i>	2013	3	3	0
Pampas Grass	<i>Cortaderia spp.</i>	2002	4	0	4
Season vine	<i>Cissus verticillata</i>	2012	1	1	0
Velvet Leaf	<i>Clerodendrum macrostegium</i>	2012	4	4	0
Wax Myrtle	<i>Morella cerifera</i>	2012	2	0	2

* Target species that have been eliminated (placed on 5 year plan or decommissioned) from all delineated sites are indicated in bold font.

1) Miconia (*Miconia calvenscens*)



Miconia is KISC’s number one targeted plant species. It is the top priority and will receive the time and resources necessary to eradicate all discovered populations and individual plants.

If miconia escapes the Wailua area and becomes established in the rugged terrain of the Halelea Forest Reserve, it will challenge all of Kaua’i’s resources to control it. Approximately 158,000 acres of native wet forest, prime habitat for miconia, are at risk.

Background:

Miconia calvenscens is native to South and Central America and was introduced to the Hawaiian Islands in the 1960’s via the horticultural trade for its landscaping appeal. Also known as the velvet tree, miconia is a unique plant with large, velvety green and purple leaves. Annual seed production for a single miconia plant is well over one million seeds, which are dispersed via birds, wind, water, animals and humans. With this enormous reproductive capacity it did not take long for this landscape ornamental to escape its cultivated surroundings. Though hardly a

dominant species in its' native forests, miconia has thrived on the Pacific islands. In Tahiti, miconia dominates over 70% of the forests and causes significant erosion problems. Control of *miconia calvescens* on the island of Kaua'i began in the mid-1990's after plants were reported in the Wailua Homesteads area. An effort coordinated by Hawai'i Department of Agriculture (HDOA) personnel resulted in the removal of several dozen plants, primarily from private properties near the nursery. Another dozen plants were located on State land nearby in the canyon of the Wailua River State Park (WRSP).

In September of 2000, after a period of no activity, reports by the Kaua'i Sierra Club of a reemerging miconia population reached the Division of Forestry and Wildlife (DOFAW). DOFAW, assisted by volunteers and staff of the Koke'e Resource Conservation Program (KRCP), began systematic searches of the WRSP. In 2002 KISC organized miconia searches in the Homesteads area, and a public awareness campaign was also resumed.

Aerial surveys were conducted by KISC in 2003 in the Wailua Game Management Area where a population of flowering and fruiting mature trees were discovered. This new discovery drastically increased Kaua'i's known infestation area and ground surveys were initiated to eliminate all detected plants.

Currently, the potentially "contaminated" area on Kaua'i is to 3,500 acres in these three areas; Wailua Game Management Areas, Wailua Homesteads, and Wailua River State Park. This is based on the experience of control teams on the islands of Maui and Hawai'i, where juvenile miconia have been located as far as 1,000 meters away from the nearest adult plant. However, miconia are often found as far as 2,000 meters up or downstream from the source in river valleys. This probably reflects transport by birds using the river corridor as a flyway, pigs collecting seeds on fur or hooves through rooting or by water movement. On Kaua'i, measurements are also based on species of individual birds found and how far they are capable of flying while distributing eaten seeds.

Generally, a period of two years is allowed to elapse between visits to infestation areas as it allows newly germinated plants to grow to a height where they can be easily seen but without any danger of them reaching maturity. However, it is supposed that plants germinating deep within the thick uluhe (staghorn fern) may take longer to reach maturity in that darkened environment.

Aerial surveys are conducted quarterly throughout the entire 1,000 meter buffer area primarily in the GMA. Aerial surveys also utilize Herbicide Ballistic Technology (HBT) to immediately treat any found plants. Plant locations spotted by air are marked with a GPS unit and ground crews follow up with more thorough ground surveys and treat any additional plants that are found. Occasionally, aerial surveys are conducted outside of the traditional core area in order to account for seed dispersal by wind, water, pigs and far ranging birds.

Objectives: Eradicate

Strategy: The known population of miconia on Kaua'i is relatively small and has been managed successfully by striving to eliminate plants before they become mature. Because the seed-bank can persist for >16 years, we must maintain our ground efforts coupled with survey flights at least quarterly.

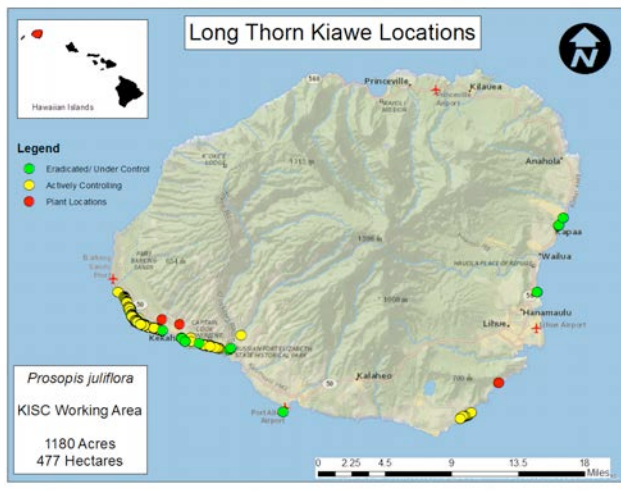
Actions:

- Continue to search the Wailua River State Park and all other lands considered high-risk areas, map, and treat all plants discovered;
- Perform aerial surveys of appropriate areas, such as the Wailua Game Management Area and surrounding Halelea Forest Reserve, utilizing HBT;
- Conduct monitoring of sites where mature plants have been found and mapped, and remove any seedlings. Work with DOFAW to carry out monitoring in the Forest Reserve;
- Contact landowners for access permission and re-survey likely miconia habitats on private property in the Wailua Homesteads area;
- Current distribution data is being used within GIS to quantify specific habitat parameters (such as elevation, precipitation, temperature and land-cover type) in order to make a habitat selection model for miconia. This will increase our search protocol and effectiveness
- Continue to prioritize resources towards miconia as KISC's number one target, for the long term, to insure adequate follow-up takes place. KISC will review progress and develop a strategic plan for continuing a comprehensive miconia eradication program.
- Outreach to both the general public and residents in and around the infected zone.

Methods:

- Current distribution data is being used within GIS to quantify specific habitat parameters (such as elevation, precipitation, temperature and land-cover type) in order to make a habitat selection model for miconia. This will increase our search protocol and effectiveness.
- Organize transects to allow thorough coverage of search area;
- Seedlings and small trees are pulled, and hung upside-down in trees for roots to dry. Large trees are cut and immediately treated with 100% Garlon-4 (in accordance with the label). For any mature trees found, all panicles with fruits are removed and bagged for incineration and metal marker tag attached indicating date and size of tree;
- The utilization of HBT with aerial surveys as well as ground surveys in areas of difficult access will be carried out;
- All survey areas are mapped using GPS with data and GIS entered into KISC database;
- All gear worn or used during miconia surveys and treatments are dedicated and only used for miconia field operations. A dedicated miconia washing machine/ dryer at the KISC base-yard where all gear is decontaminated, according to protocol, and stored in a separate room.

2) Long thorn kiawe (*Prosopis juliflora*)



Background:

It must be noted that *Prosopis juliflora* varies from the more common species of Kiawe (*Prosopis pallida*) found on Kaua'i. *P. juliflora* contains thorns up to several inches long which are sharp enough to pierce through automobile tires. This long-thorned variety first appeared in Hawai'i about 1978, and is found on O'ahu, Kaua'i and Ni'ihau. On Kaua'i there are currently three known populations: on the beaches of Mahaulepu, and from Pakala Point to Mana on the western side of the island. The potential range for *Prosopis* is within a few hundred feet of the high water mark from Nawiliwili to the Napali Coast (approx. 40 miles). *P. juliflora* is in the legume family, producing multiple seed pods which can tolerate saltwater, are drought resistant and persist in the soil for multiple decades. Long Thorn Kiawe is considered a major threat to the tourism industry on Kaua'i not only because of its treacherous thorns, but because it restricts access to the beaches. Long Thorn also seriously threatens endemic coastal strand vegetation by creating a monotypic, impenetrable bramble that no native vegetation can grow through. Mechanical control and the herbicides Spike and Garlon-4 have been identified as the most efficacious means to control *Prosopis*.

Prosopis juliflora is a long-term target for both KISC and HDOA. The relatively slow growth rate of Long Thorn makes it a manageable target that does not require rapid response but its ability to out-compete native vegetation in combination with the persistent seed-bank make it a primary target that can be managed over the long term.

Objective: Eradicate

Strategy: Control and monitor

Actions:

- Keep areas of light infestation under control by continual monitoring/treatment for seedlings and re growth.
- Continue work at the well-established hedge in the Mana area that spans about 4 miles along the coast. Because of sensitive cultural aspects of the area where the hedge is located, mechanized control is not a viable option. Manual removal

of Kiawe is very time and labor intensive requiring persistent effort and an appropriate management time frame spanning multiple seasons.

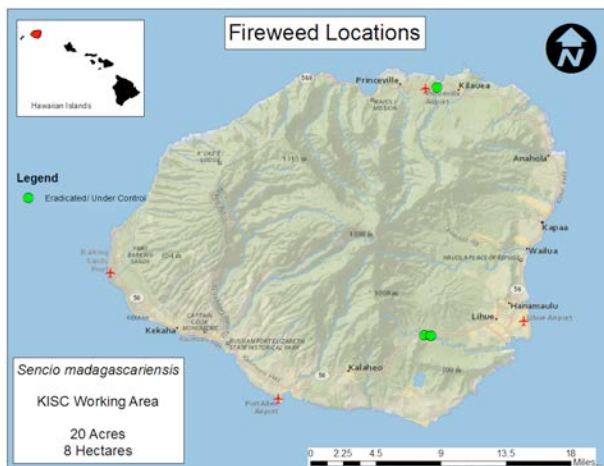
- Opportunistically partner with the Pacific Missile Range Facility on mechanical removal of *P. juliflora* at the base.

Methods:

- Hand pull newly emerged seedlings. The root system is too well developed on plants any larger than ~1’.
- On larger plants we use a cut stump treatment; cutting the tree with a chainsaw horizontally as close to the ground as possible. A 50% Garlon/forest crop oil mixed herbicide is applied immediately after the fresh cut for the most efficient herbicide translocation into the root system.
- Plant material is left at the site and we are investigating ways of mulching the downed trees to make access to seedlings easier upon post treatment monitoring.

