



Detection and Control of Invasive Species on
the Island of Hawaii (Grant C51507)
Final Report to the
Hawaii Invasive Species Council
2015



Detection and Control of Invasive Species on the Island of Hawaii

Grant Number: C51507

Award Amount: \$955,000

Project Period: November 1, 2014-April 25, 2016.

Final Report: July 18, 2016

Programs Funded: Detection & Control including basic operating costs (\$650,000) Outreach (\$50,000) Axis Deer (\$125,000), Nursery and Roadside Surveys (\$150,000). An Unmanned Aerial Systems research project awarded \$30,000 was redirected to the University of Hawaii Hilo.

[Additional award to the Three Mountain Alliance, transferred to BIISC:](#)

Grant Number: 4501370

Award Amount: \$30,000

Project Period: August 1, 2014-December 31, 2015

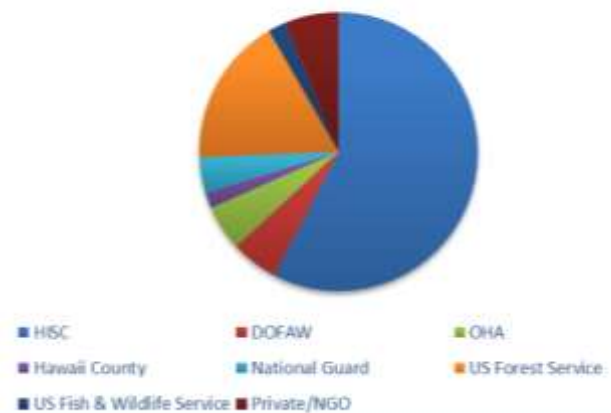
Program Funded: Control of an Incipient Plant, *Photinia davidiana*, on Windward Mauna Kea, Hawai'i Island

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The Big Island Invasive Species Committee is a project of the Pacific Cooperative Studies Unit of the University of Hawaii at Manoa and directed by Dr. David Duffy, Ph.D. Staff are employed by the Research Corporation of the University of Hawaii, an Equal Opportunity Employer.

In 2015, the Big Island Invasive Species Committee (BIISC) was grateful to receive the highest level of funding in its twenty year history. The majority of this funding came from the Hawaii Invasive Species Committee (HISC) and we offer our sincere thanks to the hardworking staff and legislators who secured these funds on our behalf. BIISC has emphasized a steady focus on program productivity, relevance, and quality for the previous two years. Due in part to the strong state funding, news-worthy events like Tropical Storm Iselle that highlighted invasive species issues, and work to build new professional relationships, BIISC attracted funding from a diverse group of county, state, federal, and private funders. Our new albizia team received more than half of its funding from county, federal, and private funds. The spike in funding produced some growing pains, as we juggled the demands of increasing staffing, opening a new office space, navigating new funder relationships and requirements, and soliciting service contracts while uncertain about continuing funds. This learning curve admittedly caused some delays and reduced BIISC's usual participation in some partner activities.

2015 BIISC Funds By Funding Source



Needless to say, we were happy to have the chance to rise to the challenge. BIISC is proud to present this report highlighting what we were able to accomplish with a strong funding base in 2015. I believe the numbers speak for themselves (Figure 1). Our Early Detection Team surveyed over 500 miles of roads and 27 nurseries—eleven of which earned the Plant Pono Nursery Endorsement. Our Rapid Response crew surveyed 5,210 acres—that's over 1000 acres per crew member, the majority on foot—and controlled over 16,000 plants targeted for local or island-wide eradication. The albizia program, which merged the public outreach and plant control activities of BIISC, agency partners, and community members in a new, incredibly productive way, engaged over 450 participants to control 53,000 albizia trees in strategic locations. A three-year, federally funded ecological monitoring project was launched to scrutinize the effectiveness and ecological impacts—positive and negative—of the extensive albizia control program. The outreach program organized or attended 84 events, providing in-person information to over 5,000 people, and having an estimated reach through media in the tens of thousands. A new team of wildlife biologists were hired to design a system for the early detection of new invasive animals—and surveyed over 49,000 miles in the process.

Regardless of the level of effort, all our work means nothing unless it reduces the impact of invasive species on our environment, economy, and way of life. We were pleased therefore to confirm that for *Pereskia aculeata*, a vining cactus and one of our nine target species, eradication now appears to be within reach. This has been the second year in which no mature plants or seedlings of this species were found on the island. Albizia, little fire ant, ungulate, and rabbit control have produced immediate, tangible results. We continue to seek new ways to measure our progress toward eradication of target species, and now have defined stages (0-4) tracked at the scale of individual parcels, research goals to meet knowledge gaps, and a systematic, measured approach to annual work plans.

The close-knit network of conservation programs on the Big Island gives us the opportunity to assist one another, and find help when we need it. BIISC's coalition seeking funds for UAV research turned \$30,000 in HISC project funding over to the UH Hilo SDAV lab, but maintained close ties and collaborated regularly to continue research and development of platforms for this technology which is now viewed as "must-have" for cost-effective operations. Due to staffing changes, the Three Mountain Alliance (TMA, a watershed partnership) handed off the HISC-funded Photinia survey and control project to BIISC. This project allowed BIISC to formally evaluate Photinia as an eradication target species, and launched a new relationship with the USFWS, making BIISC an Invasive Species Strike Team for the island, and opening new access to federal funds. TMA also facilitated the purchase of a Forward-Looking Infrared (FLIR) device, with the help of HISC and DOFAW. This was used primarily by BIISC for deer and rabbit monitoring surveys, and to assist the NARS to dispatch the last two sheep from a Natura Area Reserve enclosure. We were very pleased to be able to assist the Hawaii Ant Lab in their community-based eradication project in Naalehu, allowing BIISC to gain hands-on experience in the management of little fire ant infestations, and share outreach theory and practice to improve outcomes for our island communities. In addition to our usual partners, BIISC provided services under contract to the Office of Hawaiian Affairs, Thirty Meter Telescope Corporation, Hawaii Department of Transportation, and Hawaii National Guard.

A small but significant portion of HISC funding in 2014 and 2015 helped develop a single program area I hope will one day outshine everything we do—our internship program. BIISC is committed to developing Hawaii's next generation of conservation leaders, right here on the Big Island. As a mother of three in a rural part of the Big Island, I know that opportunities for students are few and far between. Our community engagement program this year affirmed that providing student jobs and internships provides a direct entry point into communities with which we otherwise have difficulty connecting. Nine of the 26 staff pictured on our report cover are students or recent graduates, ranging from age 18-26, and five of us are a bit more senior alumnae of Big Island schools. In the coming years, we will continue to focus on high-quality training and expectations for our coordinators, field crew leaders, and staff, so that students completing our program leave inspired to complete their degrees in natural resource management fields, willing to share what they've learned with family and friends, and able to contribute in a meaningful way to any team in Hawaii.

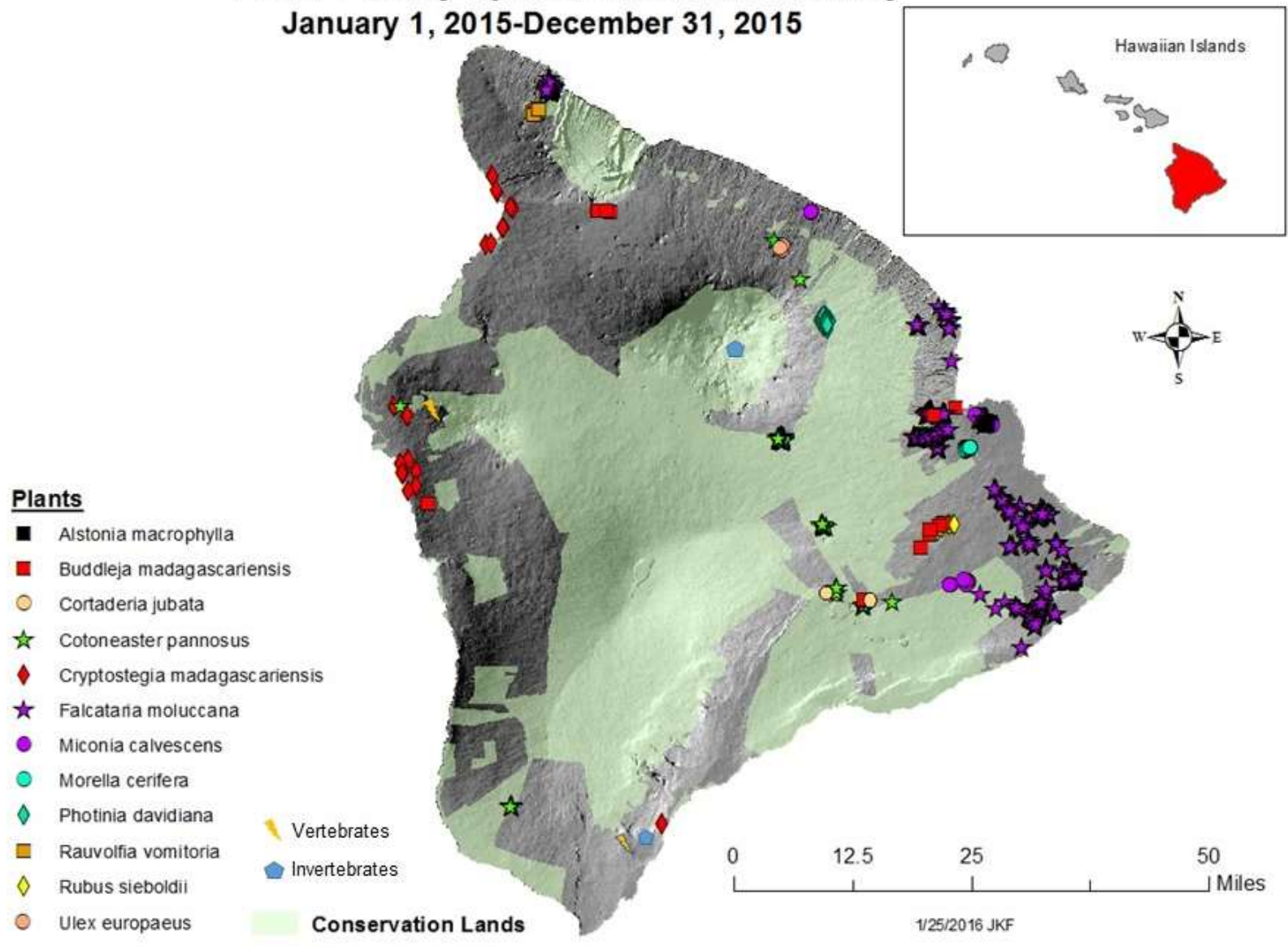
Throughout this incredible year, my primary job as manager was to ensure that our program remains steadfast in its commitment and to our mission, and alignment with the objectives laid out by our primary funders. BIISC continues to provide a reliable, flexible workforce to meet the needs of public agencies in accomplishing tasks that are interdisciplinary, inter-agency, are awaiting dedicated staffing, or cross land ownership boundaries. Whether we are assisting power and transportation agencies to control albizia; connecting the horticulture industry to weed risk assessment tools; managing an invasive population that spans state, federal, and private lands; providing services on contract, providing comment on key policy decisions; or empowering communities to take action in their own backyards, we hope that our actions reflect our commitment to meeting the objectives of the Hawaii Invasive Species Council.



Taxon Name	Common Name	Acres		# of Plants Controlled			Control Type		Hours			
		Inventoried	Treated	Mature	Immature	Total	Chemical	Mechanical	BIISC	Contributed	Volunteer	Total Hours
PLANTS												
Alstonia macrophylla	Deviltree	50.8	5.00	143	788	931	144.0	787.0	198.0	9.0		207.0
Buddleja madagascariensis	Smokebush	194.5	1.50	144	20	164	142	22	185.5			185.5
Cortaderia jubata	Pampas Grass	6.1	0.08	16		16	6	10	189.0			189.0
Cotoneaster pannosus	Cotoneaster	1,170.5	82.20	1,056	2,040	3,096	1,257	1,837	2,089.5		293.0	2,382.5
Cryptostegia madagascariensis	Rubbervine	340.4	0.13	55	47	102	83	19	566.3			566.3
Falcataria moluccana	Albizia	1,071.0	729.45	51,619	1,505	53,124	53,124		6,913.0		890.5	7,803.5
Miconia calvescens	Miconia	2,055.5	30.19	48	4,173	4,221	79	4,142	1,234.0		104.0	1,338.0
Morella cerifera	Wax Myrtle	96.5	7.45	842	412	1,254	1,251	3	648.0			648.0
Pereskia aculeata*	Barbados gooseberry	22.0		0	0	0			40.0			40.0
Photinia davidiana	Photinia	669.0	21.00	383	191	574	445	129	756.0		64.0	820.0
Rauvolfia vomitoria	Poison Devils Pepper	448.0	9.60	77	340	417	102	315	832.0	243.0	10.0	1,085.0
Rubus sieboldii	Molucca raspberry	43.3	8.57	5,294	33	5,327	5,327		297.0			297.0
Ulex Europaeus*	Gorse	134.5	0.00	3		3	3		50.0	20.0		70.0
PLANT TOTALS		6,302.0	895.18	59,680.0	9,549.0	69,229.0	61,963.0	7,264.0	13,998.3	272.0	1,361.5	15,631.8
VERTEBRATES												
Axis Axis	Axis Deer	48,191.0		-		-			214.0			214.0
Oryctolagus cuniculus	Rabbit	244.0		-		-			14.5			14.5
Ovis orientalis	Mouflon	1,340.9		1		1		1	125.0			125.0
INVERTEBRATES												
Wasmannia auropunctata	Little Fire Ant	95.9	20.90						96.0			96.0
Arthropod Species		0.1	N/A						325.0			325.0
OVERALL TOTALS		56,173.9	916.1	59,681.0	9,549.0	69,230.0	61,963.0	7,265.0	14,772.8	272.0	1,361.5	16,406.3
Early Detection												
Miles Surveyed	574	Acres										
Nurseries Surveyed	27											
Nurseries Endorsed (includes 2014)	11											
Outreach												
Number of Events	Number of media pieces produced	*Number of People Reached in person	Number of participants at hands-on training/ workdays									
84	unrecorded	5,400	456	*HPR has 175,000 weekly listeners--1 radio interview *Star Advertiser has 200,000 readers weekdays, 164,000 Sundays-one albizia story								

Figure 1: Summary Table of 2015 Activities. (January-December 2015). Some figures discussed in the text include data from November 1, 2014 through April 25th, 2016, the extended project period. For year to year consistency, summary only includes 12 months of data.

BIISC Priority Species Treatment Activity **January 1, 2015-December 31, 2015**



Project 1: Early Detection

The primary objective of the Early Detection program on the Big Island is to find potentially invasive species before they become established, harmful pests. We often say, we are trying to find the next “albizia,” or the next “little fire ant” --before it is too late. The ED team works with BIISC steering committee members to craft appropriate responses, studying the biology and distribution of the species, helping to develop treatment methods if needed, and making determinations about the feasibility of mounting any response. In 2015 we continued traditional surveillance activities, bolstered by newer programs working directly with the horticulture, timber, transportation, and construction industries. The Plant Pono Nursery Endorsement program took off under the guidance of an added staff botanist. We also completed a two year effort to re-visit and re-assess six target species under management since 2009, and added two new species to our eradication list. During this project year BIISC also began to transition the axis deer response team from a stand-alone project to a component of the early detection program, focused on vertebrate detection. The ED team also accepted responsibility for mapping and control of Photinia, which is discussed later in this report as a stand-alone project.

2015 Objectives

Objective or Deliverable	Outcome
Eradication Target Species	
Clearly demonstrate and document the risk factors associated with proposed target species, including potential island-wide distribution and specific impacts in written documents.	BIISC completed a two year effort to re-visit and re-assess six target species under management since 2009, and added two new species to our eradication list. Updated target species fact sheets and research needs for each. Developed clear standards for documenting and assessing potential eradication targets.
Revisit and reassess six target species under management since 2009.	No new Pereskia found in 2014 and 2015, monitoring will continue until 2017 when eradication can be claimed. Scope of work for all six redefined.
Roadside Surveys	
Survey 150 miles of County Roads, focused on “hot spots,” e.g. roads near nurseries and botanical gardens. HISC funds were expected to leverage an anticipated \$80,000 in HDOT SNIPP funds to survey 200 miles of State highway.	BIISC surveyed 574 miles (14,579 acres) of roadsides. The anticipated SNIPP highway funds did not come through due to internal delays at the funding agency and project is anticipated to begin in late 2016. Surveys therefore remained focused on hot spots on county and private subdivision roads and remote access roads in high value conservation areas.
Assess new target species for eradication potential.	Confirmed three new target species: <i>Ilex cassine</i> (related to Holly), <i>Markhamia lutea</i> (related to African tulip), and <i>Porophyllum ruderale</i> (a new Asteraceae).

Nursery Surveys	
Document and discontinue the importation and sale of high risk invasive species in the horticultural trade. High Risk plants have an HP-WRA score of 7 or greater. Survey a minimum of 18 nurseries.	By end of 2015, BIISC documented 104 worrisome species for sale in 27 nurseries. These included 11 plants on the Plant Pono “Do not plant” list, at least 12 well-known invasive species (including Strawberry guava, <i>Lantana camara</i> , and a variety of fountain grass) and over 80 unknown species needing assessment which were recorded and investigated. The most commonly sold invasive plants were night-blooming jasmine and medinilla (related to <i>Miconia</i>).
Educate nursery owners/staff about invasive species issues and encourage participation in the "Plant Pono" endorsement program.	Eleven nurseries have earned the endorsement, agreeing to discontinue or never sell the 42 plants on the “Do not plant” list, use the HPWRA to screen plants prior to importation, follow all biosecurity rules and laws, and implement best management practices for coqui and little fire ants. Several nurseries have agreed to stop selling particular invasive species, such as Cogon Grass, even if not ready for a Plant Pono endorsement.
Provide Little Fire Ant best management practices and promote the economic benefits of prevention and treatment.	LFA were detected in nurseries two new districts, and referred to CTAHR’s Dr. Arnold Hara for assistance. A requirement to eliminate LFA and Coqui infestations was the primary reason nurseries in East Hawaii declined to join Plant Pono in 2014. So few nurseries could qualify, that the program was altered to focus on plant inventory choices and proper management of plant pests, rather than an absence of coqui or LFA.
Train palm growers/sellers on Coconut Rhinoceros Beetle signs and reporting procedures.	Used UAV platform to inspect palm crowns at two Puna palm nurseries for signs of CRB. Discussed CRB issues at HILA, HENA, and BIAN plant sale booths and with local arborists.
Educate a network of volunteers to expand our early detection and reporting capacity. Partner with HDOA, Hawaii Ant Lab, and Master Gardener Program (CTAHR).	Hosted a training for 18 new Master Gardener students in Kona in cooperation with CGAPS and HPWRA staff. Provided in-person information on Plant Pono to at least 513 people at community events. Met with the Dr. Arnold Hara lab at CTAHR to clarify roles and responsibilities for HAL, BIISC, and Hara Lab with respect to LFA, particularly for nurseries. Collaborated with HAL to develop a community LFA program. Led two days of guided hikes at the National Park BioBlitz at HAVO
Publicity for the survey and endorsement program and endorsed nurseries on the BIISC and Plant Pono Website, an island based publicity campaign and media kit.	Communications plan completed with a chapter dedicated to Plant Pono brand development and recognition. Plant Pono section updated on website www.biisc.org/plant-pono , including list of endorsed nurseries. Promotional products for nurseries and consumers distributed (endorsement signs, hats, stickers, pamphlets). Social marketing increased and media stories promoted (http://westhawaii.com/news/local-features/plant-pono-will-endorse-exemplary-nurseries). We continue to seek funds required to implement a traditional marketing plan.

Horticultural invasive plants for sale 2013-2015 (27 Nurseries surveyed)

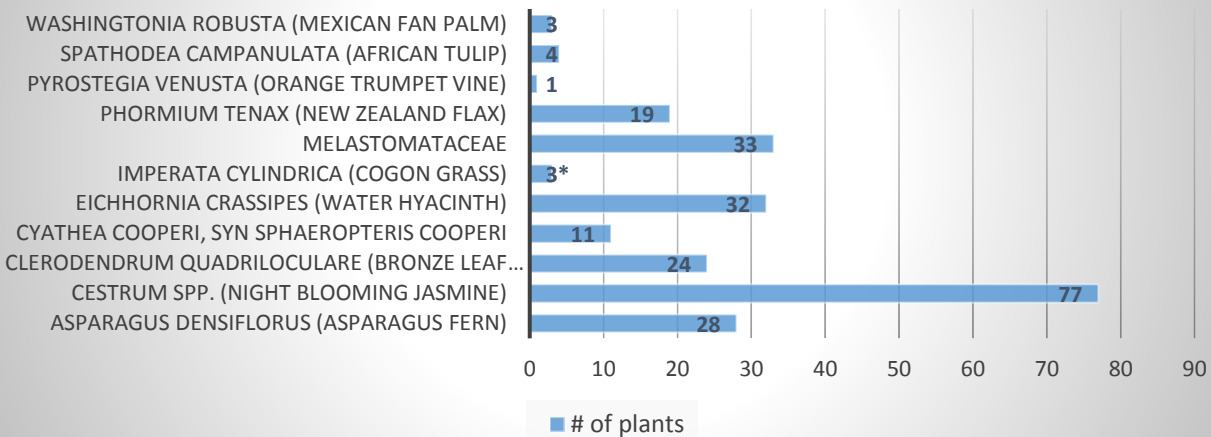


Figure 2. Invasive plants on the Plant Pono "Do not plant" list that were found for sale in 27 nurseries. 93 other species, including well-known invasive plants that were not expected to be found in the horticulture trade (e.g. Christmas berry, *Pennisetum* sp., and *Psidium cattleianum*) and species unfamiliar to surveyors or without current weed risk assessments were identified and investigated. *Cogon grass is a federal noxious weed found at a single nursery, and discontinued from sale.