A collaborative Long Thorn Kiawe removal project with KISC and The Pacific Missile Range Facility (PMRF) is utilizing mechanized removal of the trees via a hydro-axe which grinds the tree to mulch, followed by a bulldozer which scrapes debris away from the stump (being careful not to disturb possibly culturally sensitive areas). This is then followed up by ground crews making a fresh cut of the stump and immediately applying chemical. PMRF will be clearing all LTK on base beginning in June, 2015. KISC will be responsible for the monitoring and treatment of seedlings after initial removal.

3) Fireweed (*Senecio madagascariensis*)



Background:

Fireweed is a yellow flowering weed currently listed on Hawai'i's Noxious Weed List by the Department of Agriculture. This plant poses a serious threat to pasturelands as it is poisonous to horses, cattle, and other livestock. Each plant is capable of producing 25,000 to 30,000 seeds in a single growing season which can persist in

the soil for at least 50 years. In Australia, yearly losses of \$2,000,000 are attributed to fireweed.

In 1990, the weed was found along the roadway near Halfway Bridge, between Lihue and Koloa on the island of Kaua'i. This infestation probably started with some roadside plantings of grass seeds from Australia that contained some unwanted fireweed seeds. Since discovery, this plant has been a target of HDOA with KISC assisting since 2002.

In 2003 Fireweed was discovered at a residence in Kalihiwai. This introduction, again, was due to unwanted fireweed seeds mixed into hydro-mulch and then sprayed onto a hillside. Due to higher rainfall in this area, rapid germination led to quick eradication at this site.

This one known population has effectively been reduced from finding an average of 1000 plants per month to finding zero in FY2006

Objectives: Keep fireweed from reestablishing on Kauai

Strategy: All known populations of this plant have been eradicated from the island. Because past infestations have been introduced through hydro-mulching, KISC will be collaborating with companies to obtain a map of areas that have been hydro-mulched so they can be regularly surveyed in the future.

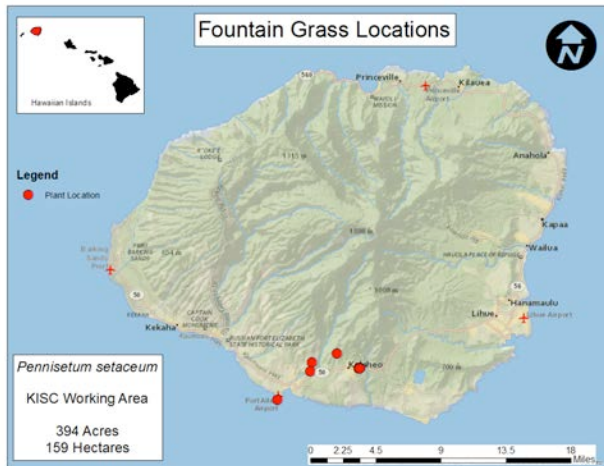
Actions:

- Areas are surveyed via transect and any plant found is pulled and disposed of in a plastic bag to make sure that no plants have seeded.
- If a seeding plant is found, the area is flagged and dated. KISC control team will work in coordination with HDOA to monitor and survey for outlying undiscovered populations, and re-treat any new plants within the core population.
- Targeted outreach to hydro-mulch and landscaping companies

Methods:

- The plant is pulled and bagged for disposal and a granular herbicide (Snapshot™) is spread within a 3 m diameter of the area. Snapshot is a pre-emergent and works by killing seeds before they can germinate.

4) Fountain Grass (*Pennisetum setaceum*)



Background:

Originally introduced as an ornamental, fountain grass has become an aggressive invader and is currently listed on Hawai'i's Noxious Weed List by the Hawai'i Department of Agriculture. Fountain grass degrades pasturelands and is not nutritionally preferred by livestock therefore resisting any grazing pressure. Unlike other non-native grasses, *P. setaceum* colonizes bare or sparsely vegetated areas, such as lava flows, thus threatening primary native ecosystems. Fountain Grass is a significant fire hazard and is in fact stimulated by fire; thus further endangering the native woody plant communities it invades. Seeds are spread easily by vehicles, humans, wind, and water and can become established at elevations ranging from sea level to over 8000 feet. Although it has a wide elevational range, it is usually limited to areas with a median annual rainfall of less than 50 inches.

Kaua'i has two known populations of Fountain Grass: in Kalaheo, Hanapepe, and possibly one on the North Shore which is unconfirmed with a voucher specimen. The core population is located mountainside of Kalaheo and is believed to have been there since the early 1930's. It is assumed that this population has remained pretty much contained due to the higher average rainfall in this area. There have been sightings of plants along the cliffs above Hanapepe River, indicating that this pest is moving west. Most of this core population is located on private land on rugged terrain, and may be inaccessible by ground crews alone.

Objective: Evaluate

Strategy: Continue to work in collaboration with the Hawai'i Department of Agriculture on all known populations and survey potential habitat for new populations.

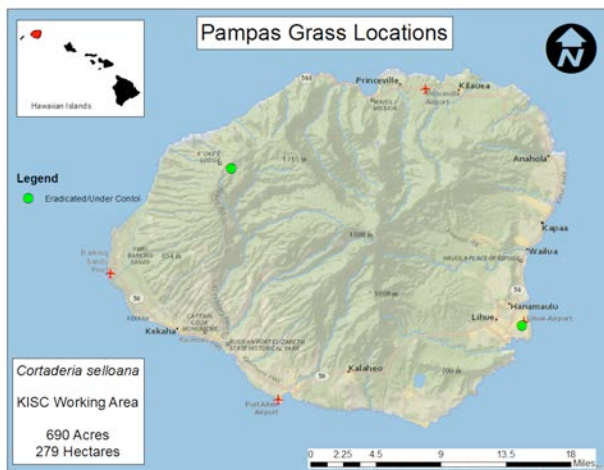
- The KISC control team will re-treat the small population location near the Port Allen airstrip and monitor the site.
- KISC and HDOA will seek access to private lands to treat outlying populations of Fountain Grass.

- KISC and HDOA will seek access to acquire a voucher specimen from a possible population on the north shore above Haena Beach Park.
- KISC is also collaborating with TNC to establish an aerial-spray operation to treat fountain grass on inaccessible slopes. (what happened to this)

Methods:

- Survey areas for re-sprouts which have been previously treated.
- When accessible, remove any seed-heads from plants and discard in a plastic bag to prevent further seed spread.
- For treatment of non-seeding plants drizzle spray with 8% Round-up mixed with water.

5) Pampas Grass (*Cortaderia jubata* or *C. selloana*)



Background:

This species, recognized as one of the worst invasive weeds in coastal areas of California, New Zealand and South Africa, and was added to the Hawai'i Noxious Weed List in 1993. Each plant can produce thousands of seeds that are wind-dispersed up to 20 miles and can remain viable, persisting in the soil seed bank for at least six years before germinating. Pampas grass invades mesic and wet forests to dry alpine shrubland. *C. jubata* reproduces through the process of agamosperous apomixes. Female plants are able to produce viable, genetically identical seed without pollination. *C. selloana* however requires both sexes for crosspollination. On Kaua'i, known populations were believed to be female plants of *C. selloana* due to lack of spread.. All known populations (Kokee State Park, Kauai Lagoons Golf Course, and Princeville) have been successfully eradicated.

Objective: Maintain eradication

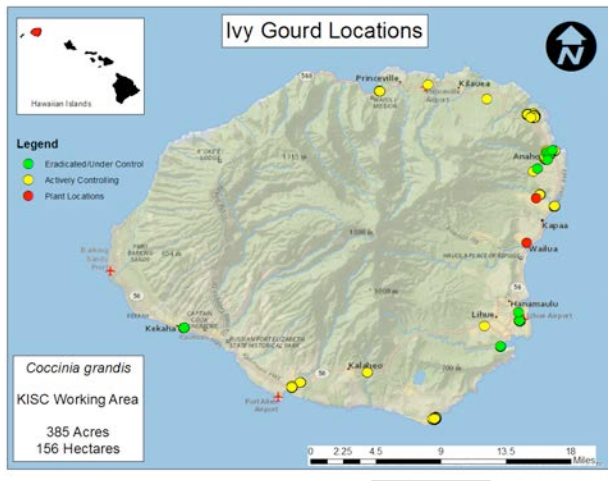
Strategy: Move to ED list

Monitor all infestation sites and survey potential habitat as well as nurseries for new arrivals of either species.

Methods:

- In residential and urban areas, where *Cortaderia* is planted ornamentally and where the use of herbicides is discouraged, plants are dug out of the ground and burned in a safe area that can be monitored for seed emergence.
- Chemical treatment for *Cortaderia* is a drizzle spray application of 8% Roundup mixed with water.
- Add to ED outreach strategy

6) Ivy Gourd (*Coccinea grandis*)



Background:

This species (on Hawai'i Noxious Weed List) commonly used in food preparation exploded on Oahu and the Big Island in Kona in the 1980s, creating problems for agriculture and conservation of lowland sites. Ivy Gourd is a choking vine that produces a cucumber-like fruit. Seeds are dispersed mainly by birds and humans and can persist in the seed-bank for up to 4 years. This plant is considered eradicable because it requires both sexes to pollinate; therefore spread is relatively contained and slow. Alternately this target is difficult to kill on the first treatment because of the sheer mass of the vine network as well as the difficulty in finding the main vine in dense vegetation. Repeated treatment is necessary and does show success over time. There are seven known populations of Ivy Gourd on Kaua'i, located in Anahola, Moloaa, Kapa'a, Lihue and Mahaulepu which cover an estimated 20-plus acres.

Objective: Eradicate

Strategy: Standard control and monitoring

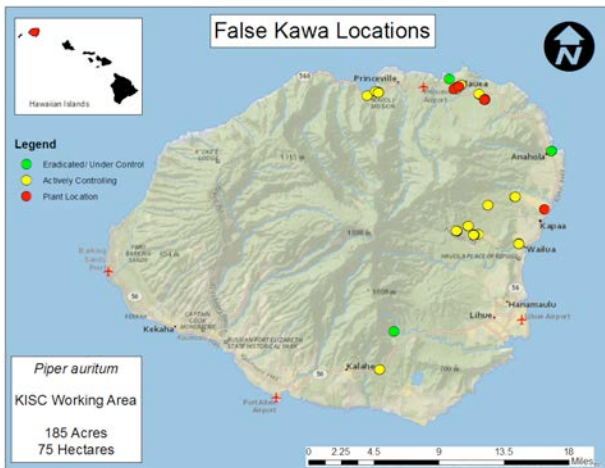
Actions:

- Treat all individuals of all known populations.
- Conduct comprehensive surveys of areas near known infestations.
- These sites as well as buffer zones will be monitored on a monthly basis.
- Outreach

Methods:

- A notch/scrape method with a 50% Garlon4 Ultra/crop oil mix seems to work well.
- Any fruit found should be removed and bagged and properly disposed of to slow the spread of new plants.
- Conduct continual surveys to find new populations. Common new sources would be residential areas and green waste dumps.