OTHER Early Detection Projects: Biological Survey, Monitoring and Inspections	
Objective or Deliverable	Outcome
Provide invasive species compliance monitoring services to the Thirty Meter Telescope Corporation	Conducted inspection of all vehicles and cargo and construction equipment, and on-site arthropod surveys weekly to monthly at the Mauna Kea Summit to prevent and detect the introduction of new invasive species.
Survey of Timber roads for Kamehameha Schools	Completed assessment of 2014 timber road surveys, which identified <i>Cinnamomum burmanii</i> , a serious invasive tree on Oahu, as a potential target species in one area of East Hawaii.
Develop a cost effective UAV platform to expand capacity to delineate the extent of invasive plant populations, survey for new pests.	Part time graduate student and two summer PIPES interns explored use of UAV to detect <i>Miconia</i> in dense forest and gorse in open shrubland. Graduate student hired on full time near the end of the year. Tested ability to detect BIISC target species and presented findings at EMAPI, an international invasive species conference, and the Hawaii Conservation Conference. Outcome is a simple, functional video camera to attachment to create low-tech, low cost, reliable visualization of invasive species without significant investment in technological training. Compared to multi- or hyper-spectral imagery and structure from motion systems being developed by other programs, our UAV has the advantage of out-of-the box user capability and less than \$2000 start-up cost. Limiting factor is density of forest canopy, and cost of a hi-def computer screen with adequate resolution (to match video feed) that should pick up smaller targets.

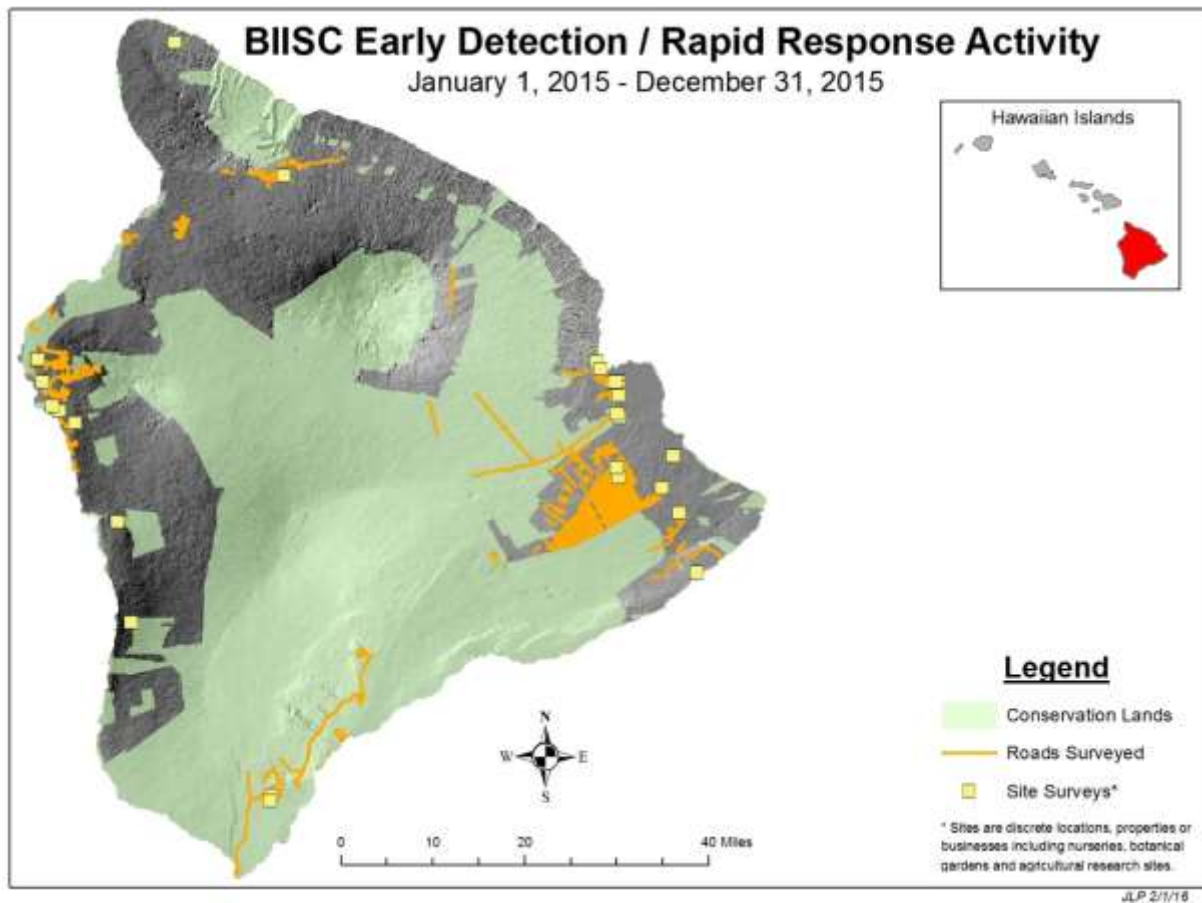
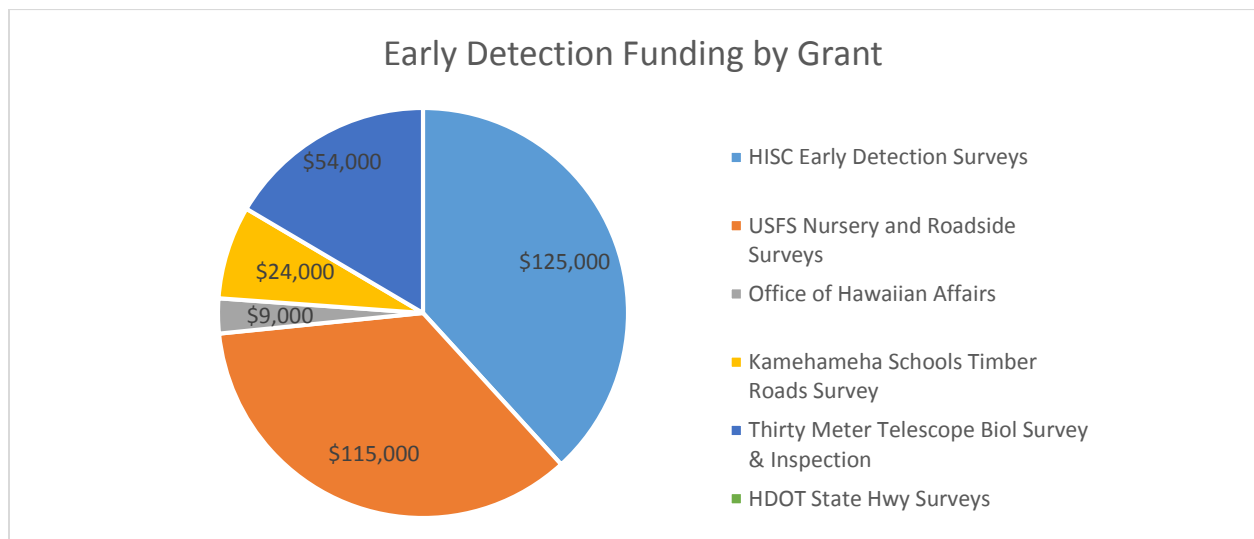


Figure 3: Surveys of 27 nurseries and 574 miles of county and private roads.

Funding



*Hawaii Invasive Species Council Grant: C51507
Detection and Control of Invasive Species on the Island of Hawaii*

Early Detection Program Staff:



Jimmy Parker, Early Detection Program Coordinator: Jimmy joined BIISC with a Botany Degree from Clemson University, to start the Early Detection program in 2009. He has surveyed over 4,000 miles of Big Island roadsides—much of it on foot. Jimmy helped launch innovative projects including a plant replacement program, the Plant Pono nursery endorsement, integration of UAV research, and strategic planning for rapid response operations. Jimmy's wife Fauna, a local artist, is a frequent contributor to BIISC graphic design needs.



Bobby Parsons, Early Detection Technician, Botanist: Bobby is one of BIISC's longest term employees, and helps set the tone for a workplace that loves hard work, team effort, and always has a good time. Bobby is a logistics whiz with an incredible eye for plants and memory for details. As part of the dynamic duo for many years, Bobby's name can be found in the Herbarium Pacificum alongside dozens of new island and state plant records.

Nelson Crabbe, Early Detection Technician, Inspections and Biological Monitoring: Nelson had joined BIISC as a field assistant in 2013, and his talent and training made him an easy choice for promotion to ED tech when several NGOs inquired about biological monitoring and consulting. When new data-heavy projects pop up, Nelson is always at the front line of figuring out how to get things done.



Molly Murphy, Early Detection Technician, Plant Pono Specialist: When US Forest Service and HISC funding aligned in support of the Plant Pono Nursery Endorsement, BIISC was lucky to be able to hire Molly to move this project forward. Molly had just completed a three year stint with the US Forest Service Forest Inventory Assessment, cataloging plants in every forest type from Hilo to the Northern Marianas. Contributing to roadside surveys as well, Molly added three new island plant records in short order. With a family background in the nursery industry, she brings the skill and broad point of view needed to build strong relationships and deliver a high quality program.

Timo Sullivan, Graduate Fellow/Early Detection Technician, Unmanned Aerial Systems: Timo is earning his Master of Science degree at UH Hilo, where he applied UAV technology to study the biology, distribution, rate and method of spread, and invasive characteristics of *Rauvolfia vomitoria* (poison devil's pepper plant). Timo was hired on at the end of 2015 to establish the cost effectiveness of surveys by UAV, compared to ground survey teams and helicopters, for a variety of species and habitat types. His goal is to develop UAV systems that are low cost and "off the shelf" operational for natural resource staff without specialized training in remote sensing. Timo supervises two PIPES interns each summer and has developed research proposals to improve eradication strategies, funded in part by OHA and the USFS.



A portion of Early Detection Program Funds also support the Public Outreach Specialist, Manager, GIS Specialist, and Fiscal Associate.

Project 2: Plant Control

The primary objective of the Plant Control program is eradication of high risk species that are in the early stages of invasion. A second objective is to provide assistance to public agencies in managing established species to reduce impact to resources—usually high value native forest or endangered plant habitat. The plant crew takes over management of new target species after the Early Detection program has completed a rapid response assessment of the risk of impact and feasibility of control—which requires having a reliable treatment method, and good picture of how widespread the pest plant has become. The plant crew staff plays a big role in the feasibility assessment, by staffing the surveys under the ED teams’ direction.

In past years, funding, lack of technological advances, and level of organization meant that invasive species committees had to decide to tackle a new species with very limited information. That is changing—we now have excellent advisors on treatment options, and methods for testing them quickly. The development of UAV technology, adequate funds for aerial surveys, and access to the UH Hilo Remote Sensing department (SDAV lab), and increasing GIS capacity has greatly improved our ability to map the footprint of an emerging species from the air and predict which habitats elsewhere on the island might harbor the plant. A growing catalog of plant characteristics and case studies helps us estimate the distance a plant can spread and for how long its seed bank is viable. A growing “eyes and ears network” made up of our community and agency partners has become an active source of new information about target species.

The plant crew’s productivity has increased tremendously over the past three years, and 2015 may have been our most productive year ever. More than 1000 acres were surveyed by each full time field crew member, for a total of 5,231 acres, including over 3,000 acres on foot. A small percentage of the land surveyed is treated—less than 5%. This small percentage demonstrates three points: we have selected target species in early stages of invasion, and the plants are either cultivated in small plantings or still rare in their new habitats; most of BIISC target species are in the late stages of our planned survey and control effort, in which the core population has been suppressed and no longer requires treatment; to make sure we have gotten the job done, large search areas are calculated based on the plant’s primary distribution model (e.g. carried by wind, birds) are scoured for outlying plants and small keiki regenerating from the soil seed bank.

Highlights

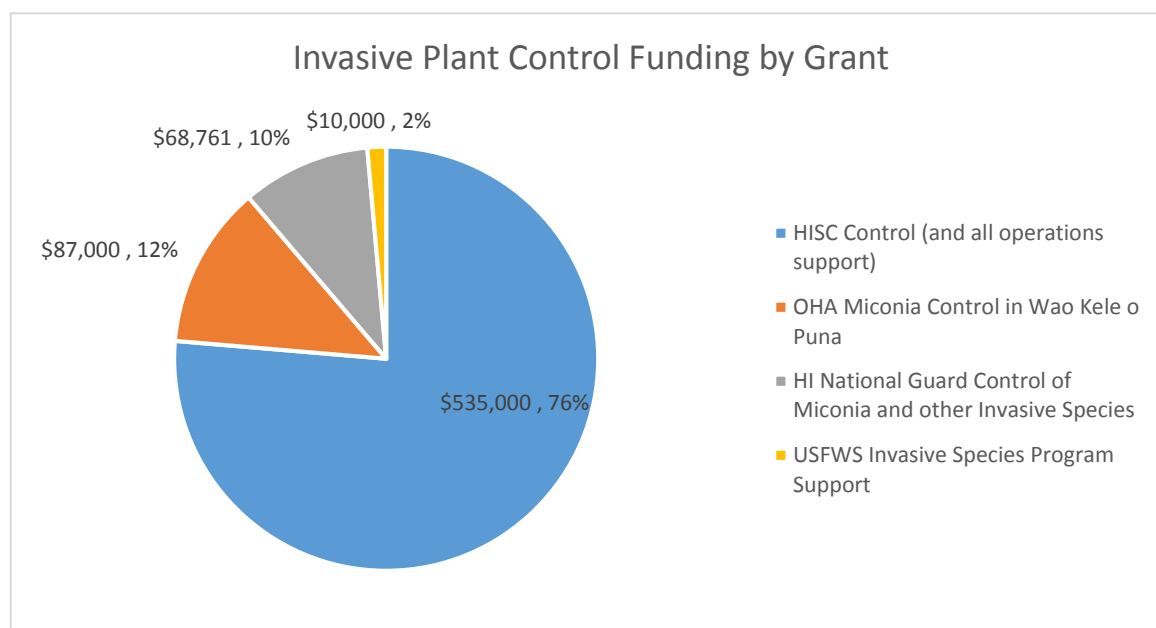
The dwindling number of cultivated Pampas Grass sites, and elimination of all naturalized sites on the island has been encouraging. Barbados gooseberry (*Pereskia aculeate*) is rapidly approaching the day we can claim island-wide eradication, and the statewide situation was presented at the international EMAPI conference. Both species can be expected to be re-discovered in new sites from time to time, as long as it remains legal to import and plant them. However, most residents have been willing or eager to cooperate in the removal of these high-impact invasives. Replacement plantings of native or non-invasive plants have been provided as additional incentive. Although there are still a few hold-outs who insist on keeping Pampas Grass, even in residential areas near the National Park and other high-value conservation areas, we continue to win them over one resident at a time.

2015 Objectives

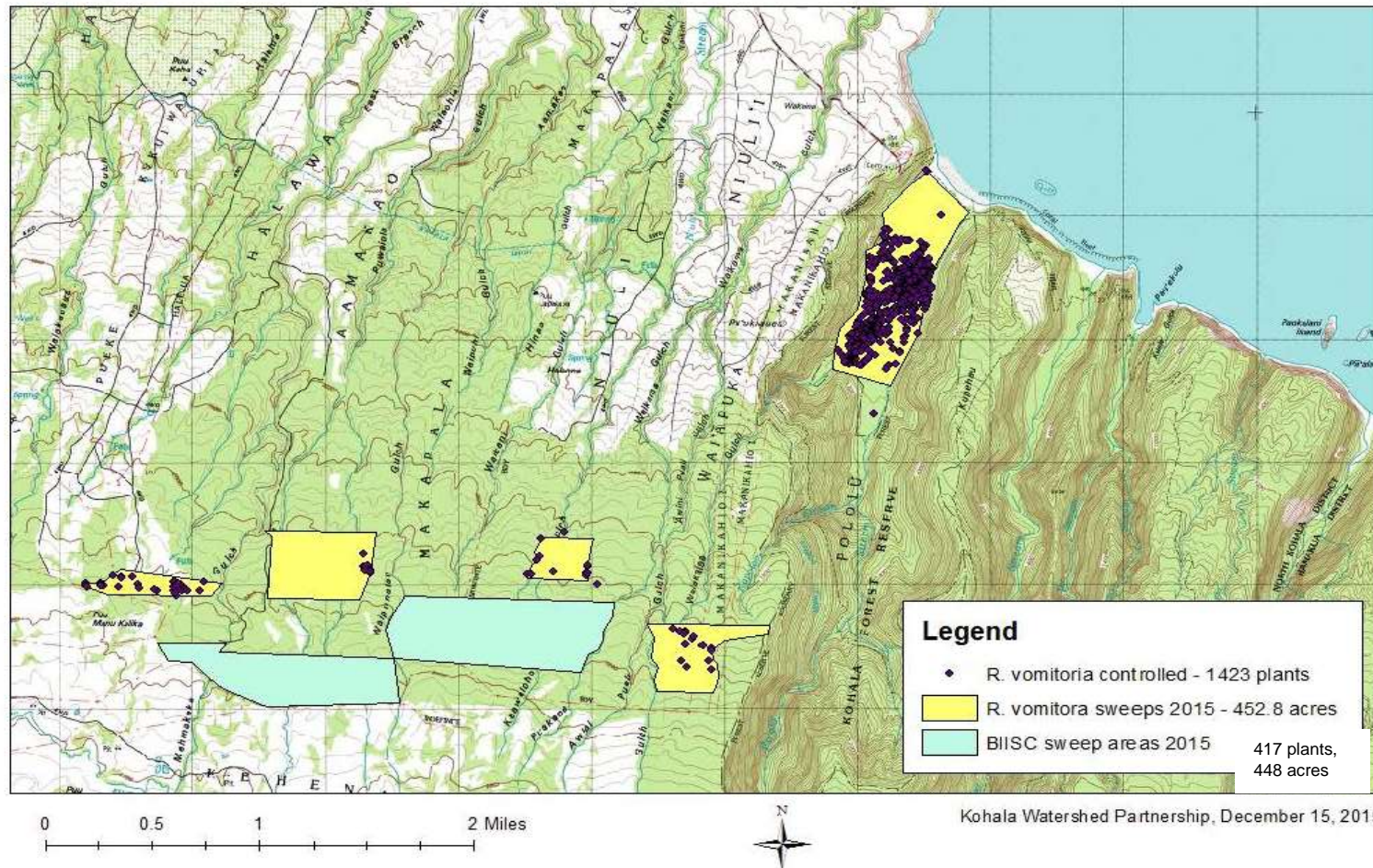
Objective or Deliverable	Outcome
Eradication Target Species	
An estimated 2,400 acres will be surveyed on foot.	Over 5,231 acres were surveyed by the plant crew. This included approximately 3,731 acres on foot, and 1,500 acres by helicopter.
Based on previous year's results, an estimated 18,000 plants will be removed, including albizia.	15,521 individual plants were removed, not counting albizia or photinia. The 15,521 plants included eradication targets and species being contained to localized areas. The plant crew assisted with those species and counts are reported in separate chapters of this document. (Grand total is 69,229 plants).
Containment operations for Miconia: preventing spread to Kohala, suppress along state highways in Hamakua, suppress at Hawaii National Guard training areas, eradicate from WKOP forest reserve.	BIISC surveyed 2,055 acres for Miconia, in each of the planned work areas. Survey and control operations continue to suppress northernmost populations of Miconia, and none have been found in Kohala. HI National Guard-funded work at Kilauea Military Reserve, near the Hilo Airport continues, with the goal of preserving endangered plant habitat and preventing spread via the military equipment pathway. HDOT SNIPP project was postponed until late 2016, but training is planned to help HDOT road crews improve suppression of Miconia within their rights of way. BIISC concluded operations in Wao Kele O Puna Forest Reserve with two aerial sweeps using Helicopter-based Herbicide Ballistic Technology, courtesy of Dr. James Leary. Analysis of time and costs confirmed the cost effectiveness of this technology.
Resume assistance with control of <i>Rauvolfia vomitoria</i> , "the next Miconia," in the Kohala Watershed area. The primary goal is containment of this species to Kohala, as it is not found anywhere else in the state.	HIISC funds supported a joint effort between BIISC and the Kohala Watershed Partnership to survey and control a combined 900 acres and 1,800 plants. Each organization contributed over 1000 staff hours of survey work to the effort, and KWP played a key role in training the BIISC crew on updated treatment methods and reorienting the new crew to the area (last treated by BIISC in 2011). With delineating maps complete, a strong management strategy can now be put into place by KWP staff.
Field staff support to Neighborhood Invasive Pest Projects (up to 15% of staff time)	BIISC staffed 84 events in 2015, several of which were large, all hands-on-deck community events. The BIISC plant crew members assisted with Albizia Assassin events and Little Fire Ant control at the DOFAW baseyard and Na'alehu until dedicated staff were hired and trained to carry out these projects, and continue to assist with large events in Puna. One staff member is assigned to LFA control as a special project area.
Field staff development and training: all certified pesticide applicators and at least one fully trained BTS responder.	All plant crew members hold current pesticide applicator certifications, and our field supervisor was trained in Brown Tree Snake Response in 2014.
Survey and control operations for up to 12 invasive plant species	Target species activity is summarized below. BIISC continued to manage seven eradication targets, and evaluated four new species in 2015, bringing the total to ten for 2016. BIISC manages five other established species in areas where strategic local control is feasible, including albizia, miconia, deviltree, poison devil's pepper, and gorse.