7) False Kava or “Golden False awa” (*Piper auritum*)



Background:

False Kava is easily mistaken for true Awa when it is small and poses serious problems for the Awa industry. Primarily false kava “dilutes” the quality of genuine Kava by being harvested and unintentionally mixed. When buyers, both in the Pacific and in larger external markets, learn of this, shipments may be rejected and local and export markets lost. Secondly, it is larger than Kava, grows more vigorously, and can be a weed interfering with the growth of other crops. It may also be an alternate host for pests and pathogens of Kava but this has yet to be demonstrated (Englberger 2001; Pest Alert 19). False Kava is spread by rhizome and seeds via birds, bats, and possibly, rodents. All plant parts are considered plant propagules as rooting can take place even from a leaf or stem piece.

There are 15 known populations of False Kava on Kaua’i. Seven of these populations have been eradicated.. Continued monitoring is necessary even with such a small population in order to insure total treatment success. Further surveys will most likely be focused on residential areas were the plant might be intentionally planted.

Objectives: Eradicate

Strategy: Standard control and monitoring

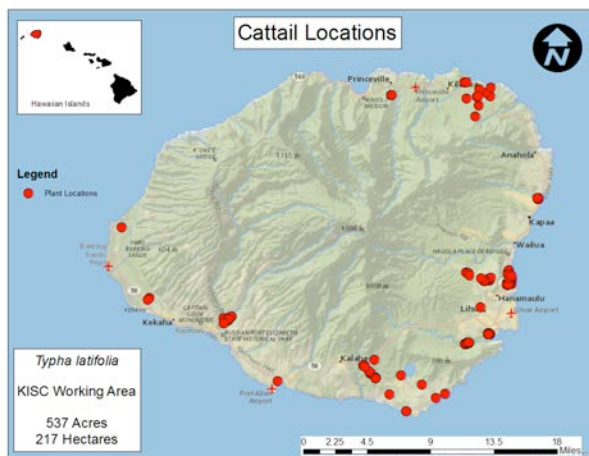
Actions:

- Continue to monitor known areas of False Kava
- Treat all plants found.
- Outreach

Methods:

- Cut stump treatment is used followed with application of Garlon 4 in forest crop oil mixed at 50%.
- The cut plant is placed in a plastic bag and properly disposed of.

8) Cattail (*Typha latifolia*)



Background:

Cattail is an invasive wetland rush which occurs naturally in Eurasia, North Africa and North America. It spreads via air-blown seeds and underground vegetative runners. It was first collected on Oahu in 1979 and has since spread to the Big Island and Kaua'i. If left unchecked, this plant can form dense, monotypic stands, effectively eliminating all open water in shallow water habitats, areas vital to species such as endangered Hawaiian stilts. Cattail is also a major threat to the taro industry encroaching into both cultivated and fallow lo'i. On Kaua'i, the known populations of cattail are still regarded as incipient. For this reason, the eradication of this potential pest can still be achieved quickly and at relatively little cost. Given the healthy condition of endangered water birds on Kaua'i, the eradication of this invasive wetland plant should be considered as appropriate water bird habitat management. At present, there are several known populations of cattail on Kaua'i; on the North shore in Kilauea, in Omao, at Poipu Beach Park, at the Wailua Golf Course, in Kapa'a stream, and a large 4+ acre population in Makaweli Valley, Waimea. Another population is located on U. S. Fish and Wildlife Service (USFWS) land in Huleia and is being monitored and treated by USFWS staff.

Objective: Control or eradication?

Strategy: Coordinate with DAR and Taro farmers to determine priority treatment areas

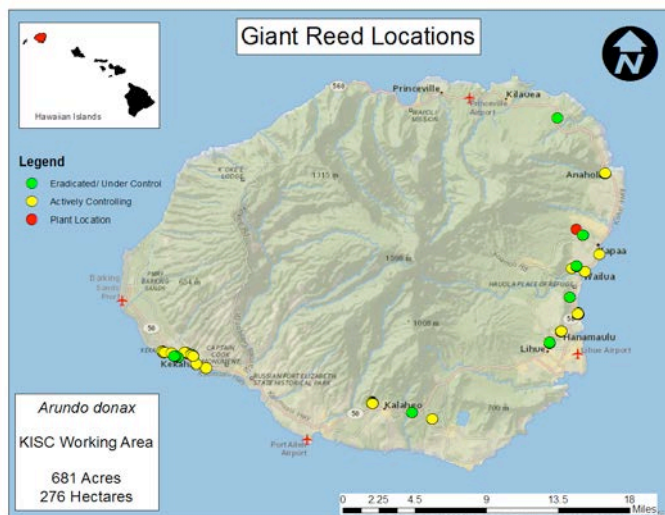
Actions:

- Cut seed heads before they flower
- Treat with a solution of AquaMaster while carefully tracking dosage restrictions
- Monitor cleared sites (cattail seeds can remain viable for up to 100 years)
- Efforts are also currently underway to add this species to the Hawai'i Noxious Weed list?

Methods:

- Cattail is treated with a 20% mixture of AquaMaster/ water/ surfactant and applied by drizzle spray method.
- Seed heads are carefully picked and placed into a plastic bag for proper disposal.
- Makaweli Valley requires some habitat modification prior to treatment which includes removing vegetation and re-aligning and deepening an old drainage ditch in order to drain the backwater area where the cattails are located.

9) Giant Reed Grass (*Arundo donax*)



Background:

Originally from the Mediterranean region, *Arundo* has been cultivated for human cultural and practical uses such as making fishing poles and roofing fiber for many centuries. It was first introduced into California in the 1800's and has since become naturalized in much of the Southern United States. This tall reed spreads mainly by underground rhizomes, forming dense stands in moist to wet sites. It is invasive in Florida and California, along riparian areas and roadsides. The dense vegetation interferes with flood control, displaces native plants and animals, and is a potential fire hazard. It has been reported to have growth rates up to .7m per week in favorable conditions (Perdue 1958). *Arundo* is a rhizome, creating dense monotypic stands that can choke out waterways. In addition, *Arundo* is transported easily by flooding waterways or as green waste and can re-sprout from plant matter. Once established, *A. donax* is hard to kill. On Kaua'i populations are found predominantly on the Westside in old irrigation ditches,

deserted pastures, near road sides, or in abandoned lots. A few populations exist on the East and North side of the island mostly on residential or industrial land.

Objective: Eradicate

Strategy: Standard control and monitoring

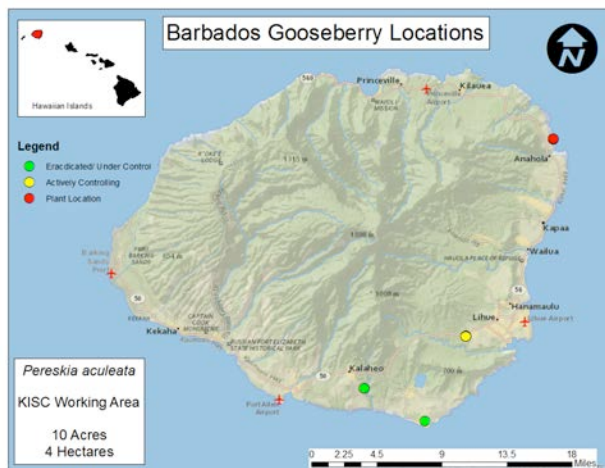
Actions:

- Early detection surveys
- Treatment of known populations
- Monitoring for ### years
- Outreach

Methods:

- Large stands of *Arundo* are cut at the base of the stem and left to resprout. It is then treated with Makaze (if away from water source) or AquaMaster (if near water source), mixed with a surfactant and H2O for an 8% dilution rate, and applied with a backpack or drizzle sprayer.
- Small re-growth patches are treated with an 8% mixture of RoundUp or AquaMaster, water, and surfactant applied with a drizzle sprayer.
- If only a few large plants are present, a cut stump method is used, and stumps are treated with a 50% rate of Makaze or Aquamaster (depending on presence of water)

10) Barbados Gooseberry (*Pereskia aculeata*)



Background:

Barbados gooseberry is native to the West Indies, coastal northern South America and Panama that is cultivated as an ornamental and is known to be invasive outside of its native range. It forms a woody shrub when young and grows into climbing, leafy vine, with branches up to 11m (33 ft) long when mature. It forms dense, thorny thickets in low elevations that overgrows and replaces other plants on Molokai and Oahu. The seeds are spread by birds and other animals that consume the fleshy fruit. This plant was first noticed on Kauai at the end of Papalina road, Kalaheo near NTBG and has

been known to grow out of plant waste piles. Several plants have been removed by KISC from nurseries such that no Kauai nurseries are currently selling this plant that we are aware of. However, one known site of potted Barbados gooseberry is still known on the island and KISC is working to acquire landowner cooperation.

Objective: Eradicate

Strategy: Standard control and monitoring

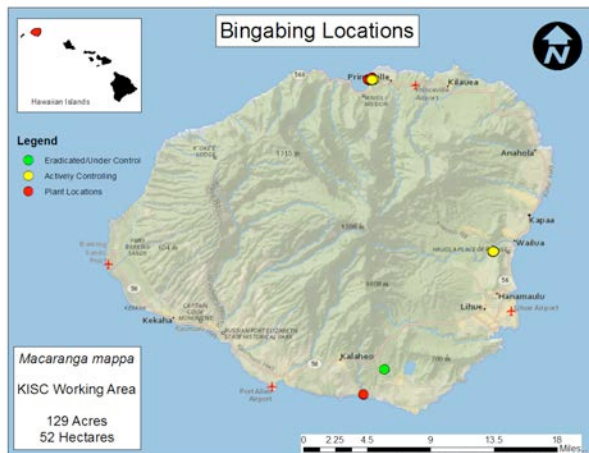
Actions:

- Number of infestation sites (total acreage)
- Continue to provide outreach to raise public awareness and respond to reports of Barbados gooseberry sightings.

Methods:

- Cut Stump treatment- All branches and fruits are cut and brought back to baseyard for disposal (either burned or stored till it rots). Base of stump is treated with Garlon 4 Ultra mixed with forest crop oil for a 50/50 ratio.