		Acres		# of Plants Controlled			Control Type			Hours		
Taxon Name	Common Name	Inventoried	Treated	Mature	Immature	Total	Chemical	Mechanical	BIISC	Contributed	Volunteer	Total Hours
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Cryptostegia madagascariensis	Rubbervine	340.41	0.13	55	47	102	83	19	566.3			566.3
Miconia calvenscens	Miconia	2,055.51	30.19	48	4,173	4,221	79	4,142	1,234.0		104.0	1,338.0
Morella cerifera	Wax Myrtle	96.46	7.45	842	412	1,254	1,251	3	648.0			648.0
Pereskia aculeata*	Barbados gooseberry	22.00	0	0	0	0	0	0	40.0			40.0
Rauvolfia vomitoria	Poison Devils Pepper	448.00	9.60	77	340	417	102	315	832.0	243.0	10.0	1,085.0
Rubus sieboldii	Molucca raspberry	43.31	8.57	5,294	33	5,327	5,327		297.0			297.0
Ulex Europaeus*	Gorse	134.50	0.00	3		3	3		50.0	20.0		70.0
PLANT TOTALS		4,562.00	144.73	7,678.0	7,853.0	15,531.0	8,394.0	7,135.0	6,329.3	272.0	407.0	7,008.3

Figure 4: Plant crew productivity for 2015. Does not include albizia or photinia work contributed by this team, reported separately.



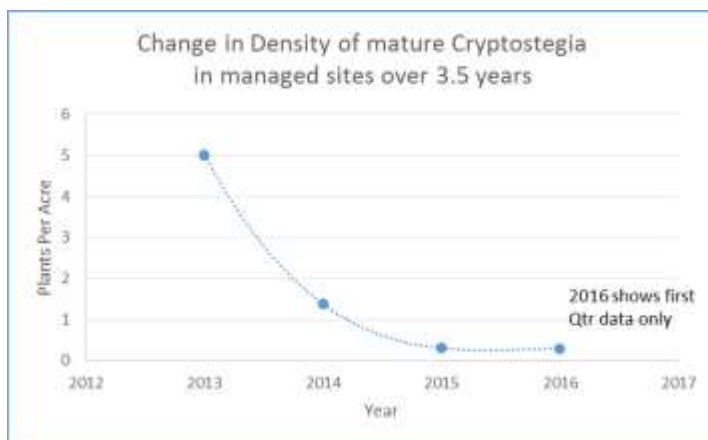
Rauvolfia vomitoria control in N. Kohala 2015
Kohala Watershed Partnership



Target Species Status

Six BIISC target species have been undergoing control long enough to report changes in population density data. Due to changes in the way data was recorded and field work was organized, data sets are reported from 2013, although some of these species have been targeted since 2009. As a caveat, these data are collected concurrently with field work, and each year represents an incomplete dataset. That is, rarely is it possible to survey an entire species search area in a single year, so a change from 2013 to 2014 might represent a change in actual population density, or it might represent a difference in density between parts of the population or amount of staffing funded to complete surveys in the second year. As staffing has increased from 2 to 7, the year to year change has become a more reliable measure, and the trend leading into 2015-16 generally represents actual change in the overall population.

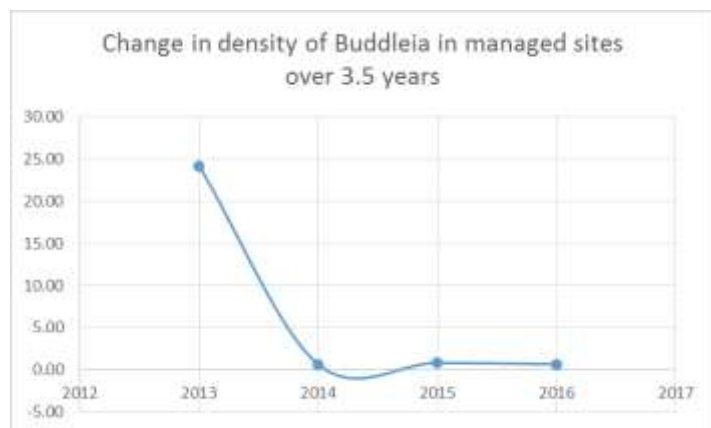
Rubbervine



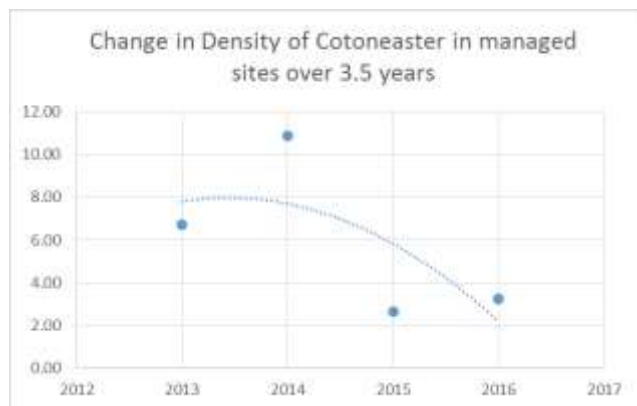
Significant effort was expended on Rubbervine core populations starting at the beginning of 2013. In 2014 effort was focused on buffers, or search areas, surrounding the core populations that were initially found. Entering into 2016, most effort is directed toward mopping up seedlings and re-contacting recalcitrant and absentee land owners, to try to get entry to remaining gaps in our survey effort.

Buddleia

Buddleia, or butterfly bush work was focused on the incredibly dense, high-biomass, core introduction sites for several years (2009-12). Once surveys of buffer areas began, the apparent density of plants plummeted, as the annual survey acreage increased by 1,300%! The current low-density status reflects the continued focus on complete and thorough surveys, and elimination of reproductive plants.



Cotoneaster

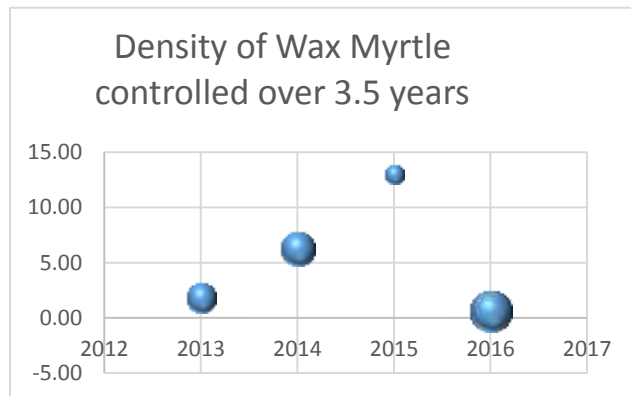


The chart at right shows a gradual decline in cotoneaster populations, with some ups and downs. This data includes effort from the Natural Area Reserves and Three Mountain Alliance crews who share responsibility for cotoneaster management at Puu Makaala and other Natural Area Reserves. Even with three teams working on this species annually, the estimated 2700 acre search effort is understaffed. This chart is probably best understood as annual work output, based more

on work site density than a trend, until consistently higher resources can be applied.

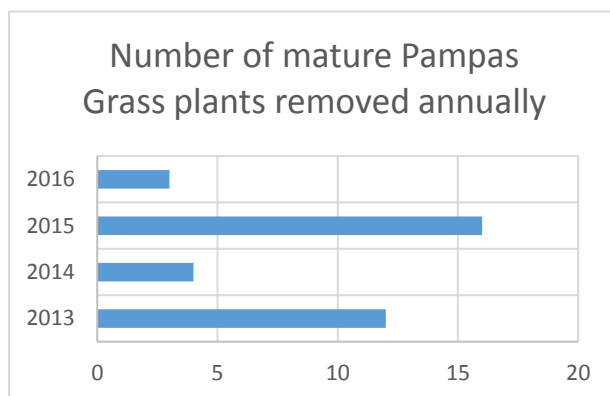
Wax Myrtle

Wax myrtle is another under-resourced target species. Found in particularly dense secondary growth forest, in boggy, miserable terrain, and difficult to distinguish from a distance from ohia and strawberry guava, this relative of the notorious Faya Tree is a ground sweep nightmare. It's prolific spread from suburban Hilo areas into high-value conservation areas keeps this species at high-priority, but we may be losing ground. The size of the dots reflects the number of acres surveyed each year—in one quarter of 2016 we surveyed 400 acres, nearly as much area as the three previous years combined, but we are still on our first pass through the buffer. One highlight—the high density of plants controlled in 2015 compared to 2014 and 2016 may indicate that we have found the core, and are now working our way to the edges of the infestation again.



Pampas grass

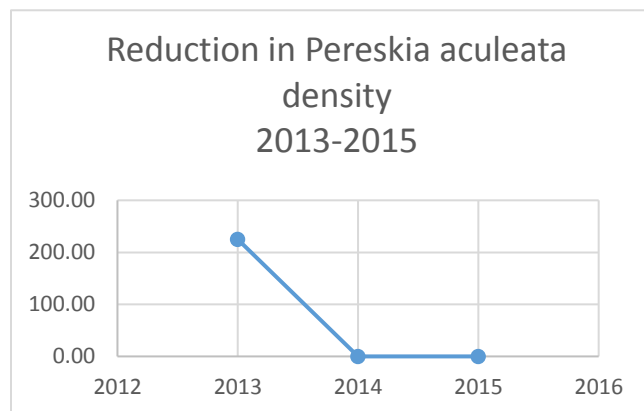
In the early 2000s, BIISC worked to control naturalizing populations of Pampas Grass around the island. In recent years, all known Pampas Grass locations have been cultivated plants—ornamentals deliberately planted by homeowners, golf courses, or hotels—most commonly in Volcano, right at the edges of our National Park. In the past four years, no naturalized plants have been detected, so no trend lines are drawn. We expect to intervene with cultivated plantings for as long as it continues to be legal to introduce this costly invader.



Pereskia

Pereskia may have been caught early enough to be a true rapid response success story. If the plant had not already taken over substantial forest canopy on other islands, it might have gone unnoticed here. 2015 was the second consecutive year without any regeneration or mature plants detected at the original control site or surrounding area. This vining cactus does have the ability to regenerate from broken fragments of plant material, so annual visits do sometimes include collection of viable

materials—including a rooted branch left exposed on a piece of corrugated metal for one year. The Plant Pono initiative is working on each island to ensure that this hardy invader stops being distributed through the horticulture trade, and we look forward to declaring mission accomplished on this species in the next few years.



Rubus and Ilex

Moluccan Raspberry and Dahoon Holly are two new eradication targets, both located on the outskirts of Hawaii Volcanoes National Park, and spreading from home gardens and highway rights of way. Each species has a relatively small search area (200 acres or less) and for the most part, landowners have been cooperative. The entire search area for Ilex was surveyed and controlled in 2014, and based on the plant's reproductive biology, revisits were scheduled to resume in 2016. Raspberry control has provided BIISC with the opportunity formally test new herbicide applications, and in 2016, to work with a landowner on developing an effective non-herbicide treatment. Its growth form and location have made it a great test case for using UAV technology to map and monitor effectiveness of treatment.

The Plant Control Crew



Joel Brunger, Field Supervisor: Joel was actively recruited to join BIISC from a long term position coordinating conservation fence crews on the Big Island. He was a previous watershed partnership team leader on Maui. Joel's leadership has been a major factor in the incredible turn-around in BIISC performance, teamwork, work environment, and image. His job includes oversight of the plant control *and* albizia crews, assisting the manager with developing the annual work plan to address nine eradication targets, and several containment/management species. Joel also serves as the program safety officer, ensuring operations are aligned with environmental laws, and uninterrupted by avoidable injuries. Joel has additional responsibility for maintaining our second office and baseyard.

Shannon Karratti: Shannon has been the BIISC field crew leader for 8 years, and has weathered years in which he and a single field assistant made up the whole crew, tasked with controlling invasive species for our very Big Island. Shannon now guides a team of at least five, surveying over 1,000 acres per person per year, making connections with hundreds of land owners, and controlling over 3,000 plants each.



Bryson Baring, Field Assistant II: When Bryson joined the team in 2013, he was the first new field assistant hired in over five years. He has taken a lead role in managing the GIS and data entry for plant control crew.

Andrew Baring-Brown, Field Assistant I: Andrew served his community as a dedicated BIISC volunteer for months when we had no funds to hire him. We continue to appreciate his hard work and dedication now that he is a valued staff member. Andrew is a point person for little fire ant control, helping us earn our keep by controlling LFA at the DOFAW baseyard.



Gizelle Geronimo, Field Assistant I: Gizelle joined BIISC as a UH Hilo student intern, then served for a year as an AmeriCorps intern before landing a Field Assistant job with the plant crew in mid-2015. Whether she is busting bad guys on the summit of Mauna Kea, roaming the darkest forests in East Hawaii, or acting in her lead role collecting property access permissions for the team, Gizelle's smile opens doors and keeps a tired crew moving!

Jean Franklin: Operations Planner/Analyst: After 10 years as BIISC's GIS Analyst, Jean is the most experienced member of the team. Jean applies her NPS training in Inventory and Mapping to keep the BIISC database and GIS in order for every crew, working most closely with the Plant Control Crew. When Tropical Storm Iselle hit Nanawale in 2014, Jean was one of many without power for weeks—and now regularly joins the Albizia Assassins as they work to stop future disasters.



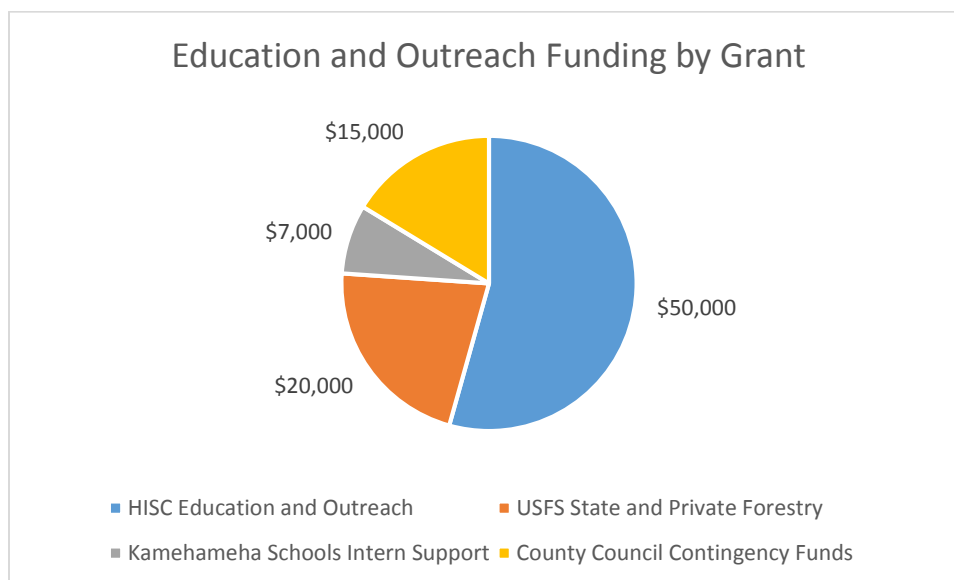
The Plant Crew also supervises two AmeriCorps interns each year, who gain 10 months' valuable training, work experience, modest pay, and a college stipend. Interns serve as full members of the crew, and contribute greatly to the team's productivity. 2015 interns: Gizelle Geronimo, Kupono Kon, (2014-15) and Kayla Alapai, Judah Winters (2015-16), KUPU/AmeriCorps interns.

Project 3: Community Education and Outreach

With the arrival of Franny Brewer, BIISC's new Public Outreach Specialist, a new era for community engagement on the Big Island has begun. Franny was actively recruited from her position as a high school science teacher, due to her strong background in management, invasive species communications, degrees in both education and biology, and demonstrated commitment to the people and communities of the Big Island. Hitting the ground running, Franny implemented an extensive community-driven albizia training program, now known as the Albizia Assassins. Within months she had added an albizia section to the BIISC website to serve as an information clearing-house, negotiated a contract for a communications plan, and held the first onsite trainings in Puna with the newly hired Albizia Coordinator and crew. In the wake of Tropical Storm Iselle, the neighborhood pest projects that we expected to include diverse target species became focused solely on albizia, and by summer 2015, outreach and albizia staff were booked at least two weekends per month. Not losing focus on the bigger picture, the outreach program continued to staff booths at select events, participated in the POWG and legislative outreach, developed materials for each of the BIISC target species, promoted Plant Pono, assisted with science fairs and youth field programs, and became involved in little fire ant and dengue education and training. This activity occurred in parallel with developing a comprehensive communications plan to establish clear goals and the strategies and tactics to achieve them.

Objective or Deliverable	Outcome
Outreach on 2015 priority issues and BIISC target species:	
Increased public awareness of, and improved opinion of the Big Island Invasive Species Committee.	BIISC staffed a total of 84 events in a single year, reaching 5,400 people <i>in person in 2015</i> . Facebook following doubled from 500 to 1000 followers receiving weekly posts. Public commentary overwhelmingly favorable, with Big Island residents—not staff—standing up for our issues and programs when occasional negative comments are posted. New funders and increased county participation suggest stronger general support for BIISC programs.
Substantive radio, print, website material posted on the new BIISC website, and made available to partner agencies and the HISC.	New albizia section added to website (www.biisc.org/albizia) includes helpful information, templates, instructions, links, and contacts for addressing almost every albizia situation we have encountered—and nearly doubled the monthly # of website “hits”. Target and common invasive species info updated to include control techniques. 2 radio interviews and 1 article in Honolulu Star Advertiser. Began planning teacher training curriculum on invasive species with a professional development credit program in partnership with HEEA and HCF.
Neighborhood Invasive Pest Projects	
Five invasive pest projects will be undertaken. County funds will be pursued. Community action plans and progress reports will be made available.	BIISC worked with 8 communities; 7 on albizia control and one on little fire ants. 5 albizia communities and 1 LFA community remain well-organized and active as of December 2015. BIISC gave 42 informational presentations related to albizia management and community-based control. We held 18 community workdays for albizia, with 316 participants contributing over 800 volunteer hours. Over 2,000 plants controlled in a single day. 8 visits to Naalehu surveyed and suppressed ants on 20 acres (with HAL). The Hawaii County Council Contributed \$30,000 to this program.

	Community action plans were written for Kalapana, Ainaloa, and Black Sands (example attached).
Plant Pono Nursery Endorsement Program	
Publicize and encourage participation in the Plant Pono Nursery Endorsement Program.	Plant Pono logo materials were developed, an article was published in the Hawaii Tribune Herald, yard signs, window clings, and electronic logo images were provided to endorsed nurseries. Program was featured at seven horticultural-industry related events, with an estimated 495 in attendance.
Nursery endorsement informational materials developed.	Nursery packet including BMPs, program goals, agreements, and incentives were delivered to each nursery in a logo-folder.
Promoting statewide priority issues	
Dengue	When the dengue outbreak was made public, BIISC compiled a list and phoned managers of every store we could think of, from the smallest rural groceries and gas stations to Home Depot and Walmart, to ask them to stock up and clearly display mosquito repellent and, where appropriate, larvicide products. Regular posts to facebook page helped spread "Fight the Bite" message.
Rapid Ohia Death	BIISC's public outreach specialist participates in the Rapid Ohia Death Public Outreach Work Group, and has taken an active role in organizing efforts to engage the public in sanitation techniques.
HISAW	Nominated the coordinator of the Hawaiian Paradise Park Albizia Control Team for her dedicated organizing work, ensuring a well-attended, regular monthly workday took place in her community.
Hawaii Volcanoes National Park Bio-Blitz	Participated by hosting a booth and leading tours, sharing our value for native species and biodiversity with approx. 550 guests.



Outreach Program Staff



Franny Brewer, Communications Director. Franny earned her biology degree and M.A. in education right here on the Big Island. She has served the Big Island as a high school science teacher, executive director of the Hawaii Island Humane Society, and Forest Service employee tasked with communicating the intent of the strawberry guava biocontrol release--only *after* it was realized that communication might be an issue. Franny's commitment to science and to her community drives her success, and that of the outreach programs she implemented in such a short time. We suspect that she works eight days a week, and does it all with a smile and her infectious laugh.

July Hasegawa, Public Outreach Assistant: July joined the Albizia crew as a KUPU intern, and quickly became a valued field crew member. A regular volunteer for weekend outreach events, her engaging communication style and organizational ability was soon recognized, and she was for the outreach team. July assists with property access logistics for the crew, staffed many of the 84 events held this year, worked with nature tour operators to field test sanitation protocols, and added Japanese-language template letters to our albizia website.



Jade Miyashiro, Little Fire Ant Technician: Jade worked in the lab of Dr. Arnold Hara for five years, testing control methods for coqui, mollusks, LFA, and other pests and sharing methods with nursery operators. When, near the end of 2015, BIISC was awarded Hawaii Tourism Authority funds to pursue community-based social marketing model for little fire ant control, we tracked Jade down and asked her to join the team. Jade provides technical know-how to the project led by Franny and Stanford University PhD student Rebecca Niemiec, provides LFA treatment advice to callers and program participants, and leads control efforts at the DOFAW arboretum.



Project 4: Albizia Control and Monitoring Program

The primary goal of the albizia control program is to develop and implement cost-effective management of albizia in strategic locations. These include satellite locations, where the species is an emerging threat, edges of forest reserves, along power and transportation corridors, particularly primary and emergency access roads and primary transmission lines, and where efforts can best leverage other legitimate priorities for control. A key focus is on removing obstacles and making it financially feasible for land-managing agencies to deal sensibly with their albizia problem—not for BIISC to take it all on.

Objectives in 2015 included finalizing a hazard mitigation plan and begin to address the most immediately pressing, large-scale emergency management projects on Hawaii Island (primary roads and electrical transmission lines). Another key objective was to raise expectations about landowner's albizia responsibilities, while educating the public about available options, ranging from contacting neighbors with well-informed, direct requests to remove hazardous trees, to treating trees with herbicide, reporting trees to the state emergency management agency, and negotiating a sensible deal with a certified arborist. Third, to work alongside public agencies to expand their impact and ensure the most cost effective, long-term strategies were put into place to manage albizia hazards. Finally, to make sure that we were making sound decisions when removing or treating with herbicide tens of thousands of trees each year, an ecological monitoring program was put in place, to quantify outcomes of treatment, including efficacy, rates of decay, and effect on remaining vegetation.