11) Bingabing (*Macaranga mappa*)



Background:

Bingabing is a large leafed tree that is native to the Philippines. It has naturalized in moist to mesic areas of lowlands, 0-220 m (722 ft), on O'ahu and Hawai'i where it forms large dense stands that shade-out understory vegetation. As far as KISC is aware, one single population of this plant remains on Kauai where it is limited to the mouth of the Hanalei River. This large population of mature trees was first delineated in 2014 and has not been treated due to landowner access issues. Other individual plants have been removed.

Objective: Eradicate

Strategy: Standard control and monitoring

Actions:

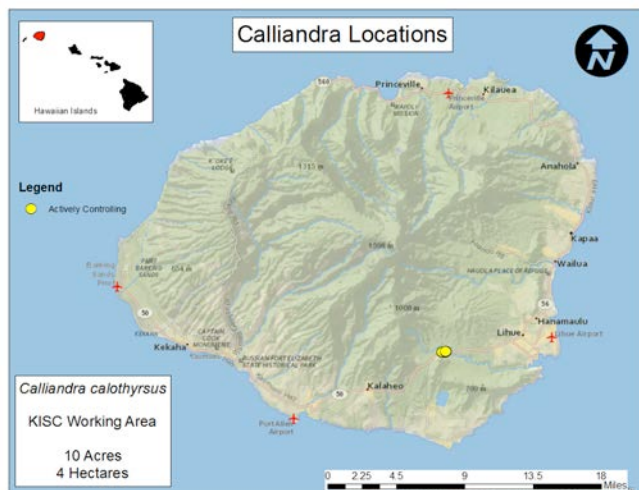
- KISC will continue to work with landowners to gain access to Hanalei site

- Monitor controlled areas such as fern grotto
- Outreach

Methods:

- Cut Stump treatment- Trees are cut by chainsaw, handsaw, or machete. Stumps are treated with Garlon4 Ultra mixed with forest crop oil at a 50/50 ratio. Debris is left on-site.

12) Calliandra (*Calliandra calothyrsus*)



Background:

Calliandra is a small nitrogen-fixing tree or large shrub that is native to Central America and Mexico. It has been utilized outside of its native range for agroforestry purposes and is known to colonize river banks and disturbed areas. It has naturalized outside of its native range and is considered naturalized on Maui, the Lanai Islands and Hawaii. It is currently found on Kauai at the Hawaiian Mahogany Inc. planting site located east of Kahoaea and west of Half-Way Bridge where it was planted as a nurse crop for *Eucalyptus*. However, the nurse crop was never harvested. Past control of Calliandra has been localized to saplings that are naturalizing adjacent to Highway 50 as part of the Department of Transportation Statewide Noxious Invasive Pest Program (SNIPP), while mature trees continue to grow on the planting site.

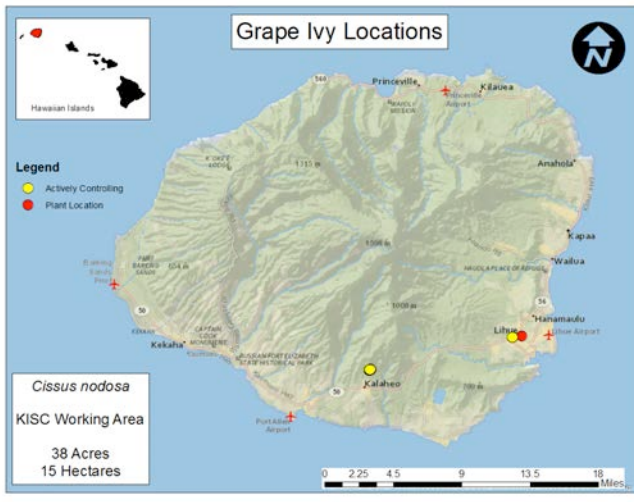
Objective: Eradicate / Evaluate

Strategy: Standard control and monitoring

Actions:

- As KISC’s mandate is to take on targets that can be eradicated, this plant will need to be re-assessed for feasibility of control. This will involve inquiry about whether land-owners will cooperate regarding access and conducting surveys of identify the extent of the infestation.
- Identify other calliandra species and evaluate for WRA and Ecosystem Risk Assessment scores

14) Grape Ivy (*Cissus nodosa*)



Background:

Grape Ivy is a large vine native to Indonesia and Malaysia with a smothering growth habit that will quickly climb nearby trees and structures. It has naturalized on Oahu and the Big Island. KISC has tried multiple herbicides to control this plant with little success.

Objective: Reevaluate

Strategy: Treating this plant has proved labor intensive, and good taxonomic skills are required to identify grape ivy from other vines growing at invested sites. KISC plans to re-evaluate the feasibility of tackling this plant as a target.

Actions:

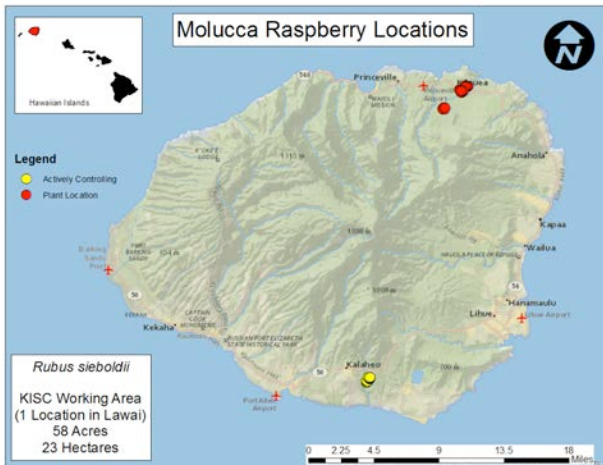
- Provide training in identification
- Work with Dr. James Leary of CTHAR to determine effective treatment methods

Methods:

The following trial applications have been attempted with little success:

- Fill in Notch/scrape method- vine bark is scraped (about 3 to 4 inches) and 50% Garlon4 Ultra/crop oil mix is applied to wound.
- Foliar Application-Stalker (Imazapyr) applied at 3% and diluted with water. Sprayed on foliage using squirt bottles/ back pack sprayers
- Drizzle Application- 20% Stalker diluted with water
- Foliar Application of Milestone (aminopyralid) at 3% diluted with water.
- Foliar Application- Milestone at 3% mixed with ammonia sulfate and water
- Foliar app- Milestone at 7% mixed with water
- Foliar app- Milestone at 7% mixed with water and ammonia sulfate.
- Foliar app- MCP Amine 4 (2-Methyl-4chlorophenoxyacetic/2-4D) at 1% mixed with water
- Foliar app- MCP Amine 4 (2-Methyl-4chlorophenoxyacetic/2-4D) at 3% mixed with water

15) *Molucca Raspberry (Rubus sieboldii)*



Background:

This spiny shrub is native to Australia and western Asia and is known to occupy a wide range of elevations and environmental conditions in its native range. It was brought to Kauai as a cultivated plant where it was noticed naturalizing in the 1970's in Lawai Valley and Kilauea. This plant appears to be becoming more abundant on Kauai as sightings from the field crew and partners have been increasing around Kilauea. However, the population at Kilauea may be too large to eradicate.

Objective: Re-assess this species as a target. This will involve consideration of whether eradication from the south shore while conducting perpetual surveys to ensure containment at Kilauea will be beneficial and affordable.

Strategy: Standard control and monitoring

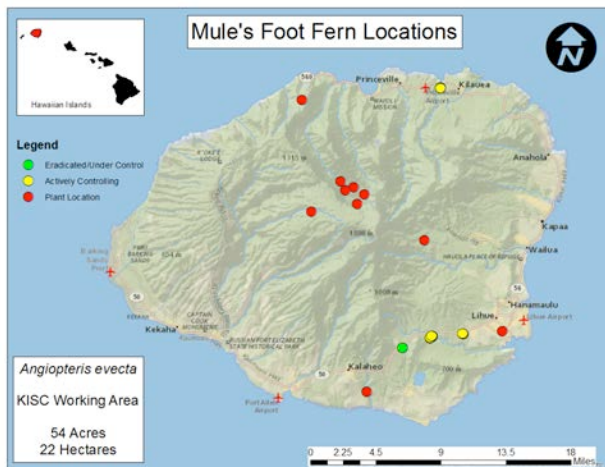
Actions:

- Continue controlling site at Lawai to prevent spread in Koke'e
- Survey/monitor Kilauea population for containment

Methods:

- Drizzle application- Garlon4 Ultra at 20% mixed with forest crop oil
- Foliar Application- Garlon4 Ultra at 8% mixed with fco

16) Mule's Foot Fern (*Angiopteris evecta*)



Background:

Mule's Foot Fern is a large fern native to Australia and New Guinea, Melanesia, Micronesia, and Polynesia that is recorded as naturalized in Hawaii and Jamaica. In Hawaii, natural ecosystems are altered by dense stands of this plant, which crowds out native species. Currently this plant appears to be less abundant on Kauai than other Hawaiian islands. Three KISC sites near lowland cultivated areas have been discovered by and herbarium records and partners indicate that this plant has occasionally been seen on Kauai at moist sites at various elevations.

Objective: Evaluate

Strategy: Standard control and monitoring

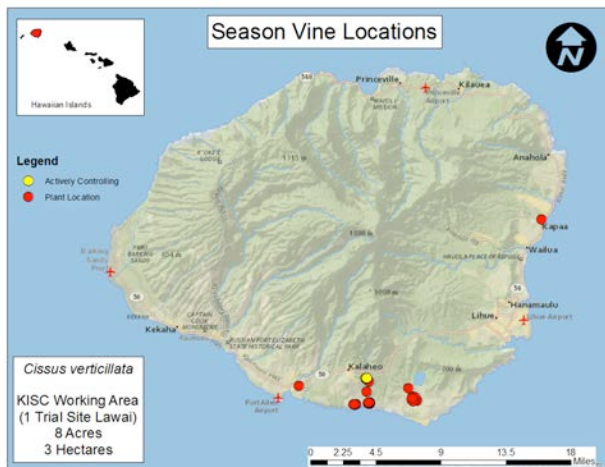
Actions:

- Continue controlling known infestations
- Attempt to compile additional information from partners and other conservation groups about the distribution of this plant across the island.
- Re-assess this species for feasibility as a KISC target and discuss partnerships to eradicate/contain this species island wide.

Methods:

- Fill in IPA (incision point application)- Garlon 4Ultra at 50% mixed with forest crop oil. Brain of fern is notched and herbicide is applied to the notch.
- Foliar Application- Garlon4 Ultra at 8% mixed with forest crop oil. Used on small seedlings.