Hazard Mitigation Plan:

The draft plan put forward by the albizia technical working group in 2014 included 15 stand-alone projects along county and state highways and primary transmission lines. BIISC's role in each project was to coordinate land access, cajole agencies into action, and use herbicide to treat standing albizia in a broad safety buffer, after immediate hazard trees were cut down by much more expensive certified arborists. With the assistance of HELCO contractor SSFM, a final plan was produced and published at the end of 2015. \$1.5 million/year legislative appropriation was made to HDOT in 2015 and 2016 to accomplish the objectives in this plan. In combination with HELCO funding, all but the County areas of responsibility are well underway to completion.

Coordinated Control of Albizia

In 2015 our work was tied to whichever planned project was able to get underway. For the most part, these were powerline projects, as HELCO had funds immediately available to cut hazardous trees.

By February 2015 BIISC and HELCO had completed our first joint project since Iselle, which hit in August 2014, a mile of Piihonua Transmission line, cleared 60 feet wide by HELCO arborists, and treated with herbicide to 200 feet on either side by BIISC crews. BIISC treated 14,000 trees on 60 acres in 6 weeks, at 1/10th the cost of the hazard tree removal, on five times the acreage. We then moved onto other primary transmission lines in Puna. Other significant achievements included partnering with HDOT to control emerging albizia stands along Akaka Falls Road (a state highway accessing Akaka Falls State Park), re-opening the view of Pe'epe'e Falls at Boiling Pots (Wailuku River State Park), and control of re-sprouting and regenerating albizia along the former albizia tree tunnel in Nanawale, near Lava Tree State Park, and County Highway 132, where more than 30 volunteers treated over 2,000 trees in a single morning.

Community Empowerment Program:

The program goals and structure are outlined in the Education and Outreach Section of this report. At one point part of our Neighborhood Invasive Pest Project, the albizia training program took on new life after Tropical Storm Iselle, consuming nearly all public outreach time and emerging with the new name, ACT!, and later the Albizia Assassins. Volunteer control efforts were focused on non-hazardous trees—those trees that are either too small, or too distant from infrastructure to pose a threat. Trees are treated with herbicide, mainly to stop the spread and re-seeding of albizia into high-traffic areas (rights of way). Hazardous trees—those trees immediately threatening homes and rights of way—must be removed first by contracted arborists using traditional methods. The combined process was intended to reduce the long-term maintenance costs for road and power infrastructure.

Early lessons learned resulted in some changes to the structure of the volunteer program. Lack of funds or agency support for large scale removal on county and private subdivision roads continues to be a significant obstacle. Non-hazardous tree removal typically must wait until after the hazard trees are removed. Despite the committed efforts of road maintenance crews and BIISC, control of hazard trees along most of the county rights of way is very limited in scope, and the volunteer's work has to remain focused on the smallest trees, or places where hazard trees are not an issue.

Our original adopt-a-highway model was adapted, and each community was encouraged to develop its own goals for its community and worked with BIISC to identify and gain access to areas where albizia could safely and legally be treated by a large group of volunteers. Extensive mapping work was conducted to identify albizia infestations across the island. Control work was primarily conducted on state forest bordering residential areas, along electrical transmission lines cutting through forested areas, and on undeveloped public and community association land in natural areas. In sections of road that lost the majority of hazard trees during Tropical Storm Iselle, work to prevent regeneration and regrowth has been brisk. For example, more than 60 people have contributed time to control albizia regrowth along Highway 132, in the vicinity of Lava Tree State Park, controlling as many as 2,000 plants in a single day, ranging from 12 inch tall saplings to 150 foot tall trees of massive girth.

BIISC and over 300 volunteers controlled 40,828 albizia trees on 434 acres in the Puna District in the past year. Island-wide, altogether, BIISC controlled 53,124 trees. Volunteers were encouraged to continue work on their own on lands to which they have safe, legal access. While participants have almost unanimously declined to officially report work conducted between trainings, their efforts are easily observed and are substantial. (At time of writing, BIISC is working with partners to map that effort using aerial imagery—no small feat considering Puna is the size of Oahu).

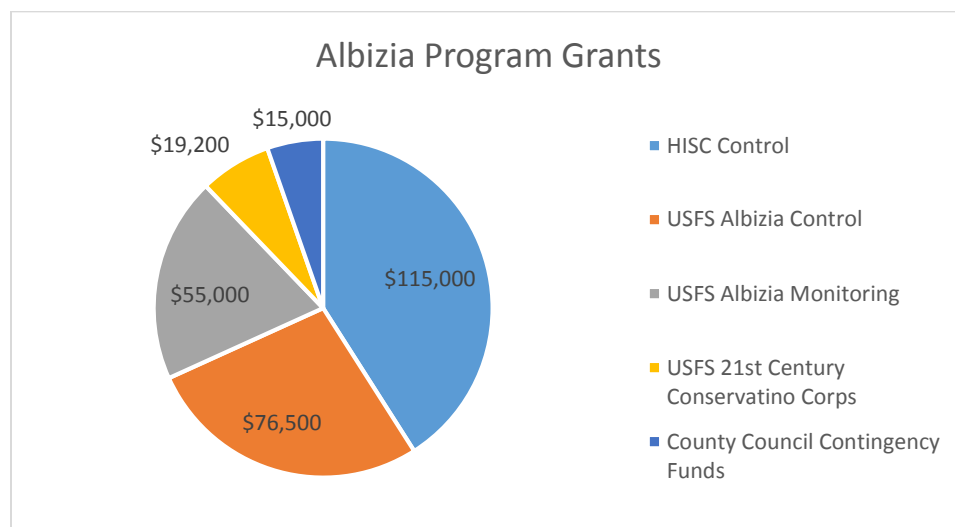
Ecological Monitoring

Research-specific funding provided by the US Forest Service will document: 1) the fate of Albizia trees as they decompose following application of lethal doses of herbicide, providing data to describe the potential failure zone of hazard trees over time, to inform best management practices and recommendations, and 2) the response of Hawaii's wet forest ecosystems to the control of Albizia stands. We will track the death and decomposition of individual trees and stand level forest succession following Albizia control actions (i.e., herbicide treatment), measuring specific parameters of tree decomposition, plant community composition, forest structure, biomass accumulation, soil and plant tissue nutrient

dynamics, and light availability. Particular attention will be focused on how trees decompose following herbicide treatment (i.e., how and when snags fall apart, and where debris falls during the process), and the probability of post-control Albizia seedling recruitment and growth. This documentation will determine the impact of proposed broad scale Albizia control strategies with regard to hazard tree mitigation, and post-control forest succession, and will guide changes if they are deemed necessary.

Five pairs of plots, a treatment and control at each site, were installed on sites around the island along a soil age gradient. Each plot is 100 m x 50 m with a wide buffer of treated or untreated albizia trees for consistency. BIISC crews controlled the trees in each treatment plot, and a BIISC biologist and UH student helper conducts all of the data collection and lab processing, under the direct supervision and guidance of Dr. Flint Hughes of the US Forest Service. Research is well underway, collecting more than 15 metrics, and will continue through 2018. US Forest Service funding covers personnel costs, with match provided primarily through in-kind support and HISC personnel funds.

Funding



Albizia Program Staff



Bill Buckley, Albizia Program Coordinator: Bill was hired for his leadership and forestry experience. I commended Bill recently for making a project most people thought was impossible appear to be inevitable. He has been greatly appreciated for an incredible work ethic, great organizational abilities, and the unique ability to make a constantly shifting roster of temporary, part-time, volunteer, student, and interns as his crew. Getting a complete team of five on within 6 weeks of his hire, Bill grew his team to

a peak in early summer, supervising 10 Hawaii residents, including a field leader, GIS contractor, 5 technicians, and three UH Hilo student workers. The project averaged five full time crew members over the course of the year, some are pictured below.

Jensen Walker, Albizia Field Leader: Jensen started as a volunteer at BIISC, working his way up through every possible job description from unpaid intern to temporary field assistant, to his current role. He is still the first person at work every day. The only long-term employee besides Bill, Jensen keeps the albizia crew running smoothly, cutting their way through over a thousand acres, and nearly 10,000 trees per person per year.



Caitlin Morrison, Albizia Ecological Monitor: Caitlin graduated from Hilo High and U.C. Berkeley, and joined BIISC to carry out the albizia research project. Working closely with Dr. Flint Hughes, Caitlin worked tirelessly to set up the program, keep the data collection schedule on track, and process and document all samples. With 10 plots to lay out and tremendous quantities of data to collect on a monthly schedule, Caitlin has done a tremendous job.

Big Mahalo to albizia crew members, old and new: Paul “Assassin” Armstrong, Mario Garcia, John Hintze, Ian Lookabaugh, Linda Lim, Kamaka Lewis, Rory Akau, July Hasegawa, Chevy Coelho, and many dedicated volunteers.



Project 5: Vertebrate Early Detection and Monitoring

While they say that science cannot prove a thing does not exist, it does not appear that Axis Deer exist on Hawaii Island anymore. We say that under our breath, and with some caution, but an axis deer has not been seen or caught on camera since 2013. Which begs the question, why does BIISC still have an axis deer program?

Objectives:

Our continuing objectives are straightforward:

- **Ensure any remaining axis deer near the known introduction site are detected and dispatched:**

In practice, this is little different than monitoring to detect a new introduction of axis deer, with the exception that we have a better idea of where to look. Proactive surveys of the original introduction site and other suspect sites (e.g. those with repeated, unconfirmed reports) remain a high priority.

- **Respond rapidly, intelligently, and effectively to any new introductions:** In the event of a new deer report, the Deer Team developed a standard sighting-response protocol, outlining every step of how to respond from receiving an initial report to the eventual dispatch of the deer or identification of a non-target animal. Some feedback has been recently provided related to improving transect density and documenting visibility from vantage points. This protocol is in the three year technical report which was completed in May, 2014. BIISC will incorporate the input of wildlife managers from other programs concerning methods and results.

In addition, it became clear that axis deer are not the only invasive animal that might, accidentally or intentionally, be introduced to the Big Island. So a third objective because the early detection and rapid response to new populations of any vertebrate, including snakes, in part to serve as a deterrent to those who might try to release a harmful pest. This differs from the kind of work that might be done by HDOA or DLNR, in that our response is focused on post-border, uncontained populations reported or found on private or public lands, and does not rely on a legal pre-determination of a “pest” species.

A final objective was to provide skilled staffing support to DOFAW and NARS programs to control invasive vertebrates, whenever breaks in rapid response efforts allowed.

Results:

Early Detection/Rapid Response:

A team of experienced wildlife biologists were hired in May to design and implement an early detection system, to determine whether axis deer remained at the introduction site or any other hot-spot location on the island. Using a newly purchased Forward-Looking Infrared (FLIR) unit, purchased by HISC and Watershed Partnership Funds, over 48,000 acres were searched for axis deer. Efforts were focused on the areas recommended for follow up in the 2014 Progress Report, and included the area surrounding the original introduction and dispatch sites, in Kaʻu, sites with repeated deer reports in Kohala, Waikoloa, Milolii, S. Kona, and Pohakuloa. No deer were found.

The deer team responded within 48 hours to all axis deer reports, including a reported deer road-kill in the Mountain View area, and repeated reports in all listed “hot-spot” sites. No deer were found.

A long drought had ended on the Big Island, and the team found that the FLIR was less effective than it had been when little vegetation grew on pastures in the south and west sides of the island. A research design that included placement of an extensive game camera grid to monitor all hot spot locations was proposed instead. Funds were sought for 30 game cameras to be spaced at intervals adequate to capture any deer whose home range fell within the grid. The intention is to move the grid regularly from site to site until it can be determined, with statistical probability based on known home range sizes, that each hot spot area contains no deer. Game cameras were purchased right at the end of 2015, and the grid was implemented early in 2016. It will continue to monitor for deer, 24 hours a day, for one year.

Notably, both expert biologists were from overseas, and were not hired until mid-year. A significant portion of 2015 project time was invested in orientation and building relationships with key staff at partner agencies and with members of the community whose cooperation is needed for successful operations. In a relatively short time, the team's expertise and consideration for the community built trust so could confidently operate.

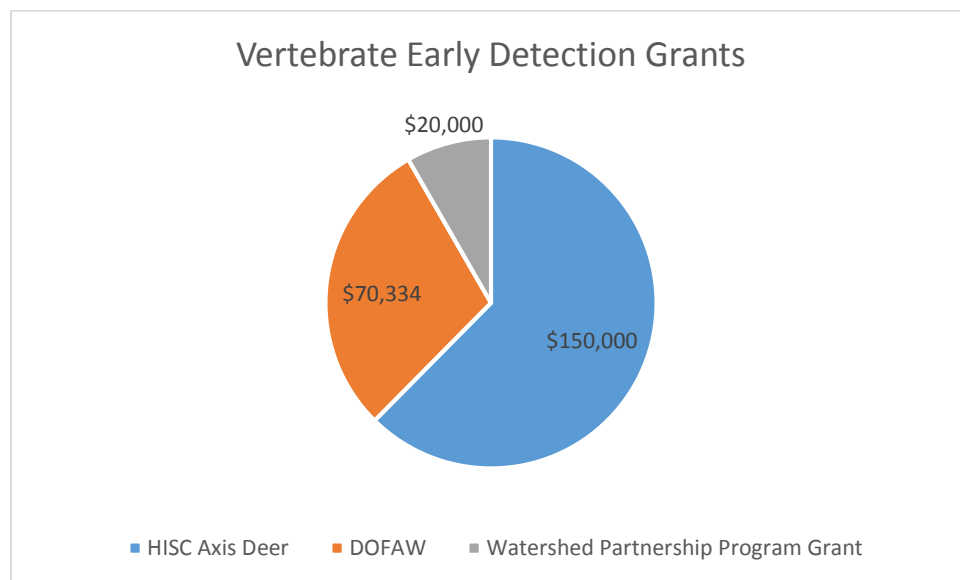
Other vertebrates:

The vertebrate team assisted DOFAW staff in following up with rabbit control efforts in West Hawaii, and spent two nights surveying 225 acres for rabbits, confirming none remained.

The team used FLIR and to track down the last sheep in a Natural Area Reserve fence, and along with a NARS technician dispatched the last two sheep. Without experienced use of FLIR, these sheep had been hunted many times without success.

Funding:

Because staff were not hired until mid-year, a good portion of funds were carried over to 2016, when the vertebrate team merged with Maui's axis deer team.



Program Staff:



Tom Gieder, Vertebrate Early Detection Coordinator: Tom's background as a hunter, riflery coach, wildlife biologist, and specifically conducting population assessments of introduced Sitka Deer to island systems in the Eastern United States, made him an easy choice to lead the new focus of vertebrate early detection. He arrived in Hawaii for the first time, and was asked to find out if there were any deer—anywhere—on 2.5 million acres of wilderness. He said, Yeah, sure, no problem. Then he went about figuring out how to get it done, one partner at a time.

Brett Gelinas joined the BIISC program from Guam, where he had been using the same USFWS FLIR unit previously used by the BIISC axis deer team to manage feral cats in critical habitat. Brett came with a wealth of experience in predator control, hunting, GIS skill, and a wildlife biology degree. His positive attitude, practical knowledge, courtesy to others, and hard work has been a real asset.



Project 6: Photinia Control

Control of *Photinia davidiana* is broken out as a separate project in this report, in part because it was a recently added target species that provided opportunity to test best management practices under nearly ideal conditions: just two landowners, both public agencies, and dedicated funding. It was also awarded as a separate grant. USFWS and HISC funding had both previously been awarded to the Three Mountain Alliance, a watershed partnership, which asked BIISC to take over the project, which was not within the TMA boundary, and appeared to have potential for island-wide eradication.

Photinia inhabits a small area on windward Mauna Kea where it has been observed spreading readily into high-value, native-dominated forest. Photinia has not been detected anywhere else on the island, and has not been found in the nursery trade. Invasive, high-risk traits noted in the Weed Risk Assessment include:

- Capable of growing in upper elevation tropical climates
- Elevation range exceeds 1000m
- Demonstrates invasive behavior in forest reserves
- Invasive relatives in the *Photinia* genus
- Host of fire blight pathogen
- Tolerates many soil types
- Self-compatible fertilization (does not need pollinators)
- Fleshy-fruited seeds dispersed by birds and mammals
- Tolerates heavy pruning

Previous (2015) HISC funds supplemented funds from the U.S. Fish and Wildlife Invasive Species Strike Team program. The joint funding allowed BIISC staff to map the infestation over large sections of Hakalau NWR and Piha Forest Reserve. Transects were planned based on data provided by the US Geological Survey, which had noted the plant's potential to impact native forest in 1986, and by the Three Mountain Alliance. Walking transects 500m long by 20m apart in Hakalau NWR, BIISC mapped approximately 400 acres; and treated more than 500 plants clustered primarily within 200 meters of the boundary of the Piha State Forest Reserve. In Piha FR, 500 acres have been surveyed along transects 100 m apart, to roughly delimit the infestation in a region that had never been surveyed for Photinia. The surveys have essentially delimited the infestation, with results indicating a 250 acre core where the density is much higher than the surrounding 250 acre search area.

Surveys also indicated that photinia aggregates in clusters at the base of large, isolated ohia trees, probably where birds perch, and on fallen ohia, sometimes known as nurse logs. Recent work by Yelenik (2016) at Hakalau NWR suggests that in this recovering rain forest area, these sites are relatively rare, grass-free sites with specific soil conditions that are key to native species regeneration. A strong competitor like Photinia may have the ability to dominate the occupation of these sites, restricting recovery of native species.

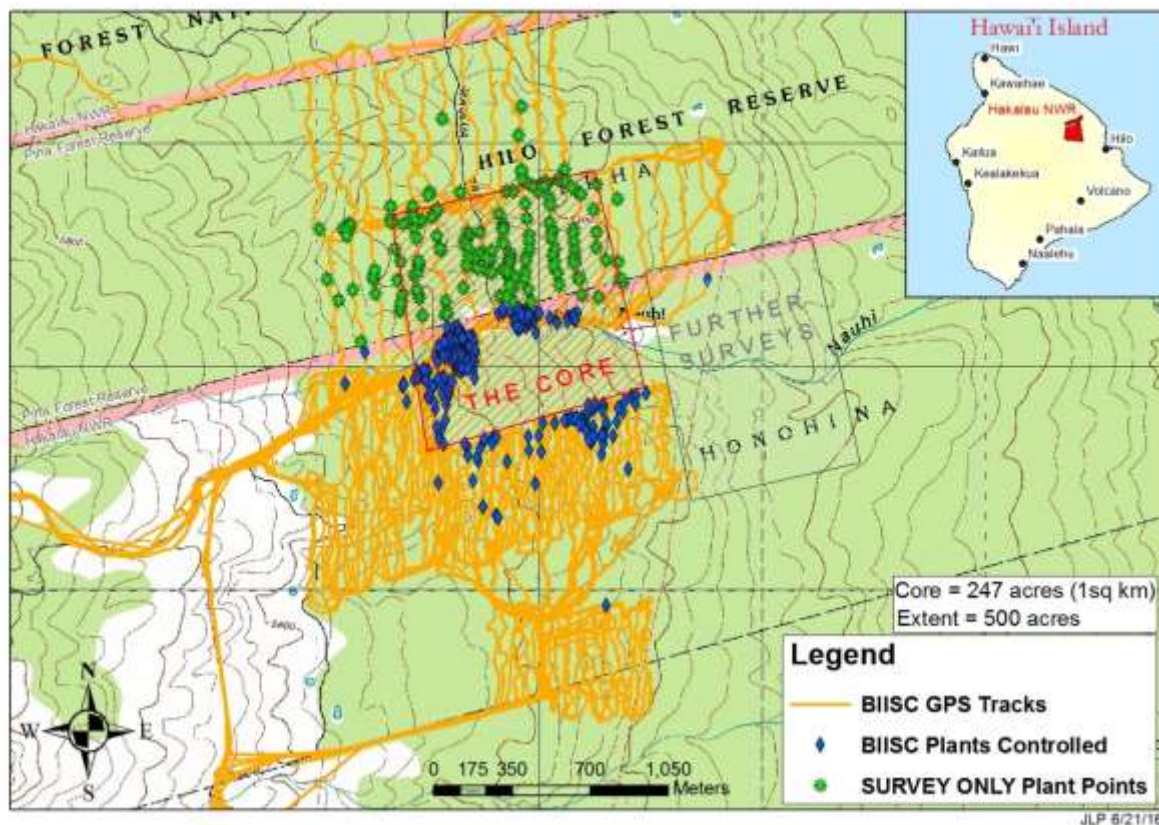
The observed aggressive nature of the plant, single, moderately sized infestation, relatively long time to reproductive maturity, and absence from trade, suggest it may be both important, and possible, to eradicate from the island.

2015-16 funding also supported herbicide trials conducted by BIISC and Dr. James Leary of CTAHR. Previous work had attempted to control the plants with triclopyr (Garlon 4) which is problematic in rainy conditions, and was found to have little effect on Photinia even when applied during good weather (BIISC 2015). The preferred method identified for controlling Photinia is a very light hack and squirt application of 100% imazapyr, applied with a 7oz thin-line bottle. This method has been proven effective at controlling small to large plants. The application of minute quantities of imazapyr directly into the tissues using shallow slices into the cambium (sap wood) of each stem is safe and effective in mist-to-light rain, which is nearly constant at Hakalau.

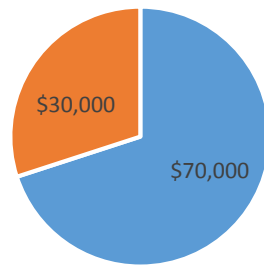
With delimiting surveys, impact assessment, and herbicide trials completed, BIISC is now ready to implement a focused eradication strategy. Achieving complete control of the densely infested sections of Hakalau and Piha forests will be a multi-year effort.

Photinia davidiana in Hakalau National Wildlife Refuge and Piha Forest Reserve

Survey and Control Efforts 2015-2016



Grants to Control Photinia davidiana (2015-16)



■ USFWS Invasive Species Strike Team ■ HISC Photinia Control

Mahalo!