17) Season Vine (*Cissus verticillata*)



Background:

Season vine is a large woody vine native to central and South America that has naturalized on Kauai and Oahu. It can grow in a wide range of habitats and is known from elevations from sea level to 2,500m. Additionally, it is an alternate host for Hibiscus mealy bug. Two populations of this plant were detected during the 2010 roadside survey. KISC has tried multiple methods to control this plant with little success and one location is known from agricultural land where herbicide application should be performed with caution.

Objective: Evaluate

Actions:

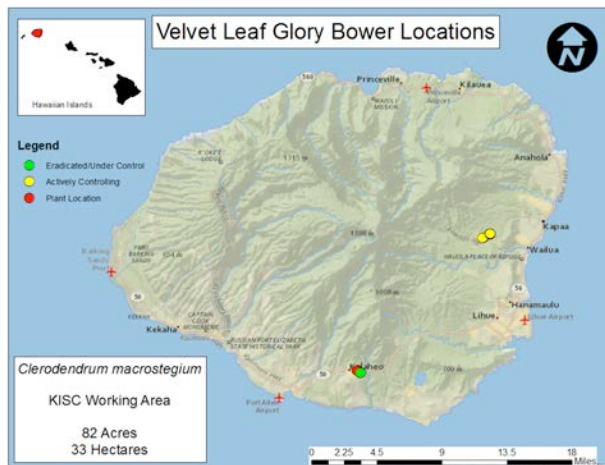
- Additional surveys to determine the extent of this plant beyond the two known locations
- Undertake research with Dr. Leary of CTHAR to explore potential control methods
- Reassess whether this plant should be taken on as a target.

Methods:

The following trial applications have been attempted with little success:

- Notch/scrape method- vine bark is scraped (about 3 to 4 inches) and 50% Garlon4 Ultra/crop oil mix is applied to wound.
- Foliar Application-Stalker (Imazapyr) applied at 3% and diluted with water. Sprayed on foliage using squirt bottles/ back pack sprayers
- Drizzle Application- 20% Stalker diluted with water
- Foliar Application of Milestone (aminopyralid) at 3% diluted with water.
- Foliar Application- Milestone at 3% mixed with ammonia sulfate and water
- Foliar app- Milestone at 7% mixed with water
- Foliar app- Milestone at 7% mixed with water and ammonia sulfate.
- Foliar app- MCP Amine 4 (2-Methyl-4chlorophenoxyacetic/2-4D) at 1% mixed with water
- Foliar app- MCP Amine 4 (2-Methyl-4chlorophenoxyacetic/2-4D)

18) Velvet leaf (*Clerodendrum macrostegium*)



Background:

Velvet leaf is a large shrub native to the Philippines that has proved to be invasive in gardens on Pacific islands through prolific root suckering. It has escaped cultivation in Oahu where it can form dense thickets. This plant was brought to KISC's attention through roadside surveys where it was discovered in areas around Wailua and Lawai. Three of the sites are being successfully treated while KISC is awaiting property access to treat the fourth known population.

Objective: Eradicate

Strategy: Standard control and monitoring

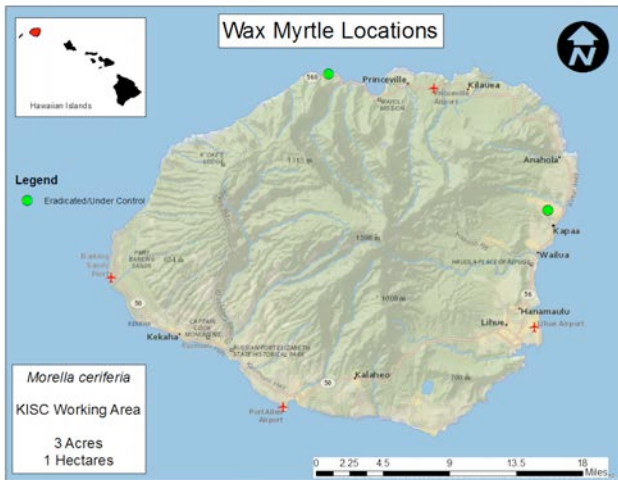
Actions:

- Work with DOFAW to obtain access to the 4th population.
- Continue to survey for and respond to sightings of Velvet leaf
- Outreach

Methods:

- Cut Stump treatment- Trees are cut by chainsaw, handsaw, or machete. Stumps are treated with Garlon4 Ultra mixed with forest crop oil at a 50/50 ratio. Seeds are collected, bagged, and brought back to baseyard to be burned or stored until they rot out. Debris is left on-site.

19) Wax Myrtle (*Morella cerifera*)



Background:

M. cerifera is nitrogen fixing shrub that is native to coastal regions of the southeastern United States. It is an early successional species that has been known to colonize watersheds on Maui and young lava flows on the Big Island. On Kauai, this plant is known from 2 two location at Haena and Kapa'a where it has been successfully eradicated.

Objective: Maintain Eradication

Strategy: Move to ED list

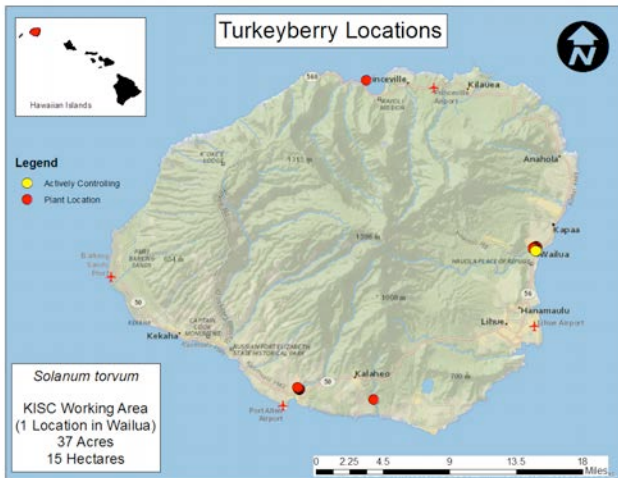
Actions:

- Continue to survey for and respond to sightings of Wax Myrtle.

Methods:

- Cut Stump treatment- Trees are cut by chainsaw, handsaw, or machete. Stumps are treated with Garlon4 Ultra mixed with forest crop oil at a 50/50 ratio. * KISC has only treated one plant. No regrowth after initial treatment.

19) Turkeyberry (*Solanum torvum*)



Background:

Objective: Eradicate

Strategy: Standard control and monitoring

Actions:

- Work with HDOA to treat all individuals of all known populations.
- Conduct comprehensive surveys of areas near known infestations.
- Outreach

Methods:

- Cut Stump treatment- Trees are cut by chainsaw, handsaw, or machete. Stumps are treated with Garlon4 Ultra mixed with forest crop oil at a 50/50 ratio. Seeds are collected, bagged, and brought back to baseyard to be burned or stored until they rot out. Debris is left on-site.

19) Other

Rubbervine (*Cryptostegia madagascariensis*), Salt Cedar (*Tamarix aphylla*), Indian Devil Tree (*Alstonia macrophylla*), Bishop Wood (*Bischofia javanica*), Chinese Privet (*Ligustrum sinense*), and Tubaroot (*Paraderris elliptica*)

Objective: Evaluate

Strategy: Assess each species for prioritization and feasibility of control f

Actions:

- Run each species through the prioritization and feasibility of control process (see Early Detection Program section).
- Determine control actions for each species based on prioritization results

Summary of Status

Latin Name	Scientific Name	Common Name(s)	Control Status	Locale	Effective Vector	Ground Buffer			Air Buffer			Revisit Frequency Kauai	Delimitation Buffer	Delimitation Frequency	Years to Monitor	Considerations
						Immature	Mature	Remote	Immature	Mature	Outlier					
<i>Arundo donax</i>		Giant reed, Spanish reed	Active control	Waterways	Other	20	20					Quarterly		See below		
<i>Cissus nodosa</i>		Grape Ivy	Active control		Wing							Quarterly				
<i>Coccoloba grandis</i>		Ivy gourd	Active control		Wing	20	20					Quarterly	100	Annually and see below	5	
<i>Macaranga mappia</i>		Bingbing	Active control		Wing	100	100					Annually	Annually		1	3 months
<i>Miconia calvescens</i>		Miconia	Active control		Wing	100	100	20	200	200	500	Annual ground, 3 mo. air		See below	20+	
<i>Pennisetum setaceum</i>		Fountain grass	Active control		Wind	20	20					Every six weeks	200	Annually and see below	6+	
<i>Piper auritum</i>	<i>Piper auritum</i>	False Kava	Active control		Wing							Monthly			2+	
<i>Prosopis juliflora</i>		Long Thorn Kavae	Active control		Other							Every 4 weeks				
<i>Typha latifolia</i>		Cattail	Active control	Waterways	Wind							Monthly			100+	
<i>Calotropis gigantea</i>		Crown flower	Monitor / control		Wind							Control only at PMRF				
<i>Cissus verticillata</i>		Princess Vine, Season Vine	Monitor / control		Wing							Monthly Trails				
<i>Clerodendrum macrostegium</i>		Velvetleaf glorybower	Monitor / control		Wing							Quarterly				
<i>Salvinia molesta</i>		Giant salvinia	Monitor / control	Waterways	Other							Quarterly				
<i>Alstonia macrophylla</i>		Indian Devil Tree	Early Detection		Wind							Quarterly				
<i>Baccharis javanica</i>	<i>Baccharis javanica</i>	Bishop Wood	Early Detection		Wing							Quarterly				
<i>Cryptostegia madagascariensis</i>		Rubber Vine	Early Detection		Wind							Quarterly				
<i>Dilemia suffruticosa</i>		Simpoh Ayer	Early Detection		Wing							Quarterly				
<i>Ligustrum sinense</i>		Chinese privet	Early Detection		Wing							Quarterly				
<i>Morella cerifera</i>	<i>Morella cerifera</i>	Wax myrtle	Early Detection		Wing	20	20					Quarterly				
<i>Derris elliptica</i>		Poison Vine	Early Detection	Waterways	Other							Quarterly				
<i>Pennisetum villosum</i>		Feathertop grass	Early Detection		Wind							Quarterly				
<i>Pereskia aculeata</i>		Barbados gooseberry	Early Detection		Wind							Quarterly				
<i>Senecio madagascariensis</i>	<i>Senecio madagascariensis</i>	Creweed	Early Detection		Wind							Quarterly				
<i>Tamarix aptyle</i>		Saltcedar	Early Detection	Waterways	Wind							Quarterly				
<i>Solanum</i>		Turkey Berry	Asst HDOA		Wing							When Craig is Able				
Notes			Meeting focus will be on species listed as Active control		Vector with the greatest spread.	If a property is greater than two acres, use the recommended buffer and also survey properties intersected by the buffer. If under two acres, survey the entire property. All distances are in meters.						Rain events or unexpected changes to a site (e.g., construction) may trigger a more frequent revisit.	If no value is listed, refer to the standard buffers listed under the ground and air buffer columns.	If reproductive plants are found or new plants are found outside of an existing buffer, delimitation survey is triggered.	Goes from date of last fruit. Numbers with a plus sign or no data need clarification based on committee input.	

KISC field crew uses a handful of different pesticides and application techniques to control invasive species on the island. KISC currently has three employees that have been certified by the State Dept. of Agriculture to purchase and apply Restricted Use Pesticides (RUP), but we have never used any RUP on any of our targets to date. We strictly adhere to the label of each pesticide in the storage, loading, application and cleanup of all chemicals. All safety precautions, proper application techniques, and PPE requirements are taught to new hires by the Field Crew Supervisor before they are allowed to handle and apply pesticides. Senior crew members also reinforce pesticide safety to the rest of the crew before each treatment.

INVERTEBRATE & VERTEBRATE

Section to be discussed at future strategic planning meeting.

MONGOOSE

Section to be discussed at future strategic planning meeting.

AQUATIC

Section to be discussed at future strategic planning meeting.

PUBLIC AWARENESS

KISC is committed to raising public awareness about invasive species, conservation, and building community involvement to address the issue. The community's collaboration and support is crucial to the sustainable success of KISC's efforts. With public awareness, KISC's priority and early detection species will be more likely recognized and reported, resulting in earlier detection of new populations and incipient pests. With community participation, the introduction of new invasive species can be prevented.

Through various avenues, KISC will educate the general public, as well as targeted audiences, on the mission and projects of KISC, the impacts of invasive species, the identification of current priority species, and tangible actions to help.

GENERAL COMMUNITY EDUCATION

The cooperation of the community of Kaua'i is the key factor in preventing and discovering any new populations of KISC's priority target and early detection species. KISC will make all project actions highly visible in order to directly address concerns and facilitate public understanding.

Objective: All Kauai Citizens and Visitors are aware of the threats posed by invasive species.

Strategy: KISC will raise awareness, build participation and partnerships, brand a positive organization image, and connect with the community on a grassroots level with a diverse demographic.

Actions:

- KISC will develop and implement a membership network "Guardians of the Garden Isle" to encourage continued engagement and awareness of KISC activities. KISC will maintain network with regular updates (emails, posts, and blogs) and provide annual volunteer and educational days.
- KISC will present general information about invasive species and specific information about species controlled by KISC at community events and venues with active and/or passive displays. Targeted venues:
 - Earth Day
 - Garden Fair
 - Banana Poka Roundup

- Agricultural Awareness & Education Day
- Kauai Farm Bureau Fair
- Arbor Day
- Ocean Awareness Day
- School Career Days
- Island libraries
- Resorts
- Private businesses
- KISC will maintain and update port signage regarding inter-island movement of pests. Signage locations will include:
 - Lihue Airport
 - Young Brother's
 - Nawiliwili harbor Cruise Ship disembarking area
 - Additional public and military ports on island
- KISC will utilize various partnerships to promote relevant campaigns/displays. Display examples:
 - Banners for Kauai Fire Department Sparky Van as part of KISC's partnership and Environmental Safety Campaign
 - Traveling Mongoose Display at various public and private venues across the island.
 - The idea of planting native over invasive through our partnership with Plant Pono
- KISC will utilize the various forms of media on Kaua'i to inform a broad-based audience on current projects and invasive species concerns. Targeted media:
 - The Garden Island Newspaper
 - Kauai People
 - KKCR Public Radio
 - Island radio stations
 - KISC website
 - Broad-based releases
 - Social Media (Facebook and Instagram)
- Provide unified messages and materials to engage the public and increase invasive species awareness with informational brochures, posters, banners, and pest alerts, and volunteer workdays. Topics for materials will include:
 - General invasive species
 - Current KISC priority targets
 - Early detection species
 - Best Management Practices and resource references (ie. CTAHR Coqui BMP)
 - Hawaii Pacific Weed Risk Assessment tool (ie. www.plantpono.org)
 - Non-invasive alternatives and resources
 - Herbicide control protocols (ie. KISC methods of control posted on website).
- Provide professional publications to update partners and the public on KISC current and past work. Publication include:
 - Annual newsletter
 - Quarterly updates

- KISC Blog
- Species specific newsletters (when appropriate: ie Coqui Flyers).
- Press Releases in The Garden Island Newspaper
- To familiarize the public with its name and mission, KISC will distribute logo giveaways.

Strategy: KISC will increase support and raise awareness in communities within or in close proximity to work sites and survey areas. KISC will maintain a positive public image with landowners, fostering working relationships to allow access for priority species control.

Actions:

- KISC will develop working relationships with landowners. KISC will keep landowners informed and updated of control work on their land and encouraging their involvement. When appropriate KISC will train landowners in proper control and monitoring methods for owner control.
- KISC will host species-specific community meetings, such as LFA in Kalihiwai, Coqui in Kapahi., CRB on Westside.
- KISC will distribute printed materials to neighbors of work sites and survey areas, such as miconia packets in Wailua and early detection species alerts in neighborhoods within species buffer zones.
- Informational signage installed at long-term public worksites to educate the public on species-specific information and decrease the unwanted spread of targeted species. (ie. Signage at the LFA infestation site)
- KISC will collaborate with the Department of Land and Natural Resources to educate hikers at trailheads in targeted species infestation areas on invasive species seed dispersal by providing information and a boot scrubbing station. Such as: Kulau Trailhead in known miconia infestation area.

Strategy: KISC will promote unified statewide outreach efforts to increase public support and awareness of invasive species concerns across the state.

Actions:

- KISC will be an active participant in the HISC Public Outreach Working Group meetings and campaigns.
- KISC will assist with the development and implantation of statewide public outreach events. For example: Hawaii Invasive Species Awareness Week.
- KISC will assist partners with invasive species outreach efforts. For example: assist in design of statewide LFA flyer, assist CTAHR with coffee berry borer awareness campaign, and HDOA with Coconut Rhinoceros Beetle.

SPECIFIC TOPICS TO TARGET AUDIENCES

Strategy:

KISC will address a variety of specific audiences that are relevant to its mission because of their role in recognizing and reporting priority target and early detection species as well as preventing the spread of invasive species.

Actions:

- KISC will conduct early detection workshops and presentations relevant to the specific audience with focus on target and early detection species identification, Hawaii Pacific Weed Risk Assessment, non-invasive alternatives, reporting resources, best management practices, and decontamination protocols. Target groups include:
 - Conservation partners
 - Neighborhood Associations
 - Rotary Clubs
 - Kauai Landscaping Industry Council
 - Kauai Visitors Bureau
 - CTAHR Master Gardener
 - Community clubs and associations
 - Nursery and landscaping professionals
 - Botanical gardens
 - Transportation entities (ie. Young Brothers, Matson, etc.)
 - Resorts and tour operators
 - Legislators
 - County and State departments
 - Kauai County Farm Bureau
 - Hunters
 - Hikers
- KISC will develop and implement science-based invasive species projects and activities for school students. Past programs included:
 - Little Fire Ant survey activity
 - Service Learning Projects for elementary students and high school students
- KISC will organize and partner with other organizations to implement cooperative volunteer days to remove invasive species. Past volunteer days included:
 - Kawaiele & Mana Plains Wetland Restoration Project – DOFAW/DLNR
 - Makauwahi Cave Reserve
 - Kokee Resource Conservation Project
 - Huleia mangrove cleanup

PARTNERSHIP PROJECTS

KISC's mission is to work collaboratively and in partnership with other entities on Kaua'i focusing on invasive species prevention, control and eradication. By continuing to build a broader foundation on which to not only unite invasive species efforts but to also draw from available expertise, KISC will be able to increase capacity on limited funding for targeted species control.

Past partnership projects include Long Thorn Kiawe removal at Pacific Missile Range Facility, clearing of invasive species at National Tropical Botanical Garden's Limahuli Preserve, assisting with weed removal and clearing for a fence-line with Waipa Foundation, a nēnē relocation project with DLNR's Division of Forestry and Wildlife, building and helping to install forest bird nesting boxes with the Kauai Forest Bird Recovery Project, and assisting Hanalei National Wildlife Refuge with the control of avian botulism.

KISC will continue to utilize on-island partners to enhance its mission of building community interest and participation. Partnering with various groups and agencies in a variety of ways also helps to increase in-kind contributions that are needed to match funding. Awareness as to the threats and effects of invasive species can be fostered in partnerships in both marine and terrestrial ecosystems.

Endorsement Program with Plant Pono

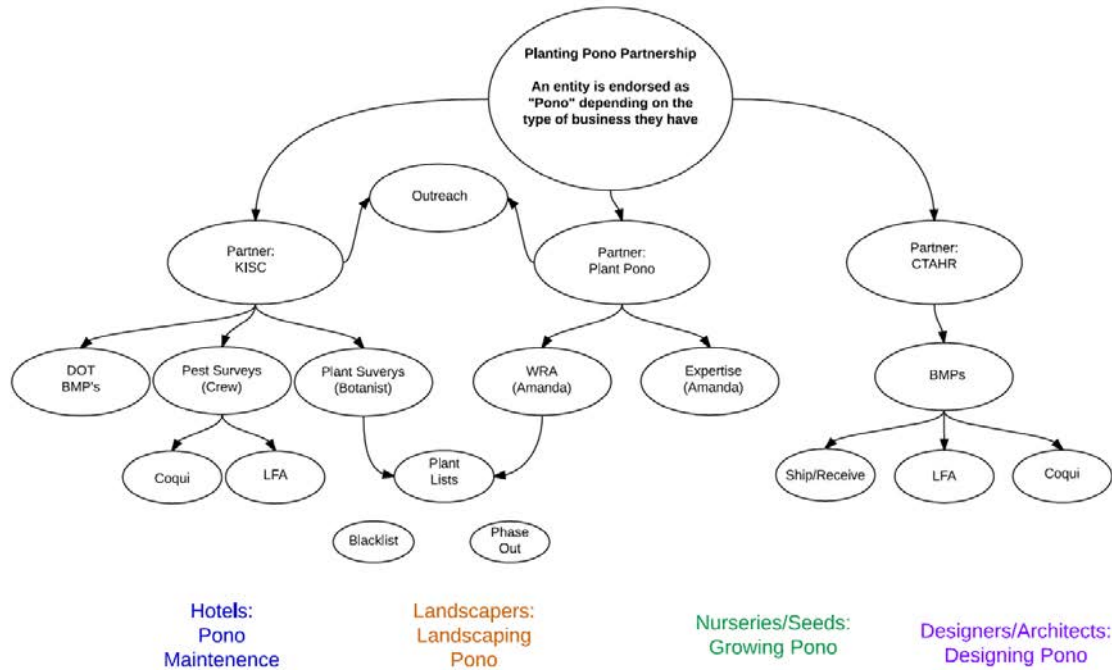
Objective: To prevent the spread of invasive species on Kauai through the nursery and landscaping industry.

Strategy: Encourage the industry to not use invasive plants and to keep target pest species from moving to Kauai on nursery/plant stock through a Pono Endorsement Program.

Action:

- Develop, implement, and maintain a Pono Endorsement Program in partnership with CGAPS-Plant Pono.
- Pono endorsement programs will be customized for individual industries. Targeted stakeholders include nurseries, landscapers, landscape architects, hotels, cut flower industry, and growers.
- Program will encourage the use of the HPWRA with promotion of www.plantpono.org
- Program will provide various Best Management Practices resources to the industry
- Program will provide plant lists to encourage the discontinued sale of targeted invasive species.
- Program will encourage participant collaboration with KISC for pest (e.g. LFA and coqui) surveys as well as botanical early detection surveys
- Program will promote the businesses that are following recommendations to reduce the spread of invasive species.

Proposed partnership flow chart



Feral Cat Task Force Participation

Objective:

Strategy:

Action:

Rose Ringed Parakeet Working Group Participation

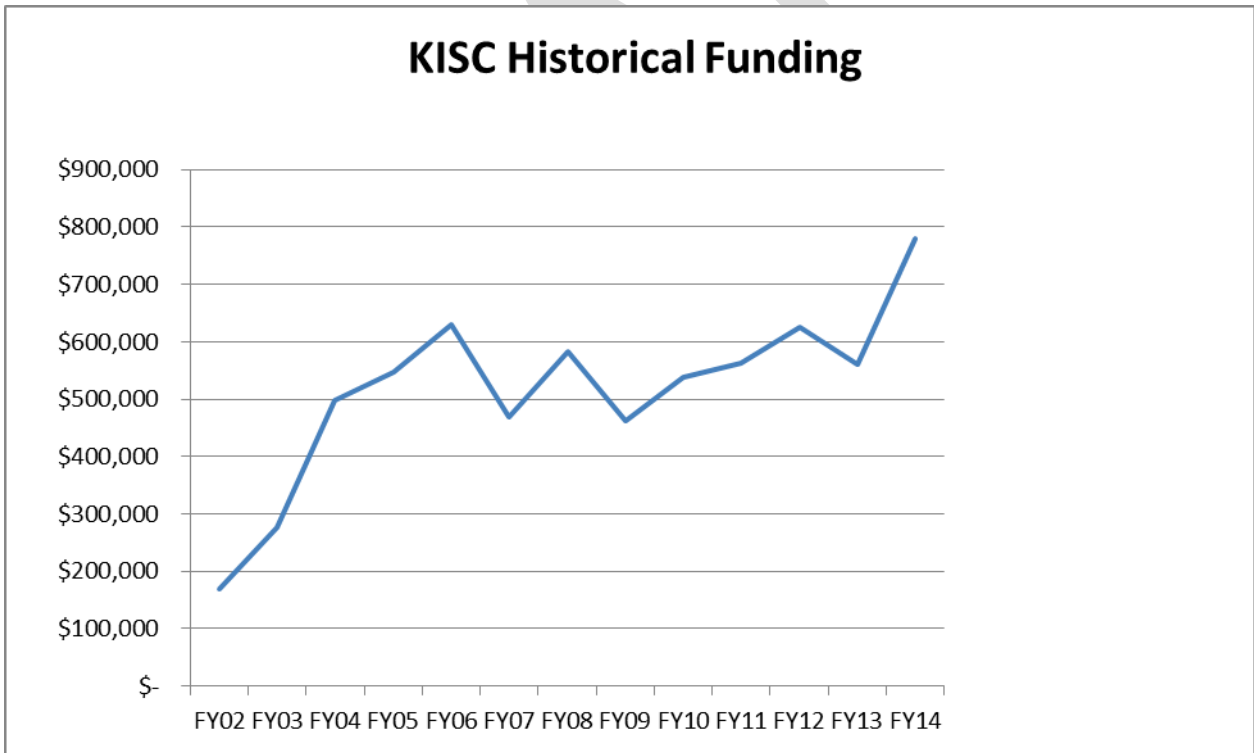
Objective:

Strategy:

Action:

BUDGET

Column1	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15
Total State	\$ -	\$ 68,000	\$ 75,000	\$ 293,000	\$ 395,400	\$ 202,000	\$ 383,609	\$385,100	\$ 192,500	\$ 253,608	\$ 347,860	\$377,541	\$ 394,663	\$623,450
HISC				\$ 220,000	\$ 277,200	\$ 150,000	\$ 262,522	\$375,100	\$ 90,000	\$ 109,800	\$ 297,860	\$233,078	\$ 314,663	\$570,000
DOFAW G		\$ 65,000	\$ 45,000	\$ 40,000	\$ 68,200	\$ 2,000	\$ 10,000		\$ 83,584	\$ 50,000	\$ 84,463	\$ 50,000		
DOFAW Coqui					\$ 50,000	\$ 50,000	\$ 91,087							
DOFAW/NAP		\$ 3,000	\$ 30,000	\$ 33,000										
SLDF							\$ 30,000		\$ 102,500	\$ 60,224		\$ 60,000		
WPPG													\$ 30,000	
SNIPP														\$ 53,450
DOH WNV														
Non-HISC State	\$ -	\$ 68,000	\$ 75,000	\$ 73,000	\$ 118,200	\$ 52,000	\$ 121,087	\$ 10,000	\$ 102,500	\$ 143,808	\$ 50,000	\$144,463	\$ 80,000	\$ 53,450
Total Federal	\$ 30,000	\$ 70,000	\$ 196,045	\$ 199,000	\$ 86,000	\$ 98,000	\$ 85,721	\$196,695	\$ 208,838	\$ 283,499	\$ 165,084	\$173,326	\$ 106,000	\$106,000
Federal - USFWS	\$ 10,000	\$ 25,000	\$ 136,045	\$ 139,000	\$ 12,000	\$ 5,000	\$109,343	\$ 53,938	\$ 50,000	\$ 50,000	\$ 70,000	\$ 10,000	\$ 10,000	
Federal - USFS		\$ 45,000	\$ 60,000	\$ 60,000	\$ 59,000	\$ 98,000	\$ 80,721	\$ 87,352	\$ 154,900	\$ 233,499	\$ 99,084	\$ 80,000	\$ 75,000	\$ 75,000
Federal - NRCS	\$ 20,000													
Federal - NAVFAC											\$ 16,000	\$ 23,326		
Federal - HIARNG													\$ 21,000	\$ 21,000
Federal - NFWF					\$ 15,000									
Total Private	\$ -	\$ 25,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Hawaii Community Foundation		\$ 25,000												
County	\$ -	\$ 5,000	\$ 5,000	\$ 5,000	\$ 66,000	\$ 330,000	\$ -	\$ -	\$ 60,000	\$ -	\$ 50,000	\$ 75,000	\$ 60,000	\$ 50,000
Totals	\$ 30,000	\$ 168,000	\$ 276,045	\$ 497,000	\$ 547,400	\$ 630,000	\$ 469,330	\$581,795	\$ 461,338	\$ 537,107	\$ 562,944	\$ 625,867	\$ 560,663	\$ 779,450



EVALUATION

It is imperative that KISC evaluate itself to determine if its programs are effective. With the diverse knowledge-base of the committee, KISC can benefit significantly from the committee's input. The KISC Manager, with assistance from other staff members, is responsible for follow-up evaluations and reporting results to the KISC committee regularly at periodic KISC meetings. At an annual all-day workshop KISC will re-evaluate the objectives and re-form the goals for the next year's action plan. The committee's goal is to make its decisions by consensus.

The KISC Coordinator and staff are responsible for documentation of all KISC activities, monetary expenditures, and accomplishments in terms of areas surveyed/treated and plants removed/treated. Maps of known locations of all target species (including annotation with population structure, fertility and history of control efforts) are being kept and updated as new reports come in. Special attention is given to all populations of target species, which appear to have fruited and/or have persisting seed banks. Short-term and long-term control operations are aimed at exhausting the seed banks established by previously controlled plants. Careful GPS data, along with data archiving and mapping of all other information gathered, is evaluated to generate an effective schedule for continued follow-up re-treatments.

By using adaptive management regarding methods of control and a reevaluation of objectives, KISC can better balance control efforts with committed funding. Prioritization of identification and eradication of incipient species as well as broadening the base of community support will be important to quickly responding to

Photo Credits

Front Cover: Lehua Prevez-Lafayette

Plant Photos: KISC crew, Forest and Kim Starr

APPENDIX A: KISC's Prioritization and Feasibility of Control Process

Adapted from OISC ED Process

Prioritizing for Weed Control

The prioritization system described here is based heavily upon a system created by Susan Timmins and Susan-Jane Owen of the New Zealand Department of Conservation. The system is weed-led, meaning it aims to control a weedy species at an early stage of establishment, and is designed to serve as a tool to guide management decisions. The system uses a six-step process to decide whether a weed can and should be controlled. The steps combine an examination of a species' threat to conservation and/or agriculture with an examination of its controllability, allowing us to prioritize control for species that pose the greater threats and, to the best of our knowledge and that of the experts we interview, have a limited distribution.

Step 1: Initial Assessment (see Appendix A)

The purpose of the Initial Assessment is to categorize species based on their potential to become invasive in Hawai'i and on their currently known cultivated and/or naturalized distribution on the island. Species prioritized for control will ideally have a) high potential for invasiveness and b) sparing cultivated or naturalized status.

Current distribution was determined primarily from road survey data, but if distribution was unknown (i.e. the species was not on the survey species list but was collected as a New Naturalized Record or New Island Record) potential distribution was inferred by using the Bishop Museum's herbarium collection and collection databases

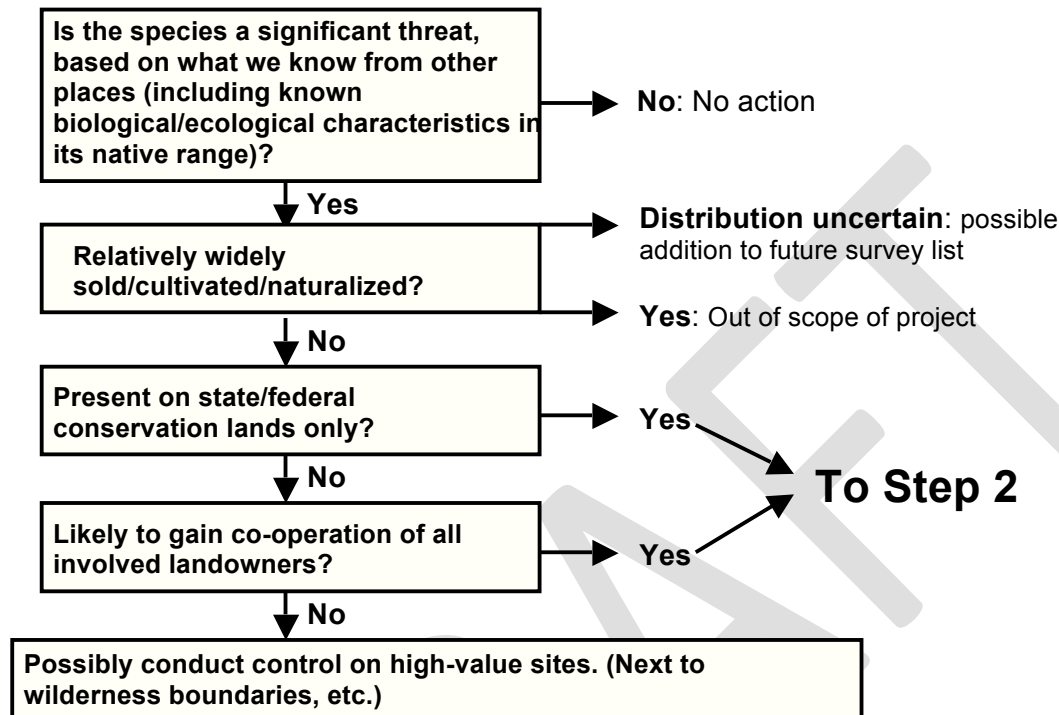
(<http://www2.bishopmuseum.org/natscidb/>;

<http://www2.bishopmuseum.org/HBS/botany/cultivatedplants/>). In addition, *A Tropical Garden Flora*, by Staples and Herbst, often provided information not found in the databases or Herbarium collection. Species described as "frequently cultivated" or "popular" were categorized as possibly too widespread for early detection. Others described as "rare," "sparingly cultivated," or "only found in botanical gardens" were usually categorized as having possible limited distributions. If the distribution of a species was unknown (was collected as a New Naturalized Record or New Island Record) this species could be proposed as a future road survey species (depending on suspected island-wide distribution gleaned from literature review, online searches, and field expert interviews), but generally was not examined further in the prioritization process (i.e. it did not pass on to Step 2.)

Weed status was determined using online weed lists, an updated Bishop Museum checklist of naturalized plants of Hawai'i, currently available Hawaii Weed Risk Assessment scores, and other resources. An online reference we often use is the Global Compendium of Weeds (<http://hear.org/gcw/>). If a species had unambiguous references to invasiveness in habitats occurring on O'ahu, it was categorized as a weed. If there were ambiguous references (i.e. found on a list of introduced plants or in a flora) and no other information was found online, it was categorized as a questionable weed. Questionable weeds with limited distributions were researched further to assess their potential invasiveness. Those exhibiting life history traits such as effective dispersal mechanisms on O'ahu and viable seed were categorized for evaluation by

the Hawai'i Weed Risk Assessment (HWRA) and field experts. Species widely cultivated in Hawai'i for over a hundred years with no references to weediness, improbable dispersal mechanisms (i.e. giraffe dispersal), and/or lack of viable seed usually received a “no” for weediness, meaning it is improbable they would become invasive.

The Initial Assessment process:



Step 2: Hawai'i Weed Risk Assessment

Species that pass through the initial assessment can be sent to be assessed by the Hawai'i-Pacific Weed Risk Assessment (HP-WRA.) It is recommended that species names be sent in small batches, since assessments can take some time. The HP-WRA asks 49 questions relating to the degree and extent of cultivation of the species; climate and distribution; whether it has been recorded as a weed elsewhere; undesirable traits (i.e., thorns, toxicity to animals); what type of plant it is (i.e., aquatic, grass, N-fixing); reproductive mechanisms (whether it hybridizes, is self-compatible); dispersal mechanism (water, wind, bird); and any persistence attributes of the species (prolific seed production, seed bank) in an effort to quantify the species' potential weediness. Expected scores for assessed plants should generally fall between 0 and 29, with 29 being a very high score (e.g., for a species such as *Salvinia molesta*, which displays many weedy tendencies), and 0 being the lower end of the scale for weediness. Some species have scored as low as -13. For more information, refer to Dr. Curtis Daehler's website at <http://www.botany.hawaii.edu/faculty/daehler/WRA>

Step 3: Assign an “Effect on System” score

The species that do not receive a low score (0 or below) on the HP-WRA are assigned an “Effect on System” score. This part of the prioritization process attempts to gather specific information regarding potential ecological and agricultural impacts of a plant species. This score is determined by researching the species’ behavior either in other areas where it has been introduced or in its native range, where it may display “weedy” characteristics such as shade tolerance, gap colonization, or a vining habit. This portion of the prioritization process was designed to put emphasis on the ecological and agricultural effects of a species that are discussed in the WRA. It will be important to cite references and document the reasoning behind each ranking (this can be done in a database format- see database form below.)

Note: The Effect on System score is similar to the second screening in the WRA (is it a bird dispersed, shade tolerant vine?) The score could fall halfway between each level, i.e. 1.5, 2.5

Criteria affecting Effect on System score:

1. Impact on natural community structure and/or composition

A. No perceived impact; establishes in an existing layer without influencing its structure and/or causes no apparent change in native populations = 0

B. Influences structure in one layer (e.g., changes the density of one layer) and/or influences community composition (e.g., reduces the number of individuals in one or more native species in the community) = 1

C. Significant impact in at least one layer (e.g., creation of a new layer or elimination of an existing layer) and/or significantly alters community composition (e.g., produces a significant reduction in the population size of one or more native species in the community) = 2

D. Major alteration of structure (e.g., covers canopy, eradicating most or all layers below) and/or causes major alteration in community composition (e.g., results in the extirpation of one or several native species, reducing biodiversity or change the community composition towards species exotic to the natural community) = 3

2. Impacts to biotic and abiotic ecosystem processes

A. No perceivable impact on ecosystem processes = 0

B. Influences ecosystem processes to a minor degree (mild influence on soil nutrient availability) = 1

C. Significant alteration of ecosystem processes (e.g., increases sedimentation rates along streams or coastlines, reduces open water that are important to waterfowl, minor reduction in nesting/foraging sites, reduction in habitat connectivity, interference with native pollinators, injurious components such as spines, toxins) = 2

D. Major, possibly irreversible, alteration or disruption of ecosystem processes (e.g., the species alters geomorphology; hydrology; or affects fire frequency; species fixes substantial levels of nitrogen in the soil making soil unlikely to support certain native plants or more likely to favor non-native species) and/or severe alteration of higher trophic populations (extirpation or endangerment of an existing native species/population, or significant reduction in nesting or foraging sites) = 3

3. Impacts to Agriculture

A. No perceivable impact = 0

B. Minor impacts (occasional and easily controllable weed of agricultural areas) = 1

C. Moderate impacts (occasional weed that has allelopathic phytochemicals that affect crop plants, or is toxic or unpalatable to grazing animals) = 2

D. Major impacts (common weed of agricultural areas that is difficult to control; forms monocultures in pastures or croplands) = 3

Step 4: Calculate the species' 'Weediness Score' and 'Weediness Group'

Weediness Score is calculated by adding the WRA score to the "Effect on System" score. The final score is used to place the species in a category, with category A having the highest potential for weediness, and category D having the lowest.

Weediness Score = Score on WRA (0-29) + "Effect on System" (0-9) score

Weediness Group:

A= 26 and up on Weediness Score

B= 17-25

C= 7-16

D= 6 and below

Step 5: Assess 'Practicality of Control'

It will be important to cite references and document the reasoning behind each ranking (this can be done in a database format- see Potential Species for Control form above.)

Criteria used in determining practicality of control:

Initial control: population size, number of landowners, landowner type (public vs. private), control method (mechanical, chemical), effectiveness of control method, terrain (for delimiting survey), dispersal method, difficulty of enforcement (noxious weed or not), and support from other organizations.

Minimal- less than 3 landowners involved, delimiting survey done in one day.

Moderate- 3 to 15 landowners involved, delimiting survey done in 2 or fewer days.

Substantial- 50 landowners involved, delimiting survey done in 10 or fewer days

Monitoring: longevity of seedbank, number and type of landowners, effectiveness of control, terrain, time to maturity, support from other organizations.

Minimal = likely to require less than 3 follow up visits to an easily accessible site.

Moderate = likely to require a moderate amount of effort in accessing and/or monitoring.

Substantial = Likely to require up to 30 years of frequent and/or intensive monitoring.

Practicality of control numbers:

Initial control effort minimal, monitoring effort minimal= **10**

Initial control effort moderate, monitoring effort minimal= **9**

Initial control effort substantial, monitoring effort minimal; or, initial control minimal, monitoring effort moderate= **8**

Initial control effort substantial, monitoring effort moderate= **7**

Initial control effort substantial, monitoring effort substantial= **6**

Control of species beyond scope of project= **5**

Step 6: Derive a 'Priority Ranking'

The last step in the process is to determine a Priority Ranking, which acts as a guide for management. The Priority Ranking is a combination of the Weediness group and the score assigned for Practicality of Control.

Action to take

Kill population immediately

High priority for control, assess for immediacy

Control possibly performed; reevaluate after further surveys

Consider continuing to map and document distribution

Out of project scope

Priority Ranking Score

A10

A7-9, B8-10, C9-10

A6, B6-7, C7-8, D9-10

A5, B5, C6, D6-8

C5, D5

At this point, scores and recommendations are passed on to the management committee for review and input.